(No Model.) 5 Sheets—Sheet 1.

C. N. DUTTON.

FLUID METER.

No. 441,614. Patented Nov. 25, 1890.

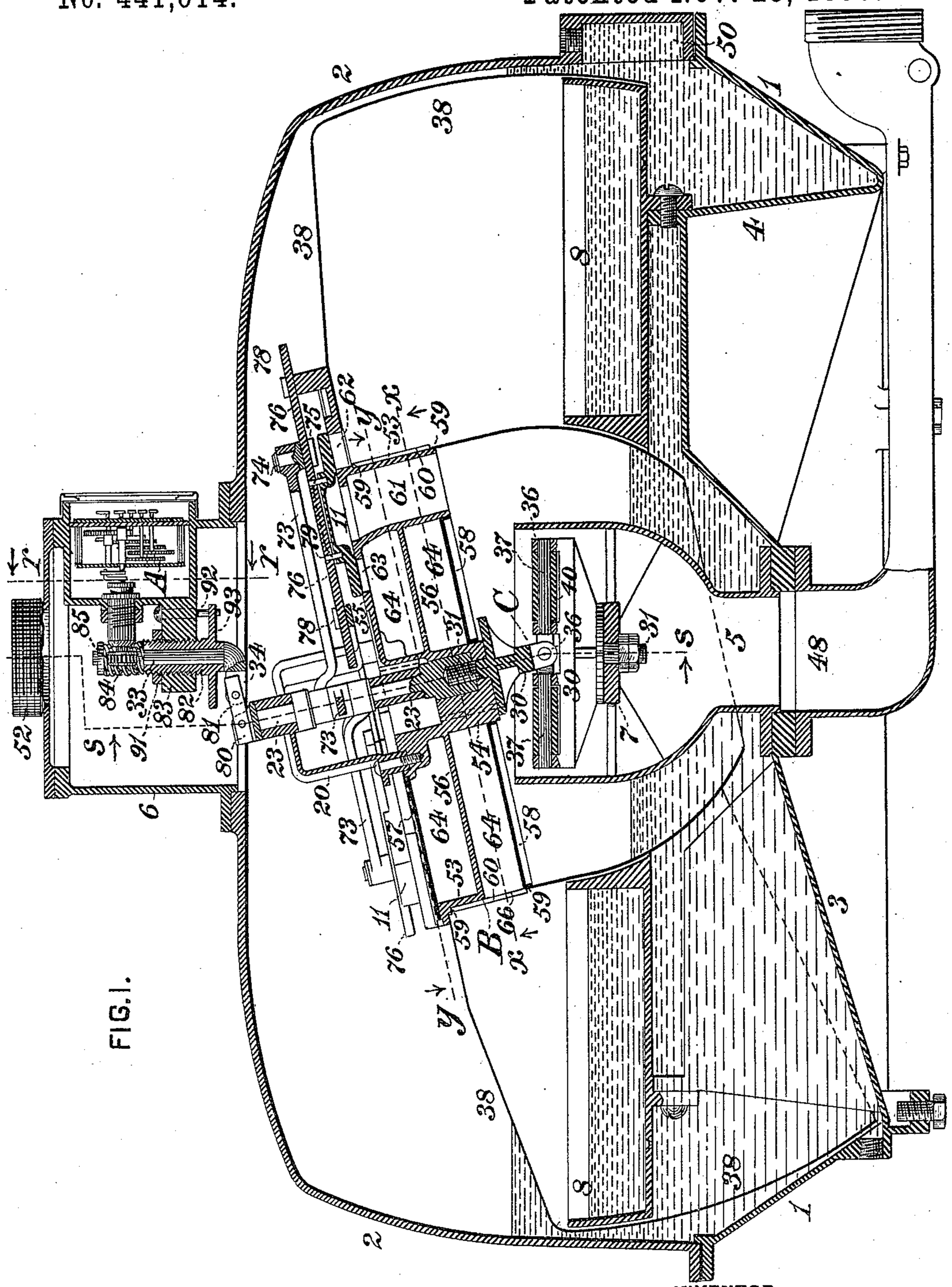

FIG. I.

WITNESSES:

