JACQUET'S WATER METER.

The Jacquet water-meter, shown in the accompanying engravings, consists of three very distinct parts:

1. A cylinder, whose capacity and number of piston strokes determine the volume of the liquid that has traversed the apparatus.

2. A system of valves that changes at each extremity of the piston stroke the direction of the distribution of water.

3. An ordinary dial-train, which, actuated by the endless screw of the arbor of a ratchet-wheel, registers the quantity of water measured by the meter.

Fig. 1 is a perspective view of the apparatus. Fig. 2 is a vertical section. Fig. 3 is a horizontal section of the distributing box, and Fig. 4 is a transverse section of this same box.

The cylinder consists of a cast iron box, having inside of it a thin brass cylinder in which moves vertically a piston formed of two pieces of leather held back to back by two disks of copper and galvanized sheet iron.

The distributing box, which is also of cast iron, is bolted on to the cylinder. It is divided by vertical partitions into four chambers—one communicating with the bottom of the piston, a second with the top, the third with the inlet, and the fourth with the outlet.

These compartments communicate with each other through four transverse orifices, traversed two by two by iron axles, each carrying two circular valves. These axles are connected by means of a crosspiece containing a rectangular aperture in its center. The axles, crosspieces, and valves form together a rigid whole, capable of being moved in a longitudinal direc tion, so that if two of the valves are closed, the two others are of necessity open, and reciprocally; or, in other words, if the inlet and the top of the piston are in communication, the bottom of the piston necessarily communicates with the outlet, and *vice versa*. In the center of the distributing box there is fixed a bracket of hard bronze, which holds in a lower groove a knife whose back serves as a bearing point for a stirrup-shaped spring. The center of rotation of this spring, which consists of six strips of Prince's metal, is in the vertical axis of the knife. Owing to such an arrangement, the knife, rolling at one side in the bracket, and at the other on the spring, is always pushed to the right or left without ever resting in the median position, which is one of unstable equilibrium. The knife, which likewise is constructed of hard bronze, carries two arms at right angles, one of which engages in the aperture in the crosspiece, and the other in a groove that the piston rod carries. The apparatus works as follows:

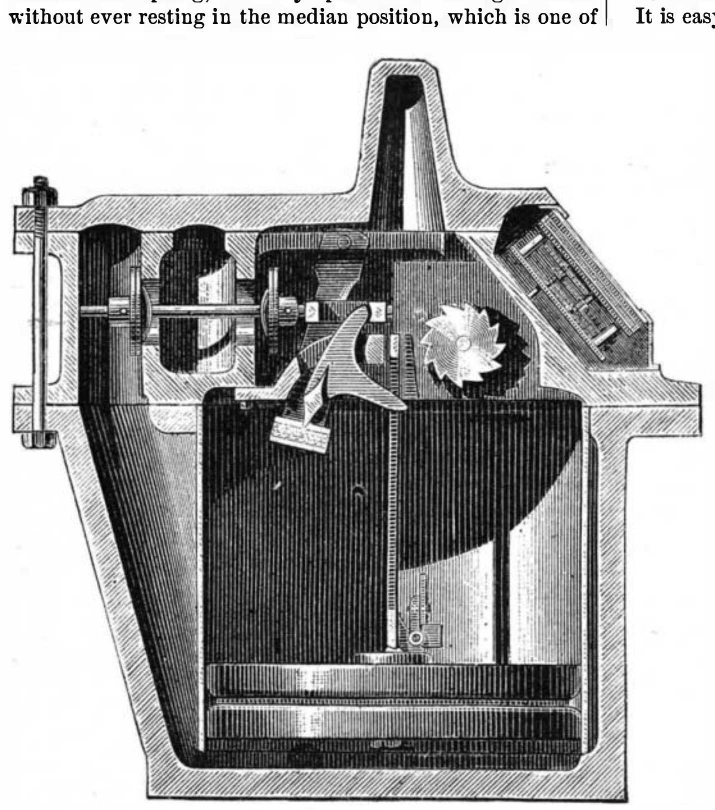

Fig. 2.—VERTICAL SECTION OF JACQUET'S WATER METER.

