E. M. Du Boys,

Diaphragm Meter,

No. 82,812. Patented Oct. 6, 1868.

Fig. 1

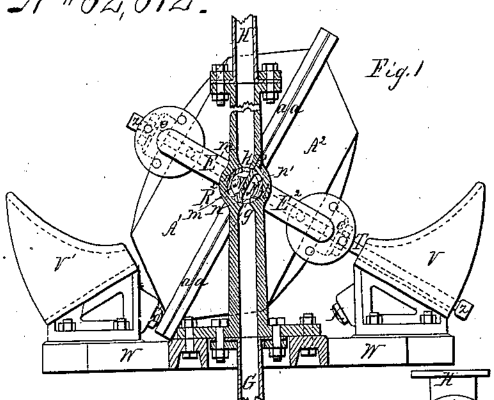


Fig. 2

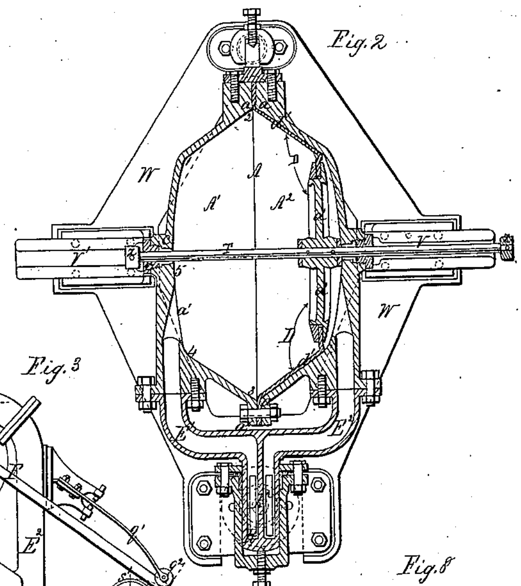


Fig. 3

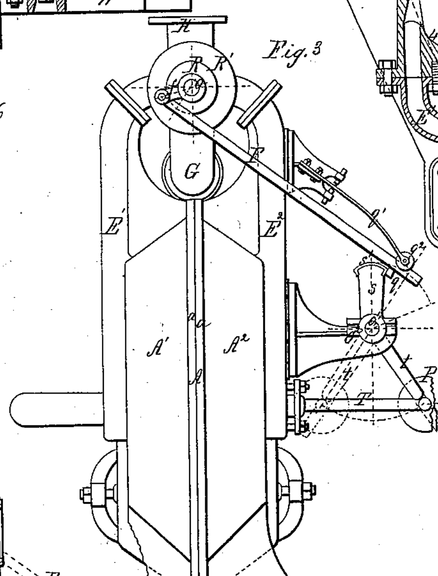


Fig. 6

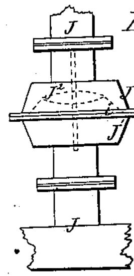


Fig. 8

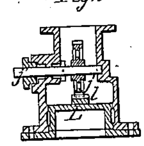


Fig. 4

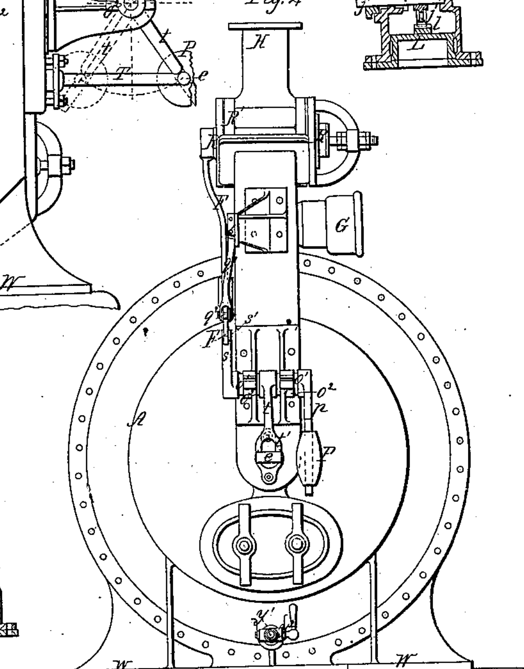


Fig. 5

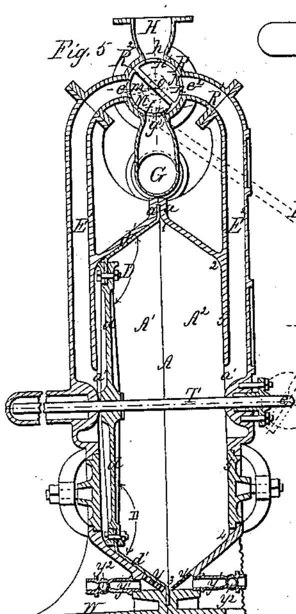
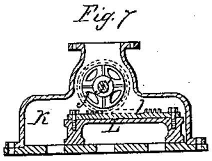


Fig. 7



Witnesses;

Inventor;

United States Patent Office.