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Chauncey N. Dutton,

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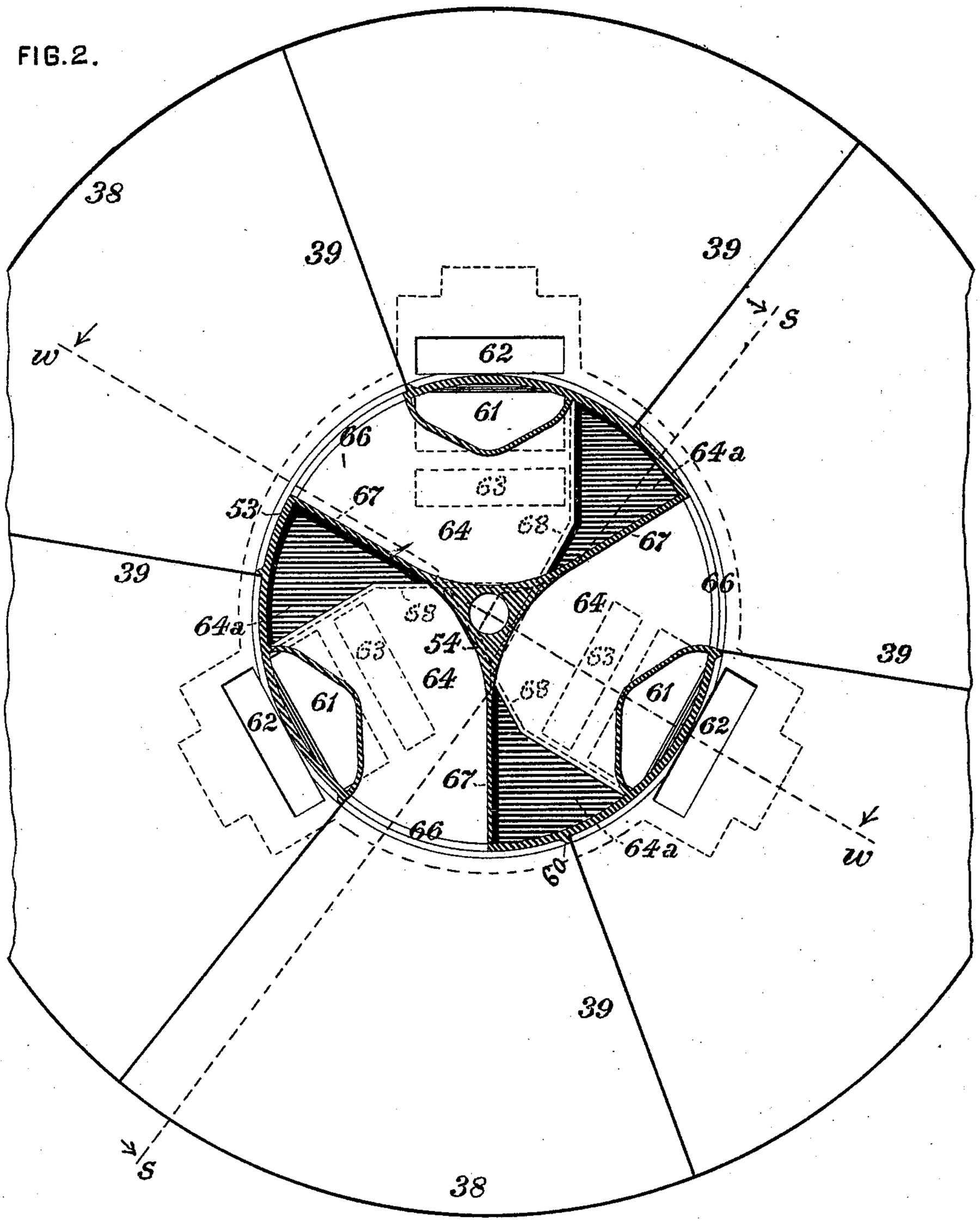
(No Model.) 5 Sheets—Sheet 2.

C. N. DUTTON.

FLUID METER.

No. 441,614. Patented Nov. 25, 1890.

FIG. 2.



WITNESSES:

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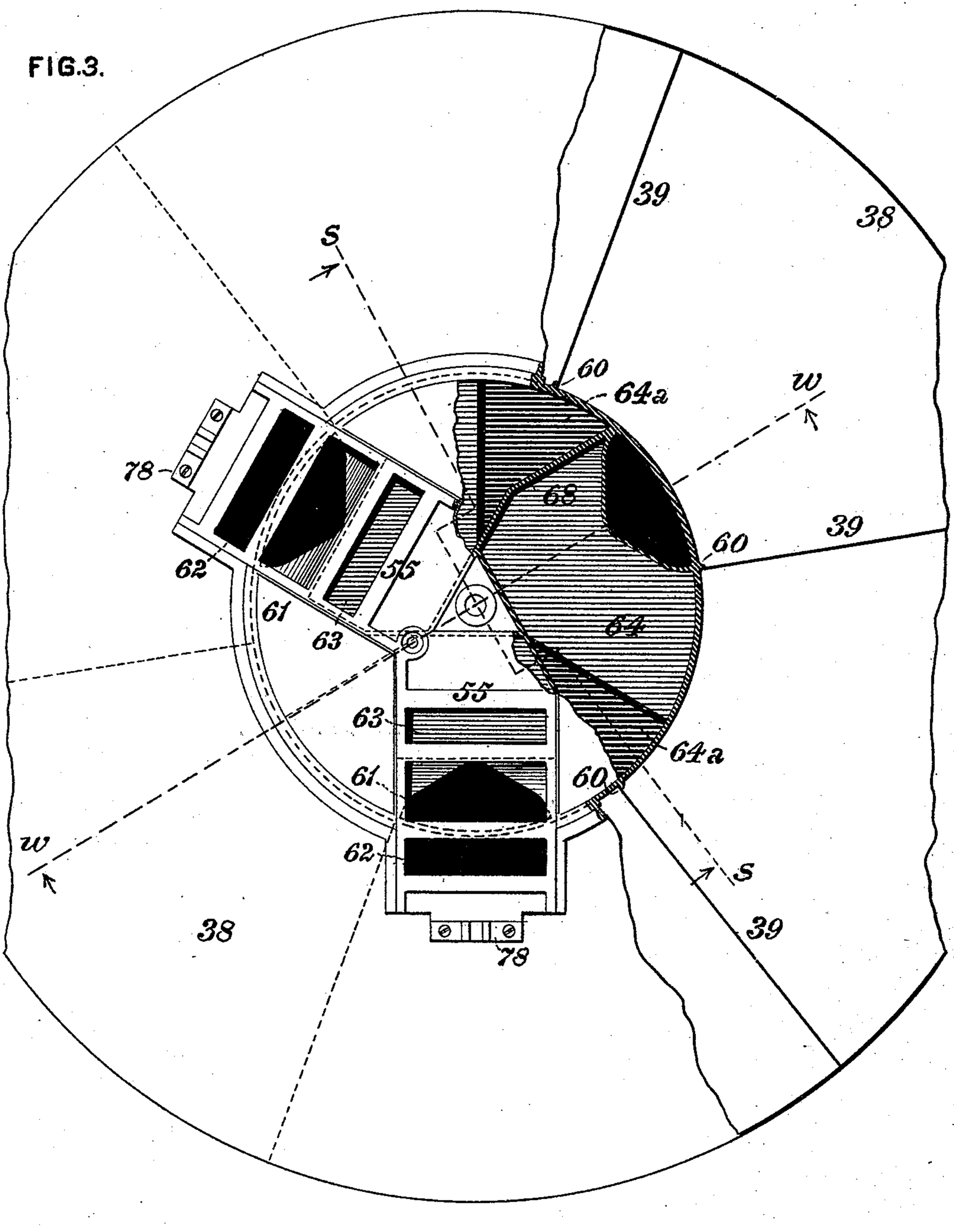
(No Model.) 5 Sheets—Sheet 3.

