D. B. SPOONER.

Improvement in Water-Meters.

No. 132,496. Patented Oct. 22, 1872.

Fig. 1.

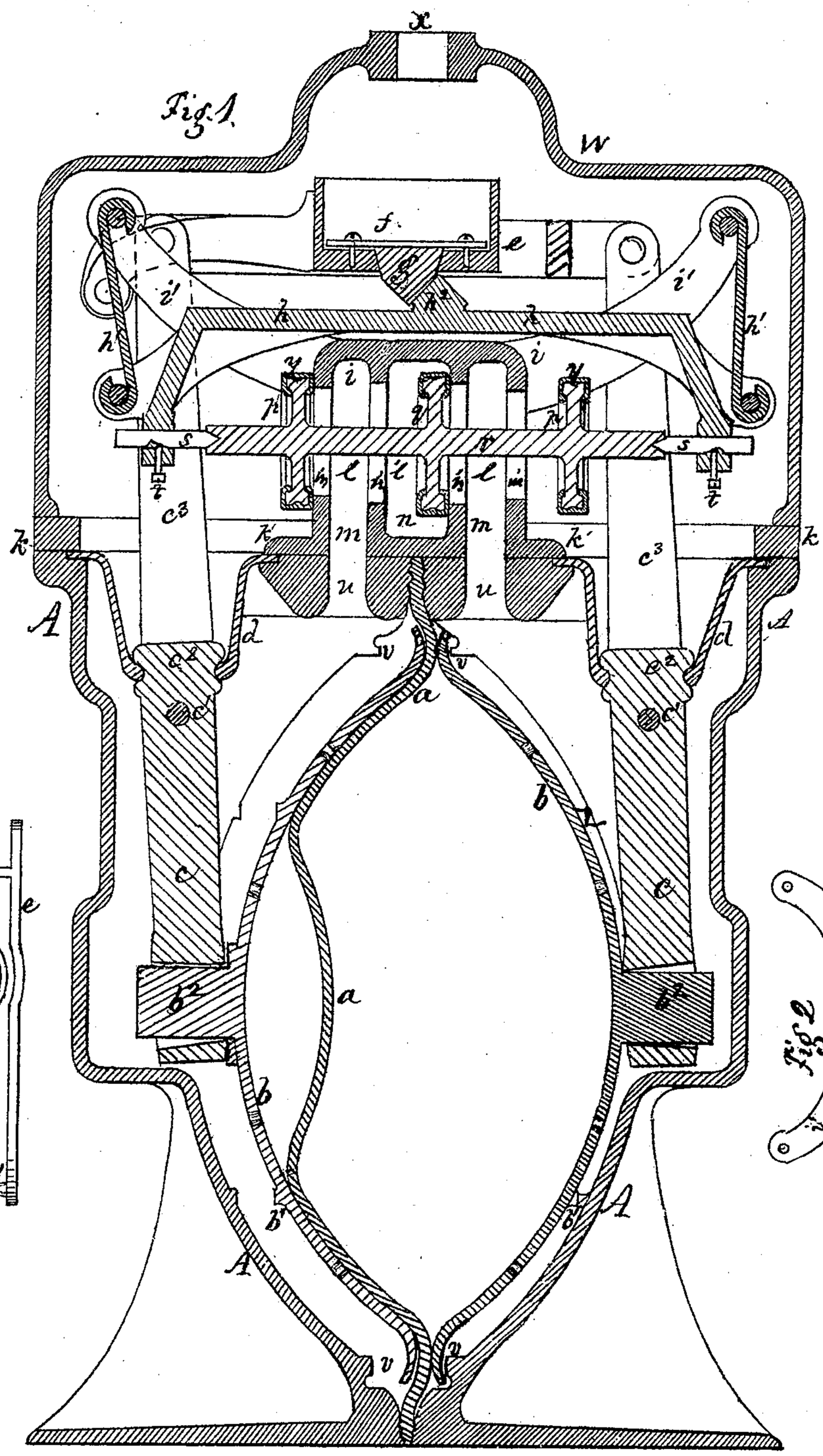


Fig. 5.

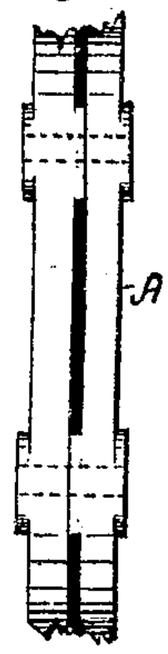


Fig. 3.

