F. E. PENDLETON.

STEAM METER.

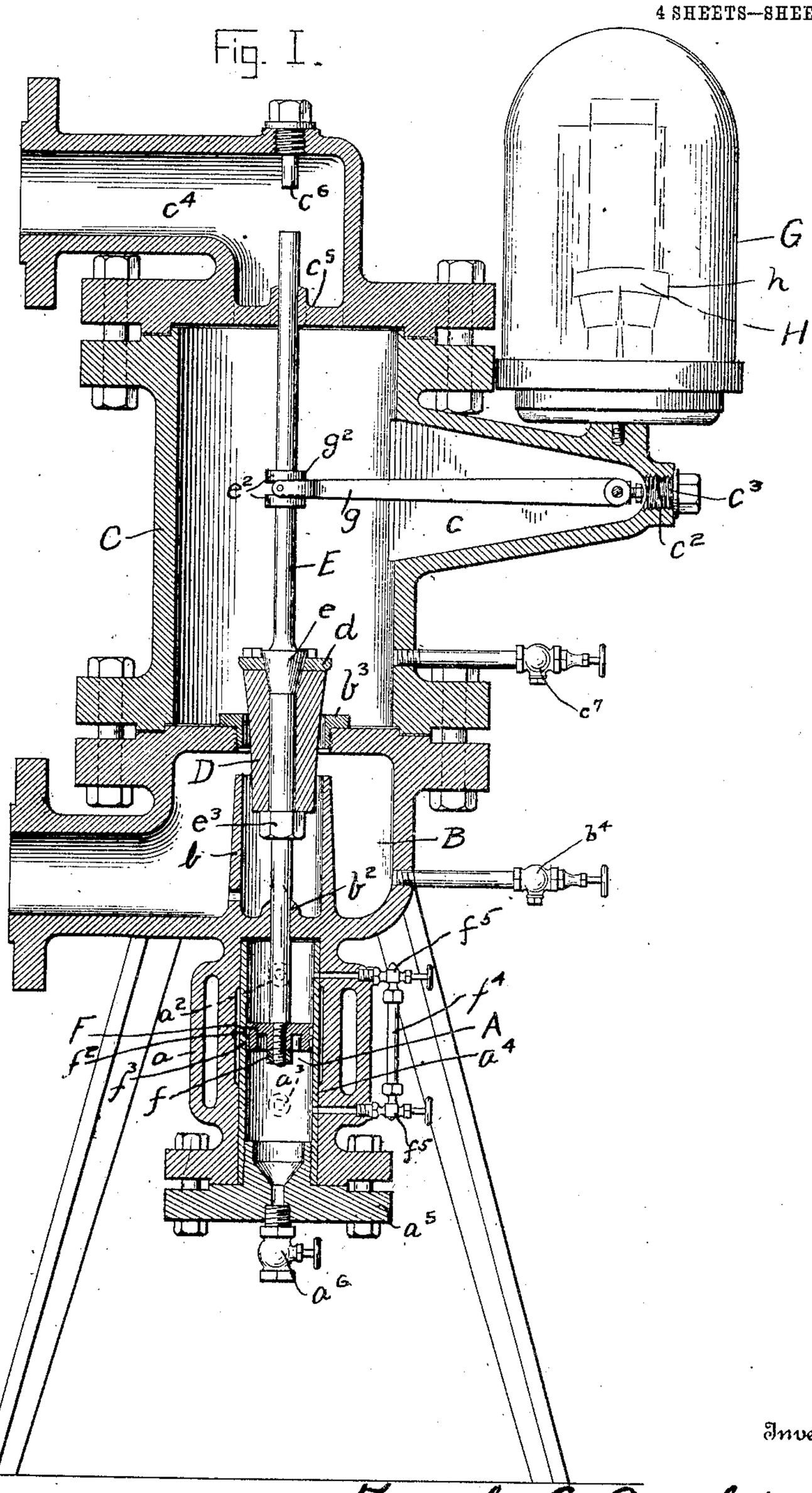
APPLICATION FILED APR. 9, 1909.

963,643.

Patented July 5, 1910.

4 SHEETS—SHEET 1.

Fig. I.



Witnesses

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4 SHEETS—SHEET 2.

Fig. II.