C. N. DUTTON.

FLUID METER.

No. 441,614. Patented Nov. 25, 1890.

FIG. 3.



WITNESSES:

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(No Model.) 5 Sheets—Sheet 4.

C. N. DUTTON.

FLUID METER.

No. 441,614. Patented Nov. 25, 1890.

FIG. 4.

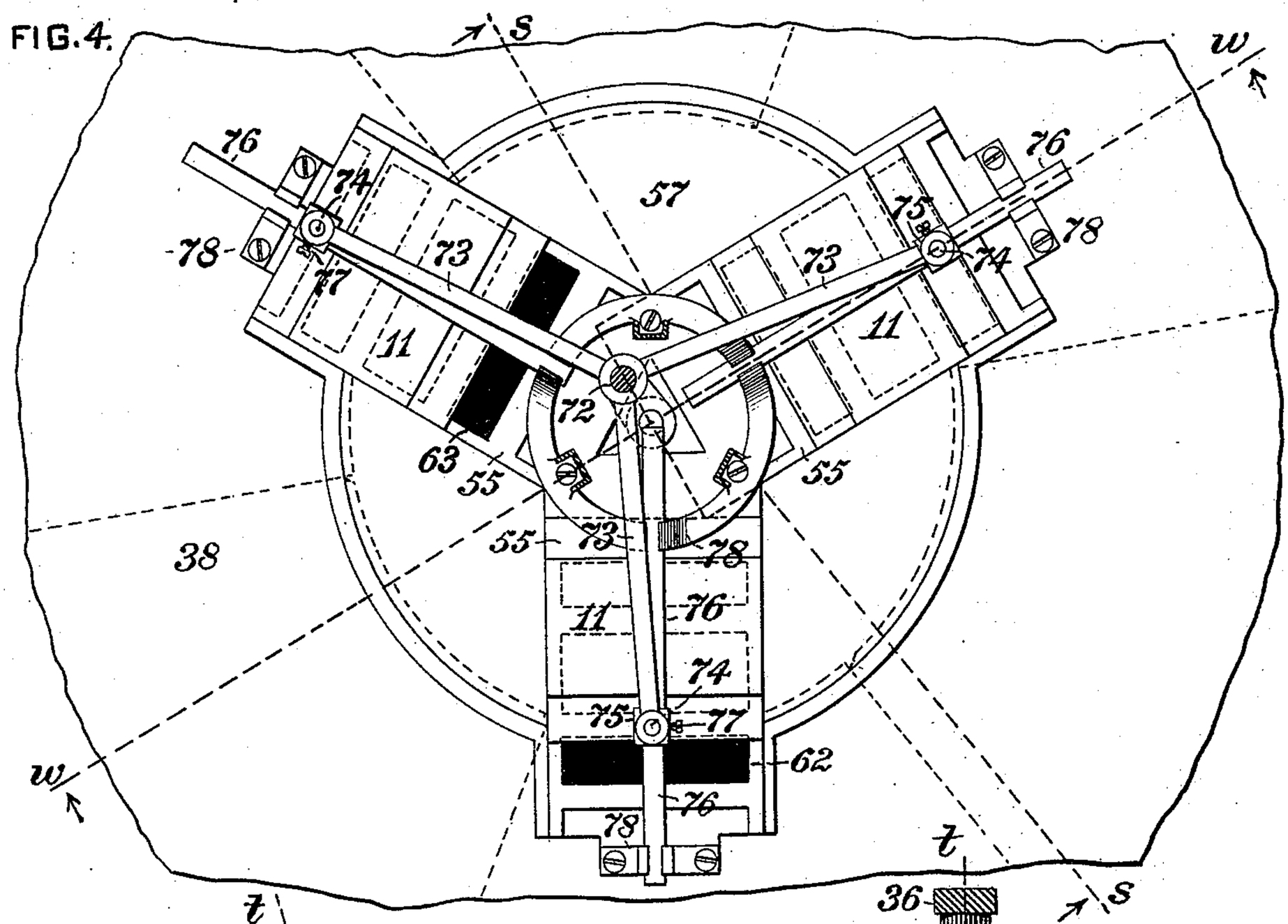


FIG. 5.