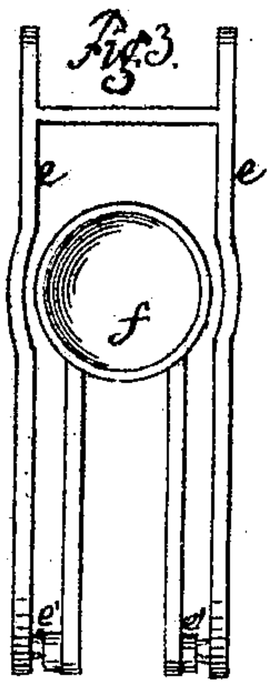


Fig. 2.

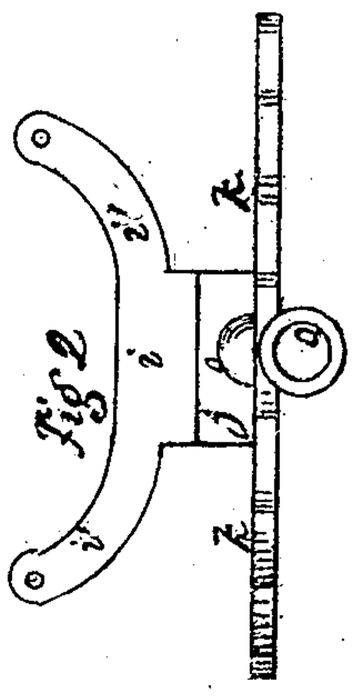
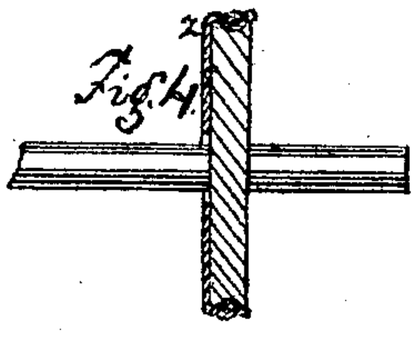


Fig. 4.



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D. BRAINARD SPOONER, OF SYRACUSE, NEW YORK.

IMPROVEMENT IN WATER-METERS.

Specification forming part of Letters Patent No. **132,496,** dated October 22, 1872.

To all whom it may concern:

Be it known that I, DAVID BRAINARD SPOONER, of Syracuse, Onondaga county, in the State of New York, have invented certain Improvements in Water or Fluid Meters, of which the following is a specification:

This invention is an improvement upon the meter shown in my application filed September 8, 1871; and consists, mainly, in certain details of construction which will be fully described hereinafter.

The several parts are illustrated in the accompanying drawing forming part of this specification, in which—

Figure 1 is a transverse vertical section through the center of the shell of the meter and the working parts in the same plane; Fig. 2 is a side elevation of the valve-chest on a smaller scale; Fig. 3 is a top view of the apex-weight and its connection with the yoke; Fig. 4 shows a modification of the flexible covering of the face of the valves; and Fig. 5 represents a view in elevation of the edge of the diaphragm-chamber, showing the bosses which regulate the distance between the halves of the casting when they are united together.