ERNEST MARIE DU BOYS, OF PARIS, FRANCE.

Letters Patent No. 82,812, *dated October* 6, 1868; *antedated May* 9, 1867.

IMPROVEMENT IN LIQUID-METERS.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, ERNEST MARIE DU BOYS, of Paris, in the Empire of France, have invented certain new and useful Improvements in Liquid-Meters, or apparatus for gauging the volume of water or other liquid flowing under pressure through pipes or other channels; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The invention consists in an improved construction of liquid-meters, or apparatus for gauging or measuring and registering the volume of water or other liquid flowing, either under a constant or a variable pressure, through pipes or other channels, either continuously or intermittingly, the apparatus being, however, principally intended for gauging water for the supply of cities or other localities, of steam-boilers, or for other analogous purposes, in consequence of which I will in this description more particularly relate to water-meters.

In the annexed drawings, two descriptions of meters are shown, viz, a rocking or oscillatory and a fixed one, both acting, however, on the same principle, and having their principal parts constructed in the same manner.

Figure 1 represents an outside or elevation view of the oscillating meter, of which

Figure 2 shows a horizontal sectional view.

Figure 3 is a front, and

Figure 4 a side elevation view of the fixed meter, of which

Figure 5 represents a vertical sectional view.

Figure 6 shows an outside view of an arrangement for preventing the concussion arising at certain moments from the hydraulic shock.

The Figures 7 and 8 respectively show a longitudinal and a cross-sectional view of a slide-valve, which may replace the cock, hereafter to be described.

In these figures, the same letters of reference relate to corresponding parts.

Both apparatus consist of, first, a shallow gauging-vessel or gauger, A, the interior of which is divided into two chambers or compartments by, second, a diaphragm, D, moving to and fro in the gauger A; third, a reversing or distributing-cock, R, which, if wished, might be replaced by a slide-valve, K, and which cock or valve serves for putting alternately one of the compartments of the gauger in communication with the entrance-pipe G, for admitting the water to be gauged into the meter, and the opposite compartment with the delivery-pipe H, for allowing the gauged water to take its exit from the meter; fourth, a balance-weight to be lifted or a spring to be bent by the effect of the diaphragm D, when this latter is moved forward in consequence of the pressure of the water entering into the meter, which weight is set free, or which spring relaxes as the diaphragm is completing its stroke, and, by means of the cock or slide-valve, procures the reversing of the conditions of entrance and exit of the water into and from the gauger; fifth, a counter or index, suitably connected to and worked by the diaphragm, the cock or slide-valve, or any other suitable part having a regular motion imparted to it, and which counter is provided with dials, or other suitable means for indicating and registering the number of times the gauger, the capacity of which has been duly ascertained, has been filled and emptied.

I must at once observe here that, in my improved meters, the gauging-vessel A and its diaphragms act in a manner similar to that of a pump-cylinder and its piston, by which they might even be replaced, without virtually altering the principle of working of the apparatus, but the shape of gauging-vessel shown in the drawings, and its movable diaphragm, offer the advantage of not giving rise to any resistance worth mentioning, and consequently to any noticeable loss of pressure in the liquid to be gauged, besides which they offer perfect tightness, and are of the most simple and easy construction.

The gauging-vessel or gauger A is formed of two shallow shells, A^1 and A^2, of cast iron or other suitable metal, and of exactly the same shape and size. By preference, the shape of these shells is that of a hollow truncated cone, 1, 2, 3, 4, provided with a calotte or spherical part, 5, and a broad rim or flange, *a*, by means of which rims they are bolted together perfectly water-tight. Each of the shells A^1 and A^2 has an orifice, a', for the entrance and exit of the water into and from the gauger, the said orifices communicating, respectively, by means of the pipes E^1 and E^2, with the cock R, (or with the slide-valve K, in case this latter is made use of instead of the cock R,) for distributing or reversing the conditions of entrance and exit of the water into and from the gauger A.