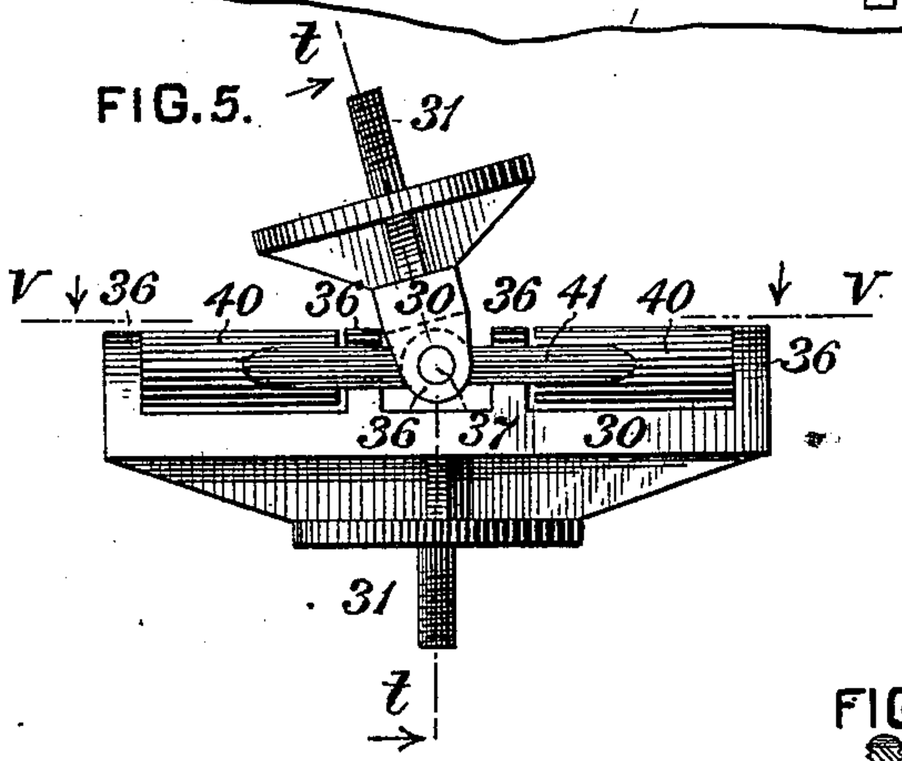


FIG. 6.

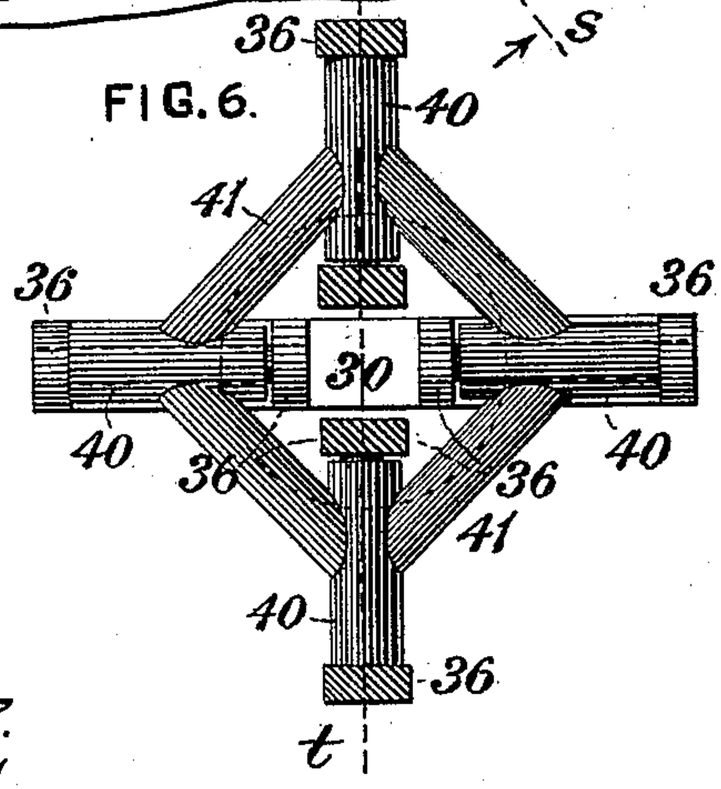
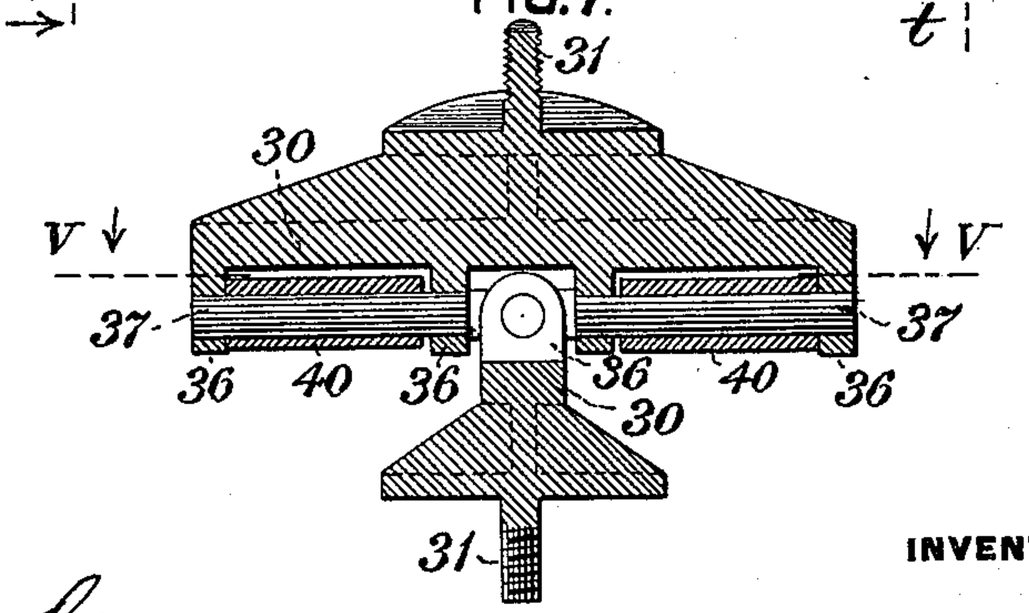


FIG. 7.



WITNESSES:

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(No Model.) 5 Sheets—Sheet 5.

C. N. DUTTON.

FLUID METER.

No. 441,614. Patented Nov. 25, 1890.

FIG. 8.