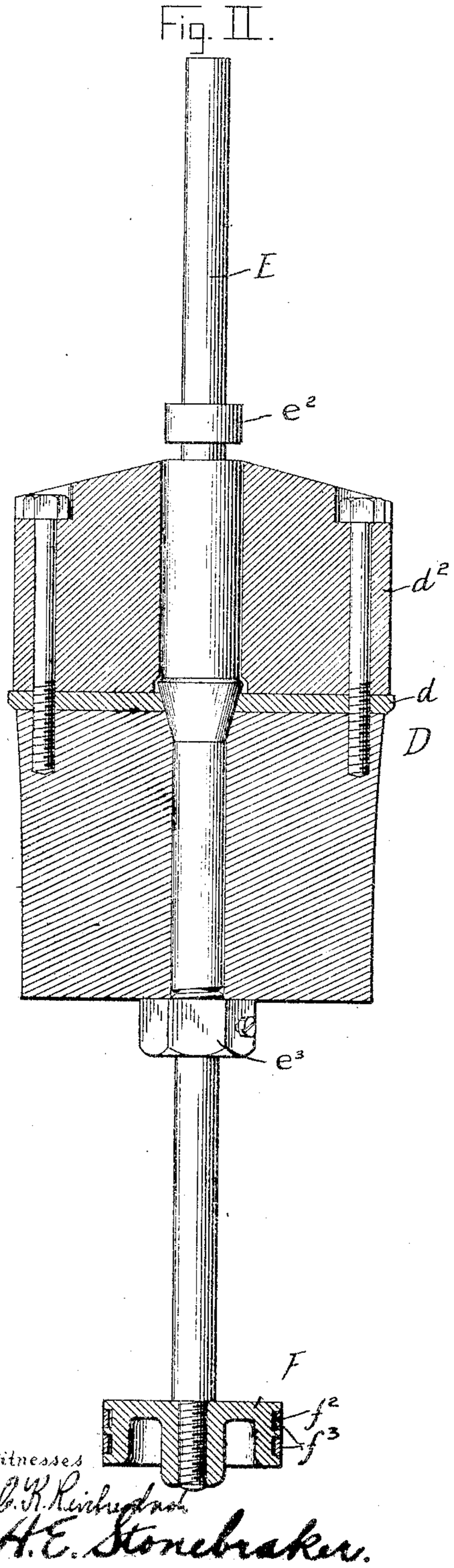


Fig. III.

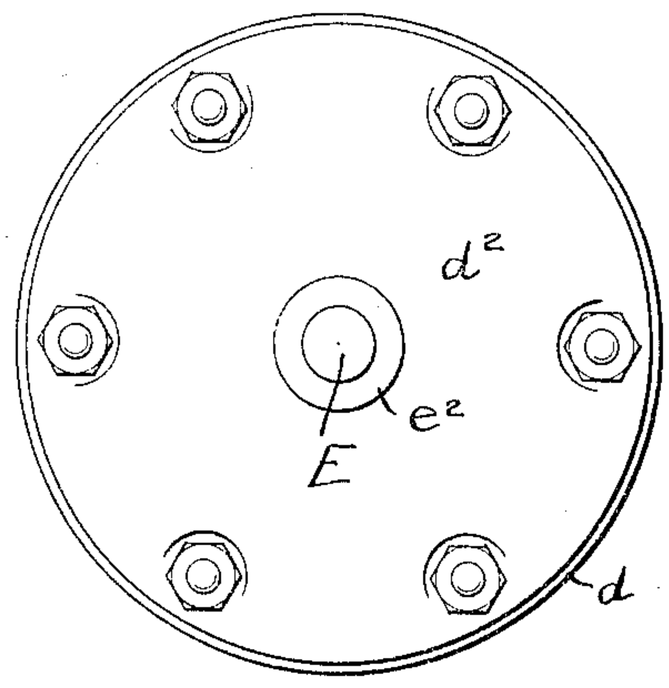


Fig. IV.

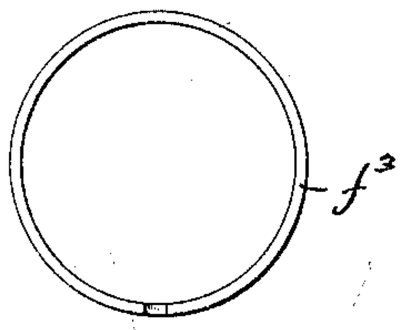
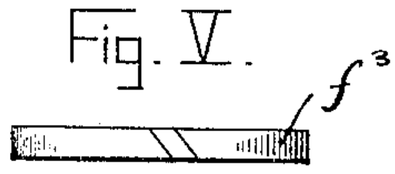


Fig. V.



Witnesses

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4 SHEETS—SHEET 3.

Fig. VI.