The diaphragm *a* when made of India rubber or other gum is molded into form with an extended surface inside the outer rim, which comes between the flanches of the two shells of the meter, so as to nearly or exactly fit the inner surface of either half of the measuring-chamber without stretching—a matter of great importance in the practical working of the machine. Other materials may be used for this diaphragm aside from vulcanized gum—such as leather, cloth, or water-proof paper—the inner surface of which may be stretched, knit, or pressed into form, as shown in the drawing, and for the purposes above described; but I do not confine myself to any particular material or mode of extending the inner surface thereof, the idea being a diaphragm formed as and for the purposes described. It will be observed that the diaphragm-rim can be compressed more or less, so as to bring the inner surfaces of the halves of the shell to varied and uncertain distances apart, which would necessitate loss of time in adjusting the valve mechanism, and in ascertaining the exact measuring capacity of each measuring-chamber. To obviate this I cast upon the faces of the shell at the joint, and outside the edge of the diaphragm, bosses that come solidly together when the two halves of the shell are bolted together, so as to determine the exact distance apart of the disks and arms irrespective of the thickness of the diaphragm; or, in place of the bosses above described, the whole circle of the shell may be raised outside of where the edge of the diaphragm comes in extent sufficient to accomplish the same result. It is important for the durability of the diaphragm that it should be bent as little as possible at any one point, and all short curves in the parts in contact therewith are to be avoided; consequently, the shell, at its junction with the diaphragm, is curved outward, as is clearly shown at Fig. 1 in the drawing. The two disks, *b*, that are placed one on each side of the diaphragm *a*, are dished in form and have their edges curved backward, as seen in section, Fig. 1, so as to prevent the diaphragm from coming in contact therewith, and they are furnished with bosses b^1 on their outside surfaces that come in contact with similar ones on the inside of the shell to determine exactly their outward movement, on which depends the quantity of water discharged at each pulsation of the diaphragm. The disks are perforated like a colander, so as to allow the water in the chamber to freely pass to either side of them. At their center, on their convex side, a spindle, b^2, projects that enters the hole of proper form to receive it in the lower end of the vibrating arm *c*, that extends up into the cap and there connects with the valve movement. The eye or hole before named is made flaring, as seen in the drawing, so as not to bind on the spindle of the disk, while on the side next to the disk it fits the spindle and holds the disk in place, but allowing it a slight irregular movement at its edge to accommodate itself to the diaphragm and the bosses upon which it strikes at the end of its stroke. The fulcrums of the arms *c* are between the center of the disks and the valve mechanism at *c'* and at the right distance from the flanch of the shell, to allow the curved faces of the disks to somewhat compress the diaphragm when the two disks are forced toward each other by the pressing apart of the ends of the arms opposite those in which the disks are hung and in-

serting the fulcrums c^1, which unite in action the yoke, apex, weight, arms, disks, and diaphragm. It will thus be seen that, by having the faces of the disks curved to an extent sufficient to carry their edges back to a line out of reach of the diaphragm, and then compressing said diaphragm between the curved faces of the disks, as described, thus causing the disks and that part of the diaphragm which is compressed by said disks to move in unison without slip or independent movement of the diaphragm at that point, great durability of said diaphragm is assured, and the disks are securely held in place. Directly above the arm-fulcrum c^1 a projection, c^2, is formed, having a groove in it into which an elastic flexible cup-shaped sleeve, d, is placed, the tension of which, aided by the pressure of water upon the outside thereof, makes a water-tight joint at that point. The bearing-surface upon the arm which receives the impact of the lower end of the above-mentioned sleeve may be increased indefinitely and a like increase made to the length of the sleeve, thereby adding to the tension of said sleeve and the pressure of water thereupon. The upper edge of this sleeve d flares out in form of a flange that fits within a proper recess around the hole through which the arm c^3 extends from the body of the meter into the cap, and when the valve-chest plate is put into position it covers the upper side of said flange and its recess in the shell; and when permanently united by the bolts which fasten the cap, valve-chest plate, and shell of the meter together the flange of the upper part of said sleeve is thereby compressed, making a water-tight barrier at that place. Perfect freedom of action is allowed the arms by the use of this flexible sleeve d, which prevents the flow of water from the cap to the measuring-chamber through the arm-ports. The lower or moving part of the flexible partition or sleeve d is attached to the disk-arm just above its fulcrum, by means of which arrangement but little motion is communicated to the partition, and consequently it is subjected to but little wearing-strain. This sleeve is formed in a mold, when made of India-rubber or other gum, and vulcanized therein; but I do not confine myself to the use of gum or to any particular form, as other flexible substances and forms can be used with like success. The upper part of arm c^3 above the sleeve d is forked, e^3, the upper ends of the fork being pivoted to a yoke, e, a plan view of which is seen at Fig. 3. This yoke is formed of two side pieces joined by a single cross-piece near one end. This yoke unites the upper ends of arm c^3 and causes them and the disks b to move in unison. The other ends of the yoke have the apex arms and weights f pivoted to them. (See Fig. 3.) From the under face of the apex-weight a triangular prism, g, projects with its apex or angle downward. This prism is made of glass, hard rubber, or gutta-percha, wood, silex, or metal; but after long experiment with different materials glass or gum seems to have the preference. The employment of glass or hard rubber, or both, for the prism is especially advantageous, because these substances will not act chemically upon the water, nor will they hold any deposit which may settle upon them. Metals, on the other hand, are not only liable to rust themselves, but also to act chemically upon the water and cause a deposition of the substances held in solution. The sediment also of the water, especially of that impregnated with lime or sulphur, will be held by the metal when deposited thereon. By these various causes the movement of the metals upon each other is impeded and finally stopped. The method of setting which I have shown in the drawing is to insert the glass through an aperture in the cup f, and screw a plate over it to hold it in place. The cup f may be weighted sufficiently for the purpose for which it is intended. Directly under the yoke e I suspend the valve-carrier h, by means of links h', that connect it with arms i', that project from the upper section i of the valve-chest. (These are shown also at Fig. 2.) At the center of the valve-carrier h I place a triangular prism, h^2, similar to g, above named, with its apex up and directly under the prism g, so that the inclined faces of the two prisms shall come in contact, as seen in the drawing, Fig. 1. The ends of the valve-carrier h are turned downward so as to come below the center of the ports, hereafter described, of the valve-chest. The valve-chest is formed in two parts or halves, the upper part i having the arms i', before described, on it, the lower half, j, being cast with the base k, that fits over the top of the openings into the measuring-chamber. The valve-chest is composed of four vertical partitions dividing it into three chambers. A circular hole is made through each of these partitions, horizontally in line with each other; but the two holes or ports in the two inner partitions of the chest—being the exhaust ports—are made somewhat larger than the inlet-ports in the outside walls of said valve-chest, to compensate for the difference in pressure between the inlet and outlet or exhaust side of the diaphragm, said difference in pressure being equal to the amount of power required to work the meter; but the valve being balanced to a nicety, the power to shift the valve is slight; consequently the difference in the size of the inlet and exhaust ports is correspondingly small. To form the ports for the passage of the water to and from the measuring-chamber, the two outside chambers l of the valve-chest open through their bottoms into the measuring-chamber, one on each side of the diaphragm a. The center one, n, has an outlet-pipe, o, Fig. 2, that discharges the water through it. This pipe o opens from the lower part j of the valve-chest, and curves down outside the valve-chest, through the base k, and comes out below it. This arrangement of the exit-pipe enables one to fit the cap to the base-plate k without any disturbance of the outlet-pipe or extra fitting which was hereto-