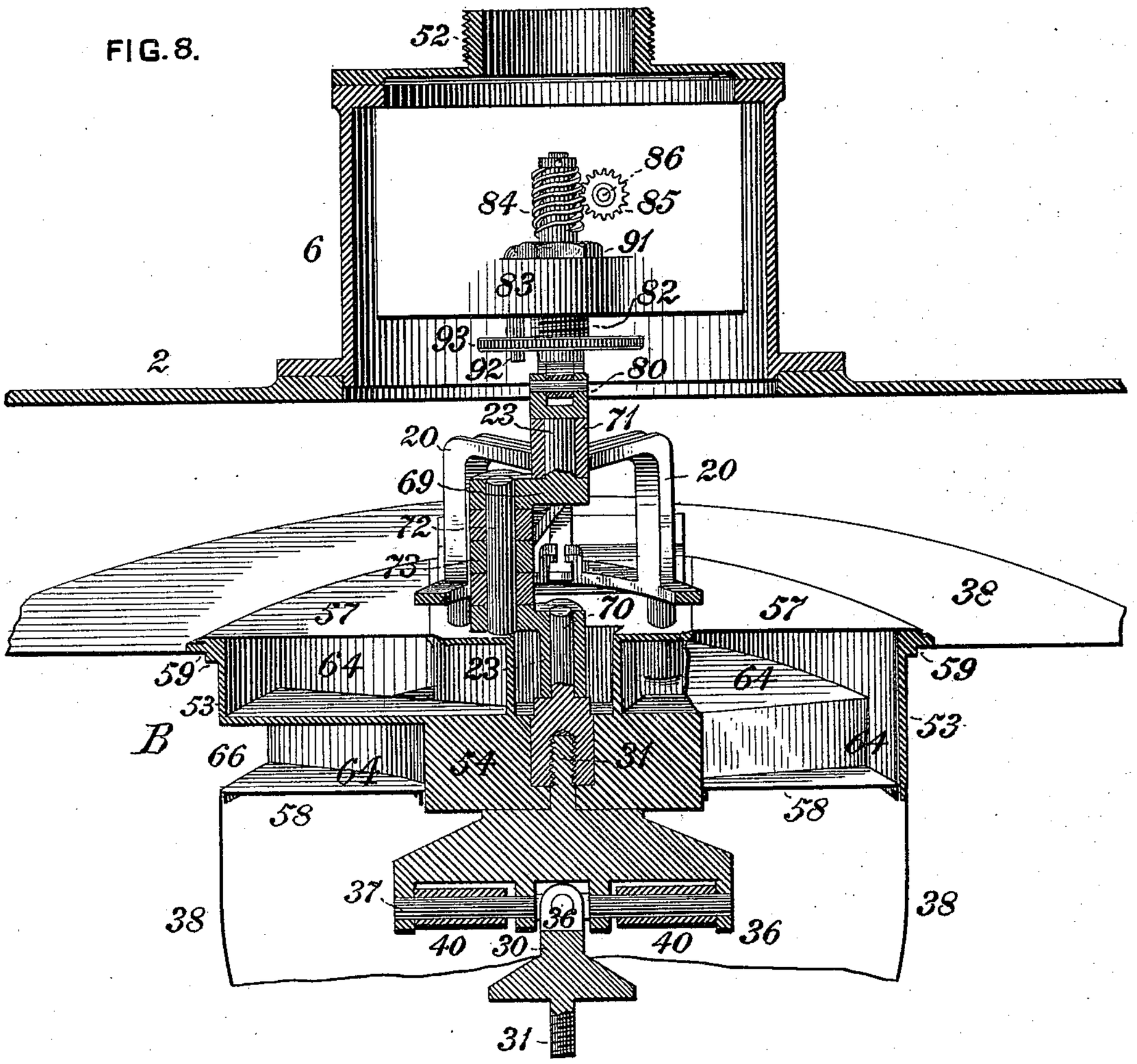
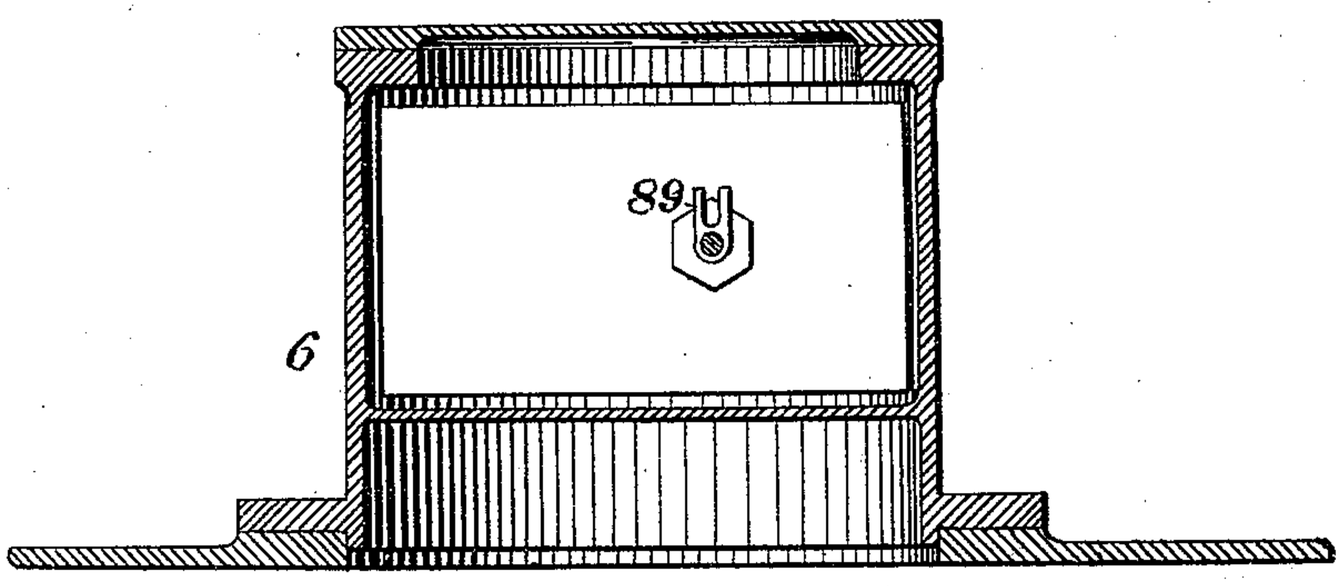


FIG. 9.