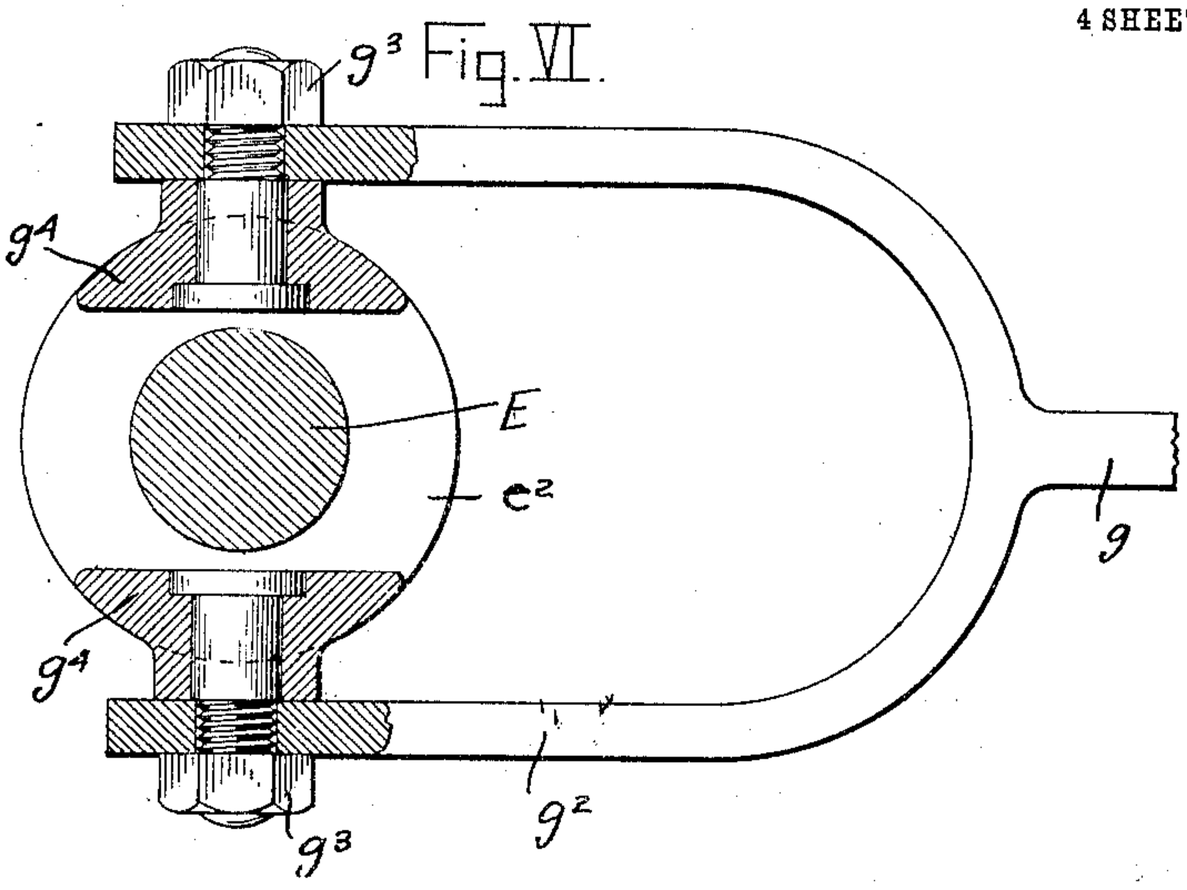


Fig. VIII.