fore required when the exit-pipe went through the cap.

The valve-chest is made in two parts, *i* and *j*, divided horizontally through the center, as seen in Fig. 2, for the purpose of inserting the valves and valve-stem in place. The parts are then closed and screwed tightly together with a lead-packed joint, or otherwise made water-tight in any convenient way. The base-plate *k* covers the top of the measuring-chamber, and has ports through it opening a communication between the measuring-chamber and the outer chambers *l l* of the valve-chest, and also openings *k'* for the forks e^3 of the arms *c* to work through. This base *k* is interposed between the cap W and shell A, all three being bolted together by the same bolts passing down through them. Three valves, *p*, *p*, and *q*, are cast solid on the stem *r*, which runs horizontally through the center of the ports, and is suspended by two centers, *s*, in the two ends, before named, of the valve-carrier *h*. The valves *p* close the inlet-ports, alternately, of the valve-chest. The valve *q* closes, alternately, the two exit-ports.

To make certain of closing the ports *p p* and *q* to an extent sufficient to prevent the escape of water under all pressures, also to prevent noise and shock to the meter when the valves strike upon their seats, and also to lessen the cost of production, I stretch over each valve an elastic covering, *y*, which serves as a cushion for the valves to strike upon, and renders the flow of water between the valve and its seat impossible whenever said valve is closed. This covering *y* is molded into form and has a hole through the center of its sides to admit of the valve-spindle or shaft *r*, and outside this hole between it and the outside edge of the covering there is a flat face raised to correspond with face of the valve-chest seat. The outside edge of this covering above named is made much thicker than the rest, and as it is vulcanized considerably smaller than the valve which it covers is made it has to be stretched to an extent sufficient to be placed upon the valve when the tension of the rubber aided by the pressure of water upon the outside of the covering not only holds the covering in position but prevents the flow of water between the covering and the material upon which it rests.

Another form and application of valve-cover is to groove the outer circumference of the valve, as shown in Fig. 4, and place a disk of rubber or other yielding substance, 2, over the face of the valve, which is fastened down around its outer edge by an elastic or other band.