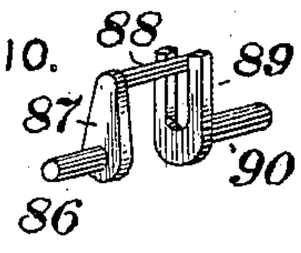


WITNESSES:

C. M. Clarke

F. E. Gaither

FIG. 10.



INVENTOR.

Chauncey N. Dutton,

by J. Howden Bell, Att'y.

UNITED STATES PATENT OFFICE.

CHAUNCEY N. DUTTON, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE FUEL GAS AND MANUFACTURING COMPANY, OF SAME PLACE.

FLUID-METER.

SPECIFICATION forming part of Letters Patent No. 441,614, dated November 25, 1890.

Application filed August 19, 1889. Serial No. 321,262. (No model.)

To all whom it may concern:

Be it known that I, CHAUNCEY N. DUTTON, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Fluid-Meters, of which improvements the following is a specification.

My present invention relates to improvements upon certain features of construction of the fluid-meter for which Letters Patent of the United States No. 400,420 were granted and issued to George Westinghouse, Jr., and myself under date of March 26, 1889; and its object is to effect a structural simplification and economy in sundry details, as well as to prevent the obstruction of the meter by undue variations of level of the sealing fluid under extreme differences of pressure.

The improvements claimed consist in certain novel devices and combinations hereinafter set forth, including (*a*) a measuring-shell, which is closed centrally at its top; (*b*) a port-section connected to and moving with the measuring-shell and having a series of valve-controlled ports and passages; (*c*) a measuring-shell suspended upon a universal-joint mechanism, which further acts to prevent rotation of the shell, and (*d*) a threaded bearing engaging a fixed nut for varying and adjusting the angle of libration of the measuring-shell.

In the accompanying drawings, Figure 1 is a vertical section through a meter embodying my invention at the line *w w* of Figs. 2, 3, and 4; Figs. 2 and 3, horizontal sections at the lines *x x* and *y y*, respectively, of Fig. 1; Fig. 4, a plan or top view of the valve-seat and valves; Fig. 5, a side view in elevation of the universal-joint mechanism; Fig. 6, a horizontal section through the same at the line *v v* of Figs. 5 and 7; Fig. 7, a vertical section through the same at the line *t t* of Figs. 5 and 6; Fig. 8, a vertical section, on an enlarged scale, through the port-section and cap of the meter at the line *s s* of Figs. 1, 2, 3, and 4; Fig. 9, a vertical section through the register-case at the line *r r* of Fig. 1, and Fig. 10 a detached view in perspective of the dog which connects the registering mechanism with the measuring mechanism.

In the practice of my invention I provide a meter shell or case which is substantially in the form of a section of a sphere, and is composed of a lower section 1 and an upper section 2, which are connected by bolts passing through outwardly-projecting flanges on their meeting edges.

In order to reduce the volume of sealing fluid, I provide, as in Patent No. 400,420 aforesaid, a series of upwardly-projecting displacers 4, which in this case are formed integral with and act as parts of the bottom plate 3 of the lower section 1 of the meter-case. A supply-pipe 48, for the inflow of the fluid to be measured, is connected centrally to the bottom plate 3 in line with a central tube 5, which is also connected to said plate and projects upwardly therefrom above the level of the sealing fluid, and a discharge-nozzle 52, for the delivery of the measured fluid, is connected to a chamber 6, fixed upon the top of the upper section 2 of the meter-case.

The sheet-metal measuring shell or vessel 38 is, similarly to that of Patent No. 400,420, substantially in the form of an annular section of a sphere divided radially by partitions 39 into a series of measuring-compartments, the lower ends of which are open and immersed in a suitable sealing fluid, each compartment inclosing one of the displacers 4. The compartments are each completely closed at top, except in the particular of being provided with a port 62 for the supply and delivery of fluid to be measured. The sealing fluid is introduced through a lateral filling-tube 50, which is cast upon one side of the lower section 1 of the case and is closed at top by a proper plug.

The meter-case of Patent No. 400,420 was divided by a partition into upper and lower compartments, and the central portion of the measuring-shell was entirely open at top, at which it thus communicated with the upper compartment and with the casing of a central valve, which was in communication therewith and controlled the supply and exhaust of fluid to and from the measuring-compartments. Under such construction the pressure in the central portion of the drum and the valve-casing was lower than that in the measuring-compartments, as a result of which

in case of extreme differences of pressure the sealing fluid tended to be forced out of the measuring compartments into the valve-casing, trapping the valve and obstructing the meter.

In my present invention the central portion of the measuring-shell is closed at top by a port-section B, connected thereto, which will be presently described, and the fluid to be measured is admitted through the lower nozzle 48 and tube 5 to the central portion of the shell, in which the maximum pressure always obtains, there being a somewhat lower pressure in the measuring-compartments and a still lower and minimum pressure in the upper portion of the meter-case above the measuring-shell and sealing fluid. The pressure therefore tends to force the sealing fluid out of the central portion of the shell, causing the fluid to stand at its lowest level therein, and tending in a less degree to force it out of the measuring-compartments, in which it will stand at a higher level, the excess of fluid being forced into the upper portion of the casing on the exhaust side of the meter, where the fluid stands at its highest level, and has no tendency to interfere with the normal working of the meter.