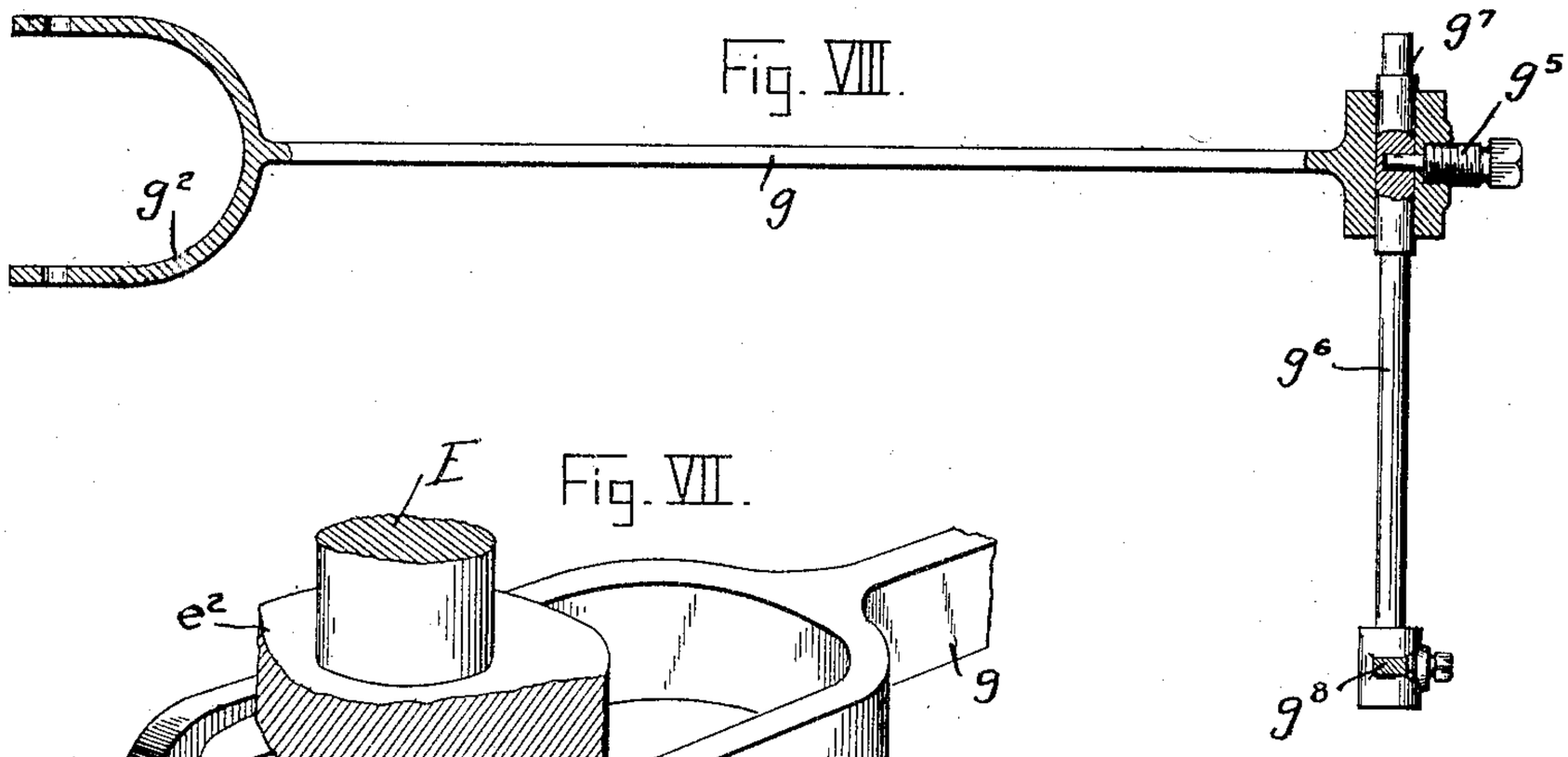
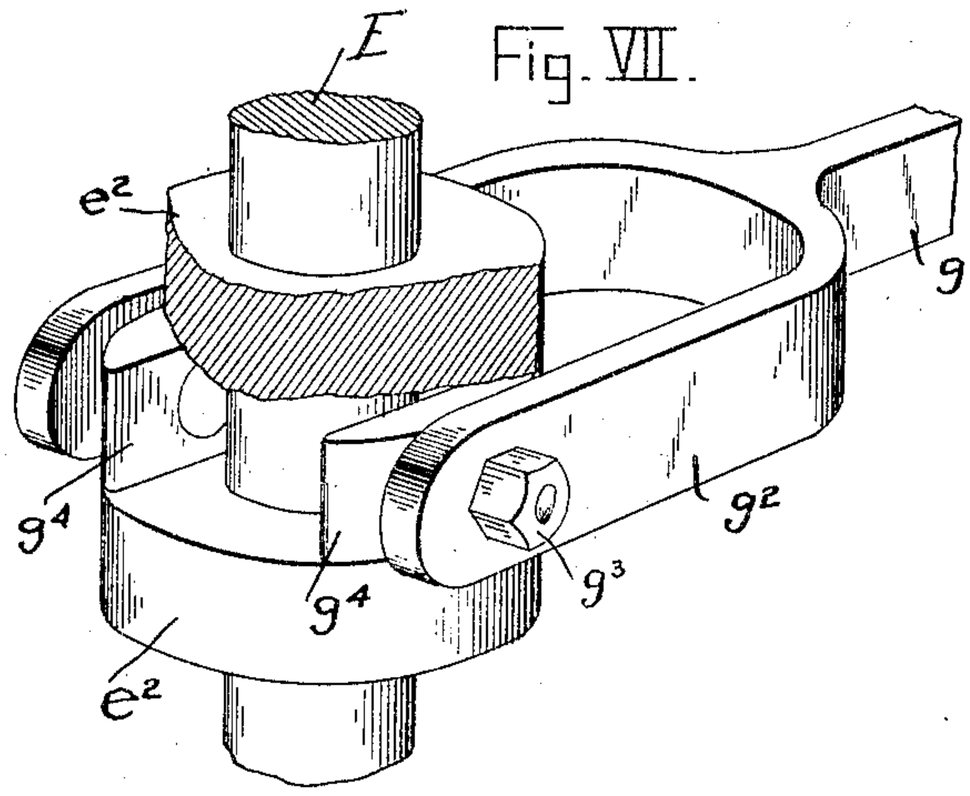


Fig. VII.



Witnesses

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STEAM METER.

APPLICATION FILED APR. 9, 1909.

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4 SHEETS—SHEET 4.

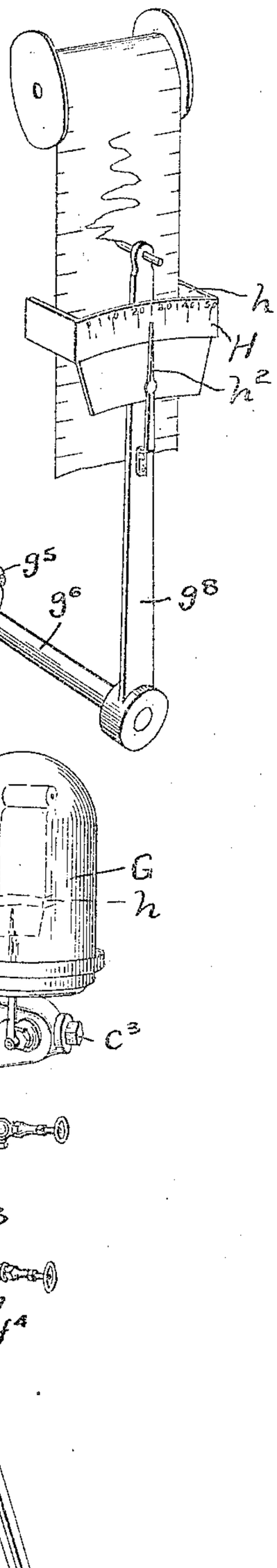

Fig. IX

Fig. X.