In order to affix the covering, Fig. 4, to the faces on the valve-stem fronting the valve-seat it will be necessary to puncture the center of the covering and stretch it over the valve, and then turn the edge back, and secure as before.

I do not confine myself to the use of India rubber or other gum for covering or facing the valves, as other elastic substances may be in like manner and with equal success used.

A modification in the mode of suspending the valve-shaft may be made by forming bearings at each end of the valve-chest in front of the valve-chest ports, and placing the ends of the valve-shaft *r* therein; said bearings must be in proper line and place for the correct action of the valve-shaft in opening and closing the valve-chest ports. By this modification the centers in the valve-carrier, which suspend the valve-shaft, may be dispensed with, and the valve-carrier be made to connect with the valve-stem *r* in any convenient manner, either outside the bearings in which the valve-stem travels, or inside said bearings between them and the valve-chest.

It will be readily seen that by thus uniting the valve-carrier with the valve-stem they will both find support upon the bearings on which the valve-shaft moves, rendering the use of the links *h'*, shown in the drawing, Fig. 1, unnecessary. These bearings may be cast with either half of the valve-chest, Fig. 2, or be made separately and secured thereto as is most convenient.

The lower half of the valve-chest, Fig. 2, *j*, before named, is cast in one piece with the base *k* that fits over the top of the openings into the measuring-chamber, with openings through it opposite those in the measuring-chamber that open a communication between the said chamber and the valve-chest, to form the ports for the passage of the water to and from the measuring-chamber into the two outside chambers *l l* of the valve-chest. The cap W covers the valve-chest and other working parts, and the inlet for the water is through its top, in the drawing, directly over the apex-weight *f*. This position for the inlet-pipe, at *x*, gives the advantage of the current directly upon the cup *f* to aid the action of prism *g* upon the valve-carrier.

The action of the meter is as follows: When the exit-port *o* is opened, the water with which the meter is filled commences running through it. Entering at the inlet-pipe *x* it descends into the cap *w*, and through the open port in the valve-chest that the valve *p* is raised from; thence it descends into the measuring-chamber until it is filled, and the disk *b*, against which the diaphragm *a* is forced, moves back until its bosses *b'* strike the rest on the inside of the shell, which movement of the disk forces back the lower end of the lever *c*, and the upper end c^3 in an opposite direction, until the prism *g* mounts up the face of prism h^2 and its apex passes that of said prism h^2. This brings the apex weight to bear upon the opposite face of prism h^2, and causes it to rapidly move in the opposite direction, bearing with it the delicately-suspended valve-carrier *e* and valves *p p q*, causing valve *p* to close its port, and thus stop a further supply to the measuring-chamber on that side of the diaphragm, and shifting the valve *q* in the same direction, which opens the exit-port from that side of

the diaphragm, and closes the opposite exit-port that communicates with the other side of the diaphragm *a*, and opens the inlet-port that admits water on that side. The water then enters and fills that side of the diaphragm, forcing it in the opposite direction, and the water out of the first side through the exit-pipe until the other side is filled, when the opposite disk is forced back and the valves are in like manner reversed. Thus the action of filling the chambers on either side of the diaphragm alternately is continued so long as the water is allowed to run; and if there is a register attached to register the number of pulsations of the meter, the number of gallons of water drawn is accurately measured, whether it runs slow or fast, under a heavy or light pressure.

A modification of the arrangement of the valves *p p q*, seen in the drawing, may be made by making the stem *r* with two double-faced valves, or with four single-faced valves upon it, and inserting two of the valve-faces within each of the two outer compartments *l l* of the valve-chest. This would necessitate the facing of the inner side of the outer walls to compartments *l l*, and the outer side of the inner walls to said compartments *l l* for the valves *p p q q* to rest upon when closing the ports alternately of the valve-chest. It will be seen that by this arrangement of the valves *p p q q* upon the stem *r*, and their insertion within the compartments *l l*, that the arms *e e* will have to be lengthened down from the center of the disk-spindle b^2 to a point between the disk-spindle b^2 and the bottom of the meter. The fulcrums c^1 will have to be removed from between the center of the disks *b* and the valve mechanism, and be placed between the center of the disks *b* and the bottom of the meter; and the disk-spindles b^2 be affixed to the arms, substantially as described, but between the fulcrums upon which the arms move and the valve mechanism. This arrangement of the valves *p p q q* upon the stem *r*, and placing them within the compartments *l l*, and inserting the fulcrums of the arms *c* below the center of the disks *b*, would reverse the action of the arms and the valve mechanism, and accomplish substantially the same result as the arrangement of the parts seen in the drawing.