The diaphragm D consists of a central rigid disk, *d*, of cast iron or other suitable metal, connected water-tight all round to a cap or hollow truncated cone, *d'*, of India rubber, greased leather, or other suitable supple, impervious material, which will yield, without extending or contracting, to the pressure of the water, and apply itself alternately and fit exactly against the conical part, 1, 2, 3, 4, of each shell, the larger periphery or basis of the cap *d'* being inserted and held in a solid and perfectly water-tight manner between the flanges or rims *a* of the two shells.

A rod, T, working in stuffing-boxes *c*, provided opposite to each other in the central part of the calotte 5 of each shell, passes through and is fixed in the centre of the disk *d*, and serves as a guide for the diaphragm, when this latter is moved alternately from one shell into the other.

The principle of working of the apparatus may now be easily understood. Supposing the gauger to be filled with water, and consequently the diaphragm applied against the conical part 1, 2, 3, 4, and calotte 5 of one of the shells, and if in that moment the cock R puts this shell in connection with the entrance-pipe G, and consequently the opposite shell with the delivery-pipe H, it is evident that, in consequence of the water-head, the pressure of the water on that side of the diaphragm facing the entrance-port, exceeding that on the opposite side of the diaphragm, this latter will be caused to advance towards the shell connected with the delivery-pipe, and thereby expel the water from this shell, and carry this water into the exit-main until the diaphragm, completing its stroke, becomes applied against the inner surface of this latter shell. The water required for filling the gauger, and which is at its turn to be expelled therefrom at the next or return-stroke of the diaphragm, will now be situated on one side only of this latter, and if, in this moment, the reversing of the communications of the shells respectively with the entrance and delivery-pipes is procured by means of the cock or the slide-valve, the diaphragm will at once begin its return-stroke in exactly the same manner as just explained for its advancing stroke, and a constant volume of water will consequently, at each stroke of the diaphragm, be allowed to enter into the gauger by one of the shells, and an equal volume be expelled therefrom by the opposite shell, which volume will be entirely independent from the pressure, the loss of pressure resulting from the resistance offered by the friction of the guide-rod T in its stuffing-boxes being too small to be worth notice.

I will now describe in what manner the reversing of the entrance and exit-conditions for the liquid to be gauged is obtained by the cock or the slide-valve, and these latter actuated by the effect of a weight, or, if wished, by that of a spring.

In the apparatus represented in the figs. 1 and 2, the moving-weight consists of that of the diaphragm D and its rod T. The gauger A oscillates between two standards, by means of two trunnions, situated diametrically opposite to each other, one of which trunnions forms the distributing or reversing-cock R, turning in its seat R^1, which forms bearing, and is provided with the ports, *g* and *h*, respectively leading into the entrance-pipe G and the delivery-pipe H.

In the other apparatus the gauger A is fixed, and the moving-weight P consists of a sort of pendulum-weight, situated at the outside of the gauger. This latter apparatus is more particularly intended for large water-meters. I will successively describe both apparatus.

Oscillating Apparatus.

The seat R^1 of the cock R leads, by its ports *g* and *h*, in the entrance and delivery-pipes G and H, which form one of the standards of the apparatus. The cock itself is hollow, and, by means of a partition, R^2, divided into two compartments, M and N, forming respectively the continuation of the pipes E^1 and E^2, so as respectively to connect one of the compartments with one shell of the gauger, and the other with the opposite shell. Each of these compartments has two ways, m and m^1 and n and n^1, situated in such manner that if one of the ways, for instance, that, *m*, of the compartment M, is made to correspond with the port *h* of the seat R^1, the corresponding way *n* of the opposite compartment connects this latter with the port *g*. These ports and ways are all of the same size. The parts m^2 and n^2, respectively situated between the ways m and m^1, and those, n and n^1, of the cock R, are a little larger than these ways, in order that, during a certain moment in turning the cock, the whole of the ports and ways be covered, so as to prevent in that moment any direct communication to exist between the entrance and the delivery-pipes, in order to obtain the same effect as is in certain moments produced by the covering of the steam-ports by the slide-valves of steam-engines, in which moments the arrangement represented in fig. 6, and hereafter to be explained, serves for preventing the concussion which otherwise would result from the hydraulic shock.

It will be easily understood how, by this arrangement of the cock R and the mode of working of the diaphragm D, the two compartments of the gauger A will be simultaneously put in communication, one of them with the entrance-pipe G, and the other with the delivery-pipe H, and also in what manner the reversing of the communications is produced by the reciprocating rotary motion imparted to the cock R in consequence of that of the gauger A, of which latter this cock forms part.