The substitution of a port section attached to and moving with the measuring-shell and carrying the valve mechanism for the fixed valve-casing of the prior construction further attains the advantages of (*a*) simplifying and cheapening the casting which carries the displacers, the tubes or channels therein leading to the measuring-compartments being now dispensed with; (*b*) providing shorter and straighter channels opening directly into the measuring-compartments, thereby reducing the friction of the fluid to be measured and increasing the capacity of the meter; (*c*) so locating said channels that they shall at all times be above the level of the sealing fluid, and therefore not be liable to be obstructed thereby, and (*d*) effecting the determination and maintenance of the normal and accurate relation of the members of the measuring mechanism by the form and position of the port-section, which serves as the rigid central support on which all the parts of the measuring mechanism are assembled, and by means of which their normal relation and operation are readily determined with the accuracy essential to the successful operation of the meter.

The measuring-shell is supported and its axis maintained uniformly at a fixed angle with the vertical axis of the meter, so that its direct oscillation shall, as in Patent No. 400,420, be prevented and converted into a "libratory" or progressive wave-like movement about its center by a universal-joint mechanism C, connected centrally to the lower side of the port-section B and to a fixed support, and a shaft 23, journaled in said section and coupled to a crank-arm 34 on a shaft 33, which is journaled in a bearing on the meter-case in line axially therewith and above the measuring-shell. The universal joint mechanism employed in this instance is composed of two blocks or carriers 30, each of which is provided with a central-threaded stem 31 and four lugs or bearings 36, projecting from its side opposite that on which the stem is fixed. The stem 31 of the lower carrier is secured to a central support 7 in the tube 5, and the stem of the upper carrier is fixed centrally in the bottom of the port-section B, the two carriers being coupled by pins 37, which fit freely in their lugs 36 and in bearings 40, which are arranged in the same plane and in pairs at right angles on a coupling-frame 41, interposed between the carriers 30. It will thus be seen that the measuring-shell is supported and adapted to move in either direction about the common axis of either pair of bearings 40 of the coupling-frame, and its axis is maintained at a fixed angle with that of the meter, so as to impart to it the desired libratory movement by its connection with the shaft 33, as will be explained in connection with the description of the valves and their operating members, of which said shaft forms a part.

The port-section B, which closes the top of the central portion of the measuring-shell 38, is a light casting having an outer cylidrical shell 53 and a central hub or boss 54, connected at top by an integral series of transverse valve-faces 55 and about half-way between the top and bottom of the casting by a transverse partition 56. A top wall 57 of sheet metal is secured to and covers that portion of the upper side of the casting not closed by the valve-faces, and a bottom wall 58, also of sheet metal, is secured to and closes its lower side. Concentric shoulders 59 are formed upon the shell 53 adjacent to its top and bottom, to serve for setting the inner and outer walls of the measuring-shell 38, and a series of vertical ribs 60 is also formed upon the periphery of the shell 53, against which the inner ends of the radial partitions 39 of the measuring-shell are set.

The space between the shell 53 and central hub 54 of the port-section is divided into a series of ports and passages through which the fluid admitted through the pipe 48 to the central portion of the measuring-shell 38 is admitted to the several measuring-compartments thereof and exhausted therefrom into the meter-casing above the measuring-shell for delivery through the nozzle 52, the admission and exhaust of fluid being controlled by a series of reciprocating slide-valves 11, working over the valve-faces 55, as presently to be described. The valve-faces are disposed equiangularly about the central hub 54, and extend radially therefrom to the outer shell 53, three being provided in the instance illustrated. A port 61 extends from each valve-face through the port-section to the central portion of the meter-casing or that inclosed by the inner wall of the measuring-shell, ad-

jacent to which port a port 62 is formed in each valve-face to establish communication, when uncovered by the valve, between the adjacent measuring-compartment and the upper portion of the meter-casing. On the inner side of each port 61 a port 63 is formed in each valve, which port, when uncovered by the valve, establishes communication between the port 61 and a passage 64. Each of the passages 64 leads from a port 63 to an opposite measuring-compartment of the shell 38, extending first between the top of the valve-section and the partition 56 and then turning downwardly, the difference of level being indicated by the tinted portions 64^a in Figs. 2 and 3, and extending for the remainder of its length between the partition 56 and the bottom plate 58 to a port or opening 66, leading into the opposite measuring-compartment. The passages 64 are below the partition 56, separated one from another by radial partitions 67, and above the partition 56 they are separated by partitions 68, which, to afford all available transverse area in the passages 64, are made partly radial and partly parallel with the radial center lines of the several valve-faces.

Under the above construction it will be seen that each measuring-compartment of the shell 38 is, by proper movements of one of the slide-valves 11, adapted to be alternately placed in communication with the supply and the exhaust side, respectively, of the port-section B.

The ports 61, 62, and 63 of each of the valve-seats 55 are controlled by a slide-valve 11, fitting truly upon the valve-seat and having a recess or cavity similar to the exhaust-recess of a steam-engine slide-valve. The valves 11 are reciprocated by a crank 69 on a driving-shaft 23, the lower end of which is tubular and is journaled on a cylindrical bearing 70, fixed centrally in the hub 54 of the valve-section B, and the upper end of which is fitted to rotate in a bearing 71, supported by a frame 20, fixed to the cap-plate of the valve-section. The valves are coupled to the crank-pin 72 by connecting-rods 73, having end eyes fitting on the crank-pin and on pins 74, fixed on adjustable blocks 75, which are clamped to guide-rods 76 by set-screws 77. The guide-rods 76 slide in guides 78, fixed to the frame 20 and to the outer end of the valve-faces, and are connected with the valves 11 by pins 79, which engage holes in the valves and effect their reciprocating movement with the guide-rods, at the same time preventing them from moving laterally and obviating liability to bending.