Witnesses

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UNITED STATES PATENT OFFICE.

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STEAM-METER.

963,643. Specification of Letters Patent. Patented July 5, 1910.

Application filed April 9, 1909. Serial No. 488,966.

To all whom it may concern:

Be it known that I, FRANK E. PENDLETON, a citizen of the United States, residing at Montclair, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Steam-Meters; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The object of this invention is, in a simple, practical, and reliable and certain manner, to improve steam-meters, greatly simplifying the construction and, at once, avoiding breakage, steadying the action, and affording safety under great pressure.

A patent granted March 1, 1898, No. 599,746, shows a steam-meter, which, though valuable and efficient in use, is, as my constant experience with steam-meters has shown me, capable of some decided improvements. In that patent, the inlet-chamber and the dash-pot are of separate construction, are, in fact, separate parts, screwed together and, thus, not characterized by the greatest simplicity of construction and wanting in strength to withstand high temperature and great pressures. Furthermore, as the weight of the meter-valve should bear a constant relation to the area of the valve at its seat, in order to produce a uniform difference of pressure on the two sides thereof and, so, afford a uniform rate of flow around the valve per unit of area of the orifice, in the larger sizes of meter, it is necessary to have a valve of great weight and consequent great size to maintain this relation; and, in that patent, in a very large meter, the heavy valve therein requisite, is of great size, is entirely in one piece and of the same metal namely, brass, involving difficulties in production and handling, and greatly-increased expense. Furthermore, the valve-rod, or guide-rod, is a two-part rod, and an objection to this construction is, that, occasionally, as from movement, or the constant vibration, or from jarring of the valve, the rods either work a little loose, or there is a slight racking, or departure from proper alinement, detracting from the true rectilineal motion necessary, whereupon there is apt to be wear and breakage with injurious, or disastrous effect. Furthermore, in that patent, there are no means for effecting constant contact of the piston-head with the interior wall of the dash-pot to insure steadiness of motion, and it having been found, in measuring fluids having a pulsating flow, that the tendency is to make the meter register higher than the amount at which it was standardized when measuring fluid at a constant flow, this tendency was sought to be overcome by supplying a perforated piston with a check-valve; but this device was not fully efficient for the purpose, as wanting in simplicity of construction and in certainty of action. Furthermore, in that patent, communication from one side of the piston to the other is through, or by, the piston-head, and no means are provided for recognition of the amount of water of condensation left in the dash-pot for steadiness, nor for efficient control of the quantity passing from one side of the piston to the other. Furthermore, in that patent, there are no means provided for sufficient cooling of the dash-pot. Furthermore, in that patent, the rod, or lever, for the indicating mechanism is attached to the valve-rod in a manner not always insuring against defect from wear and from lost motion; and finally, in that patent, there are no means of exhibiting, directly, the momentary rate of flow through the meter.

In my invention, the dash-pot and the inlet-chamber are of one casting, and strongly bolted to the bottom of the dash-pot is a blank flange, or bottom-piece, instead of a screw-cap. This feature is of great importance, greatly simplifying the construction, affording greater security against leakage, and insuring greater safety. Furthermore, in my invention, the valve for large meters is of two parts, the operative portion, or part at the seat, being of the particular metal requisite, and the other part being of a different and cheaper metal, the same being heavier and requiring little or no finishing. This is of great importance, since, as, in a large meter, the valve must weigh many hundred pounds, and the size being consequently and proportionately great, the making and finishing and handling of such a valve is a matter of difficulty, and the cost of a valve entirely, say, of brass, is very great. Furthermore, in my invention, the valve-rod is of one piece, passing centrally through the valve, and has, at the upper end of the valve, an enlargement preferably cone shaped