If, firstly, the reciprocating or oscillating motion of the gauger A causes this latter to be put alternately in the required inclined or angular positions; secondly, the oscillating parts of the apparatus be equilibriated in such manner that, on the diaphragm reaching the middle of its stroke, its centre of gravity be situated on the axis of rotation; and thirdly, the weight of the diaphragm D and its rod T be such that on reaching the end of their strokes they procure the turning of the gauger A, and overcome the resistance offered to its oscillation, the return motion of the gauger will be produced automatically at each time the diaphragm D is completing its stroke, in consequence of which an uninterrupted flow of water through the gauger A will be kept up as long as the entrance and exit-pipes remain open.

But, as the apparatus requires, also, to afford an exact measurement of the volume of water passed through the gauger, it is necessary each oscillation should correspond with the delivery of a constant quantity of liquid; it is consequently required the moving-weight should cause the return-stroke or return-oscillation of the gauger to begin always exactly on the very moment the diaphragm reaches the end of its stroke.

In order to insure this, a metal nut, z, is screwed on each end of the rod T, which nut, after each stroke or oscillation of the gauger, enters into a slot, V, fixed on the bed-plate of the apparatus in the direction of the axis of rotation, and serving as a guide for the nut z, which latter is prevented from quitting the slot V before reaching the end of this latter, and which quitting takes place at the moment the diaphragm D reaches the end of its stroke. During the time the nut z is engaged in the slot V, the gauger A will consequently be prevented from turning, even in case the leverage of the moving-weight could otherwise procure this turning; but immediately the nut leaves the slot V, the apparatus is set free, and the rocking or oscillation takes place.

In figs. 1 and 2, the rod T protrudes at both ends of the apparatus, and each end of the rod has a nut, z. Both nuts are to enter, in turn, in the grooves V and V^1, situated symmetrically opposite to each other. The rod, T, however, might be arranged in the manner as shown in figs. 3 and 5, for the fixed meter, viz, protrude only with one of its ends instead of with both, in which case the slots V and V^1 ought to be situated both at the same side of the apparatus, one above and the other below the horizontal plane passing through the centre of rotation.

The weight of the rod T and its nuts z, added to that of the diaphragm, form, together, the moving-weight. The nuts z are movable, so as to allow of being set more or less far from the axis of rotation, and thereby regulate the leverage or momentum of the gauger.

Two elastic buffers, X and X^1, serve for checking the motion of the gauger at the end of each oscillation.

The various parts of the apparatus are carried by a suitable bed-plate, W.

Fixed Apparatus.

In the fixed apparatus, represented in the figs. 3, 4, and 5, the gauger A is kept fixed. The seat R^1 of the reversing-cock R is provided with four parts, g, h, e^1, and e^2, and the cock R with four ways, m, m^1, n, and n^1, of equal size, and leading, respectively, into the entrance and delivery-pipes G and H, and by the pipes E^1 and E^2 into the two shells, A^1 and A^2, of the gauger. The cock R is divided into two compartments, M and N, by the longitudinal partition R^2, so as to allow of alternately connecting each shell with the entrance-pipe G, and the opposite shell with the delivery-pipe H. The axis, o, of the cock has a crank-arm, f, connected to a rod, F, provided towards its free end with a tappet, q, which, by the effect of a spring, q^1, and friction-roller q^2, is pressed against the curved end or arc, s', of an arm, s, fixed to an arbor, o^1, situated parallel to the axis o of the cock R, and turning in bearings in the brackets o^2. To the arbor o^1 are also fixed two other arms, t and p. The arms s and t form together a bell-crank lever, $s\,t$. The free end of the arm p carries a balance-weight, P, which may be set more or less far on the arm p. The arc s' is a little swollen out or eccentric towards the middle of its length, so as to project upwards a little beyond the free end of the tappet q. To the end of the rod T is fixed a cross-piece, e, and the axis of the arbor o^1 is situated exactly above the middle of the full length of stroke which this cross-piece e performs during the to-and-fro motion of the diaphragm D. The lower end of the arm t is made into a fork, t', for the rod T to work in, whilst the cross-piece e, in pressing alternately against one or the opposite side of the fork t', will drive the arm t alternately forward and backward, viz, from the middle to the end of its stroke, in which latter situation the free end of the fork is allowed to pass over the cross-piece e, and thus, becoming liberated from the effect of this latter, is, by the impulse of the balance-weight P, carried back to the middle of its stroke, from whence the same is again pressed by the cross-piece e during the return-stroke of this latter, and thus the arm t carried to the end of its return-stroke. The length of the arm t to the end of the fork t' is to be such, that on the rod T reaching the end of its stroke, this fork t' becomes liberated from the cross-piece e, and thus allows of the arm t being carried back into the vertical position by the effect of the balance-weight P, which latter has been lifted by the advancing of the rod T, and consequent turning of the arbor o. At the moment the fork t' is to become liberated from the cross-piece e, the rod F rests with its under side on the arc s', which latter is in that moment situated entirely on one side of the tappet q, so that when, after the liberating of the fork t', the weight P causes the arc s' to turn, this latter, pressing against the tappet q, will cause this tappet to advance, and, by means of the connecting-rod F, procure the turning of the cock R, until the eccentric part of the arc s' lifts this rod F sufficiently high for the tappet q to be again set free from the arc s', which is to take place at the moment the cock R is to be turned, for inverting the conditions of entrance and exit of the water into and from the gauger A.