I have heretofore named the curved edges of the disk *b* and their bearing against the diaphragm to insure accuracy and perfection of operation, and also the bosses *b'* for arresting the motion of the disk; but these are found insufficient to protect the disk against fracture under high pressures, if made as thin as is desirable. I therefore turn into the outer shell a recess, V, that just allows the outer edge of the disk to fit it, and gives it a bearing to rest against, which protects it against the pressure all around its edge.

The centers I have employed for uniting the valve-carrier with the valve-stem have been screwed in and had jam-nuts to hold them; but they were very liable to work loose, which destroyed at once the accuracy of the valves in closing the ports. I have therefore substituted the centers S that pass through a straight hole accurately bored, and I form in their lower sides inclined notches, clearly seen in the drawing, and insert through the arm of the carrier a set-screw, *t*, that securely holds them in place and keeps them tightly pressed up to the center in the valve-stem.

The yoke *e*, it will be seen on reference to Fig. 3, has two long arms extending from the cross-bar, with pivot-points *e'* at their ends turning inward, which enter sockets in the rigid arms of the apex-lever *f*, the spring of the arms of the yoke being sufficient to keep the points of the pivots up to their bearings as the parts wear away. This feature in the construction is important, as the entire well working of the machine depends upon the accuracy of the contact of the apexes.

The center of pivot-point of the apex-lever is located in line with the center of the apex for the purpose of causing the latter to move uniformly and in similar lines upon each side of the lower apex.

Having thus fully described my inventions, what I claim, and desire to secure by Letters Patent, is—

1. In a water-meter, the combination of the halves of the shell having the projecting bosses with the diaphragm having a thickness in excess of the distance between the halves of the shell when clamped together, the bosses being adapted to regulate accurately the distance between the halves of the shell, and also the compression of the diaphragm-edge, as described.

2. The combination of the disks *b* and the diaphragm *a*, the disks being provided with curved edges, and being clamped upon the diaphragm only at their edges, substantially as described.

3. In a water-meter, the combination of a central diaphragm adapted to vibrate between the disks, but connected therewith, substantially as described, with valve-operating mechanism, the disks and diaphragm moving together as one, as and for the purpose set forth.

4. The combination of the diaphragm, disks, disk-arms, and yoke, the disks being clamped upon the diaphragm by the disk-arms, which are spread apart and held by the yoke, as described.

5. The combination of the disks *b* having the spindles b^2 with the arms *c* having the tapering sockets, substantially as and for the purpose described.

6. The combination of the casing A having a recess, as described, with the partition *d* and plate *k*, substantially as described, for the purpose set forth.

7. The molded rubber partition *d* of the form shown and described, for the purpose set forth.

8. The combination of the disk-arms with the partition *d*, the center or moving part of the partition being located just above the fulcrum of the arms, as and for the purpose described.

9. The molded rubber valve-covering *y*, provided with a bearing-face upon its side adapted to rest against the valve-seat when the valves are operated, substantially as described.

10. The plate *k* having cast upon it the lower part of the valve-chest and the discharge-pipe, the latter communicating with the valve-chest above the plate, and having its discharge end carried below the edge of the plate, in order that the latter may be properly packed, as set forth.

11. The combination of the cast stem and valves with the divided valve-chest, substantially as described.

12. The centers *s* provided with the inclined notch, in combination with the set-screws *o*, as described, for the purpose set forth.

13. The combination of the links *h'* with the standards *i'* and the carrier *h*, the links being located at the end of the carrier, as described.

14. The yoke *e* cast in one piece with tapering points *e' e'*, the sides being adapted to spring apart to admit the rigid arms of the lever-arm *f*, as described.

15. The apex-lever *f* having the center of its pivot-point in line with the center of the apex *g*, as and for the purpose described.

16. The combination of the yoke, the apex-lever *f* with carrier-frame *h*, as described, for the purpose set forth.

17. The combination of the diaphragm and disks adapted to move together, as described, with the disk-arms, yoke, swinging carrier-frame having the apex and valves, and the apex-lever and apex, substantially as described.

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