In Patent No. 400,420, before referred to, the adjustment for increase or decrease of the angle of libration of the measuring-shell was effected by means of a crank-plate connected to the valve-shaft and moved transversely thereto by a nut. Under my present invention I attain the same end, with greater simplicity and economy of construction, by the provision of a slotted arm 80, which is secured upon the upper end of the valve-driving shaft 23, and is coupled by a link 81 with a similar arm 34, fixed upon a register-driving shaft 33, which is journaled in line axially with the meter in a tubular bearing 82, having an external thread, which engages a corresponding internal thread in a support 83, fixed to the cap 6 of the meter-casing. The shaft 33 carries a worm 84, engaging a worm-wheel 85, fixed upon a horizontal shaft 86. The pin 88 of a crank 87, fixed upon the opposite end of the shaft 86, engages a slot in a crank 89 on the first-motion shaft 90 of a suitable indicating and registering mechanism A, which is inclosed in a casing set in the meter-cap 6, and which, not constituting in and of itself part of my present invention, need not be herein described.

The register casing and mechanism are further set forth in a separate application, filed by me under date of September 2, 1889, Serial No. 322,754, and are not therefore claimed as of my present invention.

By raising or lowering the threaded bearing 82 in its support 83 the angle of the shaft 23 with the axis of the meter and consequently the angle of libration of the measuring-shell may be decreased or increased, as required, for varying the capacity of the meter. The bearing 82 is held in adjusted position by a lock-nut 91 on its top, as well as by a screw 92, engaging a thread in the support 83, and adapted to enter either of a series of holes in a disk 93, fixed upon the lower end of the bearing 83.

In the operation of the meter the fluid to be measured enters the casing through the pipe 48 and passes through the tube 5 into the central space inclosed by the inner wall of the measuring-shell 38 and the port-section B. From this space it passes through the ports 61 to the valves 11, and, as the position of the valves may determine, to one or another of the measuring-compartments of the shell 38. If the position of the valves is such as to place one or more of the ports 61 in communication with one or more of the ports 62, the fluid passes from the ports 61, through the recesses of the valves and the ports 62, into the compartments, whose ports 62 are opened, charging said compartments. At the same time the opposite compartments are, by reason of the position of the valves, being discharged. When the valves have changed their position, so as to open the port or ports 62 to the upper portion of the case and the communication between said port or ports and a port or ports 61, the fluid is exhausted from said compartments into the upper portion of the meter-casing and is thence delivered through the nozzle 52. If the position of the valves is such as to place one or more of the ports 61 in communication with one or more of the ports 63, the fluid passes from the ports 61, through the recesses of the valves and the ports 63, into the passages 64, passing through

the same, first over and then under the partition 56, and through their ports 66 in the shell of the valve-section, into the compartments communicating with said ports 66, and charging said compartments, the opposite compartments being coincidently and similarly discharged. When the valves have changed their positions, so as to open the ports 63, through which the fluid has previously been charged, to the upper portion of the meter-casing and close communication between the upper portion of the meter-casing and the ports 63, through which the fluid has been previously discharged, the charged compartments are discharged, and the discharged compartments are charged in a similar manner.

I claim as my invention and desire to secure by Letters Patent—

1. In a fluid-meter, the combination of an inclosing-case provided with inlet and outlet pipes, a measuring-shell divided into a series of separate compartments and adapted to receive a progressive wave-like movement about its center, a universal-joint mechanism supporting the measuring-shell, and two shafts coupled one to the other and journaled on the shell and on the meter-casing, respectively, one of said shafts being mounted in a longitudinally-adjustable bearing, substantially as set forth.

2. In a fluid-meter, the combination of an inclosing-case provided with inlet and outlet pipes, an annular spherical sector measuring-shell divided into a series of separate compartments and adapted to receive a progressive wave-like movement about its center, a universal-joint mechanism coupled to a fixed bearing and to the measuring-shell, a shaft journaled in bearings on the measuring-shell in line with the universal-joint mechanism, a tubular bearing mounted adjustably in a support on the meter, a shaft journaled in said bearing, and a crank-arm fixed upon said shaft and coupled to a similar arm on the shaft of the measuring-shell, substantially as set forth.

3. In a fluid-meter, the combination of an inclosing-case provided with inlet and outlet pipes, an annular spherical sector measuring-shell divided into a series of separate compartments and adapted to receive a progressive wave-like movement about its center, a port-section fitting into and closing the central space within the measuring-shell at its top, said section being peripherally secured to the inner wall of the measuring-shell and provided with a series of direct through-ports and a series of passages leading from ports in the measuring-compartments to ports in the upper wall of the port-section, a driving-shaft journaled in bearings in the port-section and coupled to an arm upon a shaft mounted in a bearing on the meter-casing, a series of valve-faces fixed upon the top of the port-section and provided with ports communicating with the through-ports and the passages of said port-section and with compartments of the measuring-shell, and a series of slide-valves, each coupled to a crank on the driving-shaft and controlling the ports of one of the valve-faces, substantially as set forth.

4. In a fluid-meter, the combination of an annular spherical sector measuring-shell divided by partitions into separate compartments and a cylindrical port-section secured to and closing the top of the inner portion of the measuring-shell and provided with annular concentric circumferential shoulders for setting the inner and outer walls of the shell, substantially as set forth.

5. In a fluid-meter, the combination of an annular spherical sector measuring-shell divided by partitions into separate compartments and a cylindrical port-section secured to and closing the top of the inner portion of the measuring-shell and provided with circumferential ribs for setting the partitions of the shell, substantially as set forth.

In testimony whereof I have hereunto set my hand.

CHAUNCEY N. DUTTON.

Witnesses:
W. D. UPTEGRAFF,
J. SNOWDEN BELL.