In fig. 3, the rod T, the lever $s\,t$, the weight P, and other movable parts, are shown at the end of the forward stroke of the diaphragm D. The lever $s\,t$ is shown liberated from the arc s', and ready for driving forward the rod F, in order to procure the turning of the cock R. The red lines in fig. 5 show the position of the movable parts at the end of the return or opposite stroke of the diaphragm.

Any of the well-known means may be resorted to in this apparatus, for preventing the concussion or hydraulic shock which forcibly will take place whilst the cock or valve is reversing its motion, and during the short period the entire of the ports is shut. I prefer, however, for this purpose, to make use of the arrangement represented in fig. 6. A pipe, J, connecting together the entrance and delivery-pipes G and H, is provided with two shells, forming a chamber, J^1, between the flanges i of which is fixed an elastic diaphragm, J^2, of India rubber, which, when the concussion takes place, yields to the pressure of the water, and immediately afterwards resumes its normal state. If required, this diaphragm J^2 might be provided on the top with a suitable weight, which, in the normal state, keeps the diaphragm depressed in the chamber J^1.

It will be obvious, from what has been above described, that various modifications might be adopted in the mechanical arrangements of the apparatus for operating, by means of a weight or of a spring, and in consequence of the to-and-fro motion of the diaphragm D, the turning of the cock R at the moments the conditions of entrance and exit of the water into and from the gauger are to be reversed.

The figs. 7 and 8 show in what manner a four-way slide-valve, K, might be made use of instead of the cock R. The slide L of the valve might be provided with a rack, *l*, in gear with a pinion, *j*, to the axis *j'* of which might be fixed the arm *s*, to be worked by the rod F, in the manner as above described.

In my improved meters, the air tends to accumulate in the upper portion of the gauger, whereas the sedimentary matters will more particularly collect in the lower portion. The air might be easily expelled by connecting, by means of a small pipe, the upper part of each of the shells, A^1 and A^2, respectively, with the corresponding entrance and delivery-pipes E^1 and E^2. The sedimentary matters may be got rid of by providing, at the bottom of each shell, a small grate or perforated plate, *y*, leading into a small discharge-pipe, y^1, provided with a stop-cock, y^2; or screw-plug, or by connecting these discharge-pipes, respectively, with the pipes E^1 and E^2.

Instead of having the gauger A in the vertical position, viz, as shown in the drawings, the same might be situated horizontally, and in that case the weight of the diaphragm D be balanced by connecting the end of the rod T, by means of a chain or string passing over a pulley, to a suitable balance-weight.

In the drawings, the counter, index, or registering-trains, for indicating the number of motions or pulsations performed by the diaphragm D, and consequently the volume of the liquid passed through the gauger, has not been represented, the same offering nothing particular, and being similar to other apparatus of the same kind. The said index may receive motion from the rod T, the cock R, or any other suitable movable part, by any suitable mechanical means.

Having thus described the nature of my improvements in liquid-meters, or apparatus for gauging or measuring and registering the volume of liquid flowing, under pressure, through pipes or other channels,

What I claim therein as new, and desire to secure by Letters Patent, is—

In combination with the shallow gauging-vessel, divided into two compartments by an elastic diaphragm, which moves to and fro therein, by the pressure of the liquid on one side and then on the other side thereof, a mechanism constructed and operated substantially as herein described, for putting the compartments in alternate communication with the entrance and exit-pipes or passages, as and for the purpose herein described.

ER. DU BOYS.

Witnesses:

H. DAVIS,

A. G. BRADE.