with the taper downward, and, just below the lower end of the valve, preferably, a screw-thread provided with a nut. The valve, which may be of any suitable metal, according to the fluid to be measured, has a disk, or cap, bolted, or secured, to its upper end, and there is a conical opening through the cap tapering downwardly. In the remainder of its length the valve has a central bore corresponding to the shape of the rod passing through it. The purpose of the cap is that of a stop upon its seat, when the valve falls to its lowest position. It will be obvious, where a nut at the bottom only is employed, with any stop-device at the upper end of the valve, and, especially, where the form of rod having the conical-shaped enlargement is employed, that, as the nut at the lower end of the valve is screwed up, the rod will be drawn down with great force and the valve tightly secured to it. Furthermore, in my invention, to insure steadiness of motion of the piston within the dash-pot, and in a simple and absolutely-efficient manner to cause the meter to register accurately under a pulsating flow, as well as under constant flow, the piston has, inset on its periphery, elastic metallic snap-rings, or rings of other suitable elastic or flexible substance, which can be made with whatever expansive force may be necessary to give delicacy of impingement of said rings against the wall of the dash-pot, most compatible with the up-and-down movement of the piston-head, piston-rod and valve, and with the necessary partial seal formed by the piston-head, snap-rings, and water in the dash-pot,—all of which gives steadiness of motion to the entire moving mechanism, which steadiness establishes a mean line in the fluctuating movement of the recording pencil upon the exterior traveling chart, from which is measured the quantity of fluid flowing. As the rings constantly tend to spring outward, it will be obvious that they are constantly in contact with the inner wall of the dash-pot, filling the clearance between the piston and this wall, and thus minimize the movement of the piston therein from sudden pulsations; while, within the dash-pot, is an inner, or bushing-cylinder, preferably of brass, within which the piston works, this cylinder merely resting within the dash-pot as a casing, or secured therein, at bottom or top, in any suitable manner, the function of the cylinder being that of a wearing-strip. In my invention, furthermore, I apply a by-pass to the dash-pot, controlling the quantity of water passing from one side of the piston to the other, with capability of regulating the same for increased, or decreased, cushioning of the piston, with the advantage of such action upon the piston and consequent effect on the valve; and the by-pass may also serve as a gage-glass, showing the height of water of condensation in the dash-pot. Furthermore, in my invention, while, under ordinary conditions, radiation from the wall of the dash-pot suffices to effect the requisite cooling and consequent condensation and precipitation of water from the fluid passing through the meter, where this is not the case, then, to effect condensation and precipitation of water from the fluid passing through the meter, to supply the necessary water in the dash-pot, I provide the dash-pot with a water-jacket, through which there may be constant circulation by connection with a return, or circulating, cold water system. Furthermore, in my invention, instead of a mere single attachment for the end of the indicator-lever to the valve-rod, I provide the end of the lever, which is at the valve-rod and at the collars there, with a yoke, and insert between each of its bifurcations and the valve-rod, a shoe, set laterally between the fixed collars on the valve-rod, and secure the shoes to the yoke by pins, or by bolts and nuts, as shown, though I may attach the yoke to the rod in any other suitable manner; and finally, in my invention, to present means of instant and immediate reading of the unit of flow, as expressed in cubic feet, pounds, or horse-power, per appropriate unit of time, I employ, with the index-finger, or stylus, which moves in an arc to record on the chart the quantity of fluid passing through the meter, a second finger, or pointer, set, preferably, in the same radial line with the first, and provide an index arranged on an arc concentric with the first pointer and set below the arc of motion of the operative end, or point, of the first pointer, and above the pivot, or center, marking this second arc with a scale of the desired denomination,—as by taking the extreme point of movement of the first index-finger in the one direction to mark the established horse-power capacity of the particular meter, and its extreme point of movement in the other direction as zero, and by radial lines between the extremes properly marking the scale.

In the accompanying drawings, forming part of this specification, and in which like letters of reference indicate the corresponding parts, I have shown, in the nature, merely, of illustration, certain forms of embodiment of my improvements.

In the drawings, Figure I is a view in vertical, longitudinal section of a medium-sized meter, where the valve, or plug, not being very heavy, may be of one piece, exhibiting the general arrangement of the parts and the relation of those which are coöperative, showing the inlet-chamber and the dash-pot as a single casting, with the blank flange, or bottom-piece, bolted to the dash-pot; the valve, or plug; a valve-rod, in one piece, passed centrally through the

valve, the enlargement in this instance, cone-shaped; the lock-nut below the valve to fix the same securely upon the rod; the disk or cap, here, bolted upon the upper end of the valve, serving as a stop and having, in this instance, a conical opening through it to accord with the shape of the enlargement; the piston, recessed for and holding elastic or resilient rings and secured to the rod by a screw and nut; the bushing-cylinder within the dash-pot, serving as a wearing-strip; the by-pass at the dash-pot, affording, also, a gage-glass; a water-jacket applied to the dash-pot; and collars on the valve-rod, above the valve, to engage with the rod, or lever, for the indicating mechanism; and the indicating device; Fig. II is a view in vertical section, partly in elevation, exhibiting a valve for a large meter, the valve being weighted, that is to say, there being applied to the valve proper a cheaper substance than that of the valve itself, and for adequate weight, the valve thus appearing, in this instance, in two parts, and, in this instance, the weight being above; this view showing, in addition to what appears in Fig. I, a part of the body of the valve-rod supplying the lower collar for the indicating-mechanism lever; Fig. III is a view in plan, looking down upon the top of the weight of the valve in Fig. II; Figs. IV and V are views, respectively, in plan and in side elevation, showing the snap-rings for the piston; Fig. VI is a view in plan, partly in section, showing the yoke of the indicator-lever at the valve-rod end of this lever; the shoes resting on the lower collar of the valve-rod, and means for securing the yoke to the shoes, in this instance, bolts and nuts; Fig. VII is a view in perspective, with a portion of the upper collar broken away, showing the valve-rod, the collars, the yoke, and the shoes between the collars, the yoke secured to the shoes, but having movement thereon by headed nut-bolts; Fig. VIII is a view looking down upon the indicator-lever, showing the indicator-lever, appearing in partial horizontal section, with a spindle, appearing in full lines, attached to the indicator-lever by a tit-screw and extending forward from the same; Fig. IX is a view in perspective, showing the indicator-arm, the spindle extending forward therefrom, the index-finger, or stylus, for recording on the chart; and a pointer and an arc to present means of instant and immediate reading of the unit of flow; and Fig. X is a view in perspective, exhibiting a heavy meter as it appears when set up.

Referring to the drawings, A indicates the dash-pot, and B the inlet-chamber, and these, as distinguished from construction heretofore, are in one piece, thereby attaining greater simplicity and readiness of production and of setting up, also absolute security from leakage, and insurance of greater safety in use. The dash-pot may be provided with a water-jacket, a, having inlet- and outlet-openings above and below, front and rear, marked respectively, a^2 and a^3; the shield of the inlet-chamber, marked b, is cast with this chamber, instead of being screwed up into it, as heretofore; and there is a central opening, b^2, from the inlet-chamber to the dash-pot. The dash-pot may have inserted into it an internal cylinder, a^4, in the nature of a bushing-cylinder, preferably of brass. Instead of a cap screwed upon the bottom of the dash-pot, as heretofore, the bottom of the dash-pot has tightly bolted to it a blank flange, or bottom-piece, a^5, and is provided with the usual blow-off, a^6.

Bolted upon the top of the inlet-chamber, B, is the exhaust-, or exit-chamber, C, which has a lateral, hollow extension, c, to serve as a housing, having an access-opening, c^2, at its outer end, closed by a screw-plug, c^3, all for a purpose which will appear later. This exhaust-chamber communicates directly with the exit, c^4, there being a brace, or spider-frame, c^5, between the exhaust-chamber and the exit to furnish a guide for the valve-rod, as will presently be described; and in direct line above the central opening, or boss, of this is a post, or pin, c^6, set down through the top of the exit to serve as a stop for the upper end of the valve-rod, as will be set forth farther on. Screwed into the top of the inlet-chamber is an annular seat, b^3. Inlet- and exhaust-chambers have pet-cocks, b^4, c^7.

D indicates the valve, and this valve tapers downward and has the parabolic incurve, as in the patent referred to, and for the same purpose. Strongly secured on top of the valve, as by stud-bolts, is a cap, d, which serves as a stop, when the valve rests on its seat, b^3, the pin, c^6, limiting the movement of the valve upward. This cap has a central opening through it, tapering from above downward, which is to accord with the shape of an enlargement of the valve-rod, to which the valve is secured; and the valve is centrally perforated from top to bottom.

While for small, or even for medium-sized meters, it is proper, and economical, to have the valve, in full length, of one metal, say of its usual metal, namely, brass, yet, where a valve is very large, involving great weight, such a valve is not only difficult in finishing and handling, but is, intrinsically, of high cost. To obviate these difficulties, I supply the valve, at a suitable situation, say, upon its top, with a weight, d^2, of some lighter and cheaper material, the same being suitably secured thereto, as by bolts through the cap, d, and by this weighting, not only are these difficulties overcome, but, thereby, the weight of the valve may be adjusted. The valve is set down through the screw-cap, b^3, into the inlet-chamber and has its

lower end entering the tubular shield, *b*, therein.

E indicates the valve-rod, which is in one piece, and is attached to the valve. The valve-rod E has an enlargement *e*, which is preferably cone-shaped, as shown. Throughout the rest of its length the rod is of any suitable shape to extend through the valve, projecting therefrom below and above. Above the enlargement, the rod has one or more collars, e^2, there being two collars where the rod is not weighted, but in case the rod is weighted, the top of its enlargement serves, if desired, for the lower collar. The purpose of these collars will appear farther on. The rod is guided, above, by passing through a hub, or boss, in the brace, or spider-frame, c^5, and, below, by passing through the central opening, b^2, which is between the shield-tube in the inlet-chamber and the dash-pot. The valve is securely fixed to its rod by a lock-nut, e^3, screwed upon it at about the lower point of the proper situation of the valve. It will be obvious, that, as the nut is turned up, the rod will be drawn firmly into and held securely in the valve, and the valve, itself, be movably fixed on the rod at its desired situation.

F indicates the piston which is on the lower end of the rod and which is securely fixed thereon by a nut, *f*. To insure steadiness of motion of the piston within the dash-pot to cause the meter to register correctly under a pulsating flow, as well as under a constant flow, instead of having the piston perforated, with a superincumbent valve upon the perforations to move upward on the downward stroke of the piston, and which is liable to derangement of action from various causes, I recess the piston, circumferentially, as at f^2, and set into the recesses elastic, or flexible, bodies, for example, steel snap-rings, f^3, and, preferably, in such manner that, while the tendency will be to spring outward, yet, on pressure, so as to allow some passage of water from one side of the piston to the other, the rings will recede into their recesses. By provision of the by-pass, marked f^4, which may, also, serve as a gage-glass, the cushioning effect of the water in the dash-pot, acting with the rings, is regulated, as by hand-valves, f^6. The bushing-cylinder, a^4, is a wearing-strip.

As abovesaid, the valve-rod is provided with collars, e^2. When the valve is fixed to the rod and is in operative position, these collars are within the exhaust-chamber, or body of the meter, and their function is, on movement of the valve, to operate the indicating and recording mechanism, G, by an indicating-lever, or arm, *g*. Instead of this lever being attached to the rod, with one side pivoted directly to the rod and at a single point, the lever, is provided with a yoke, or U-shaped spread, g^2, at the rod, and is pivoted by headed nut-bolts, g^3, to shoes, g^4, which are set, front and rear, between the collars. At the other end, the lever is fixed by a tit-screw, g^5, to a spindle, g^6, which is suitably pivoted at the rear end, g^7, in the extension, *c*, of the exhaust-chamber and passes out at the front end of the exhaust-chamber through a stuffing-box. Thi spindle, g^6, extends outward some distance, and, at its front end, has affixed to it, set upright, an index-finger, or stylus, g^8, which, in the usual manner, as by a pencil, marks a record on the chart, as shown.

In order to afford means of instant and immediate reading of the unit of flow, and not to have to make calculation thereof, as from the chart, I provide an arc, H, marked as desired, say, for horse-power per appropriate unit of time, and attach this arc to a suitable part, as shown at *h*, Figs. I, IX and X. To act in a manner coördinate with the stylus, I employ, additionally to the stylus, a pointer, to point to the unit of flow for appropriate unit of time, on the arc. The pointer is marked h^2. Access may be had to the indicator-lever, to set the same by the tit-screw, through the opening, c^2, at the end of the casing.

Having thus fully described my invention and appropriate means for carrying the same into effect, what I claim and desire to secure by Letters-Patent of the United States is:

1. In a fluid-meter, the combination with inlet- and outlet-chambers, of a valve controlling passage of fluid from the inlet-chamber to the outlet-chamber and having a vertical, central opening through it enlarged at the top, a valve-rod having an enlargement to be set into the opening at the top, and means for securing the valve and rod together, substantially as described.

2. In a fluid-meter, the combination with inlet- and outlet-chambers, of a valve controlling passage of fluid from the inlet-chamber to the outlet-chamber and having an opening through it enlarged at the top, and of a plate, or cap, fixed to the valve and perforated centrally to register with the top of the enlargement of the opening in the valve.

3. In a fluid-meter, the combination with inlet- and outlet-chambers, of a valve controlling passage of fluid from the inlet-chamber to the outlet-chamber and having a vertical, central opening through it, a valve-rod extending through said opening, a cylinder, a piston secured to said valve-rod and movable within the cylinder, and a by-pass provided with means for regulating the flow of liquid from one side of the piston to the other, this, in connection with the piston, affording the desired motion, substantially as described.

4. In a fluid-meter, the combination with

inlet- and outlet-chambers, of a valve controlling passage of fluid from the inlet-chamber to the outlet-chamber and having a vertical, central opening through it, a valve-rod extending through said opening, a cylinder, a piston secured to said valve-rod and movable within the cylinder, said piston being provided circumferentially, with snap-rings, and of a by-pass for permitting passage of liquid from one side of the piston to the other, substantially as and for the purpose set forth.

5. In a fluid-meter, the combination with inlet- and outlet-chambers, of a valve controlling passage of fluid from the inlet-chamber to the outlet-chamber and having a vertical, central opening through it, a valve-rod extending through said opening, a dash-pot, a piston secured to said valve-rod and movable within the dash-pot, and an inner cylinder within the dash-pot and serving as a wearing-strip, substantially as described.

6. In a fluid-meter, the combination with inlet- and outlet-chambers, of a valve controlling passage of fluid from the inlet-chamber to the outlet-chamber and having a vertical, central opening through it, a valve-rod extending through said opening, a dash-pot, a piston secured to said valve-rod and movable within the dash-pot, and a water-jacket surrounding the dash-pot, as and for the purpose described.

7. In a fluid-meter, the combination with inlet- and outlet-chambers, of a valve controlling passage of fluid from the inlet-chamber to the outlet-chamber, a chart, indicating devices adapted to mark on said chart, means connecting said indicating devices with the aforementioned valve, an arc appropriately marked to represent the unit of flow, as expressed in cubic feet, pounds, horse-power, or the like, per appropriate unit of time, an index-finger for the chart movable within the limits of said arc, and a pointer arranged to move, also within the limits of said arc and to act coördinately with the index-finger at the chart, substantially as described.

In testimony whereof, I affix my signature, in the presence of two subscribing witnesses.

FRANK E. PENDLETON.

Witnesses:

R. G. DYRENFORTH,

J. W. KENNEDY.