In the initial position, the valves, S and S', are closed, and the two others, *s* and *s'*, are open. The inflowing water communicates with the bottom of the piston, while the top is in communication with the outflowing water. The piston rises, and the knife arm engages with the groove in the piston-rod. But, when this latter reaches the limit of its travel, the bottom of the groove rests on the arm, forces the knife to describe a rotary motion, which has the effect of stretching the spring. During this time the other knife-arm slides in the aperture of the crosspiece, and, at the precise moment at which, through its presence there, it is about to change the distribution, the spring, which has gone beyond its maximum point, stretches and suddenly opens the valves, S, while at the same moment the second valves close. As the inlet is then in communication with the bottom of the piston, the latter instantly redescends, driving out through the outlet the water that it has measured during its travel. The motion then takes place in a contrary direction, until the top of the groove in the piston-rod produces, through its action on the knife-arm, an opposite effect, but one that is identical with that just described. Finally, during the ascent of the piston, a pawl carried by the latter causes a cast iron ratchet-wheel to advance by one tooth.

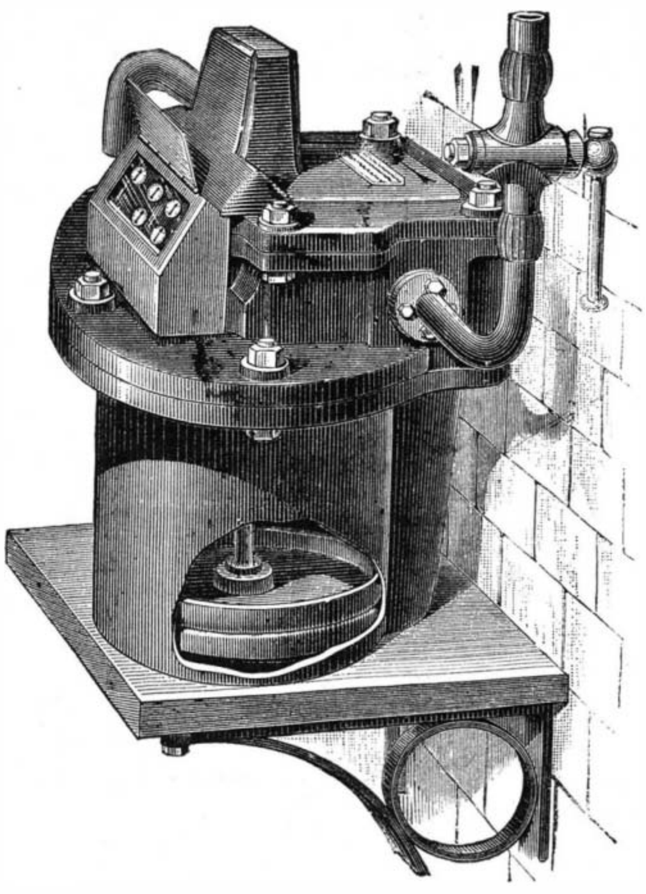

Fig. 1.—JACQUET'S WATER METER.

The arbor of this wheel actuates, through an endless screw, a clockwork movement, which in its turn registers the water that traverses the apparatus in cubic meters, hectoliters, and decaliters.

It is easy to understand that, as the water is measured by the volume of the cylinder, and as the piston makes a tight joint at every pressure, this meter registers with exactness all the water that has passed through it. Moreover, the closing of the valves on their seats being tight, and the change of distribution occurring instantane ously, the apparatus marks and measures with exactness to a minimum discharge of one liter in a hundred minutes. As for the maximum discharge of the meter, the following table, drawn up from experiments, will give sufficient information.

Diameter of the Orifice of the Meter in Millimeters.	Pressure on Entrance in Meters of Water.	Discharge in Litres, per hour.
10	30	2,400
13	30	4,000
15	30	5,400
20	30	8,000
25	30	10,000
30	30	12,000
40	30	24,000
70	30	100,000

As regards the length of time that the Jacquet meter will work well, it must be remarked that provision is made against wear by a sandbox placed at the inlet to the apparatus, and which prevents gravel and other solid bodies from entering the distributing chambers; and, as regards all plastic impurities, such as mud, carbonate of lime, etc., that the water might hold in suspension, no deposit of these is to be feared. The piston, in fact, working vertically, deposits could only occur on the bottom of the cylinder or the top of the piston, without ever being in contact with the parts in friction.

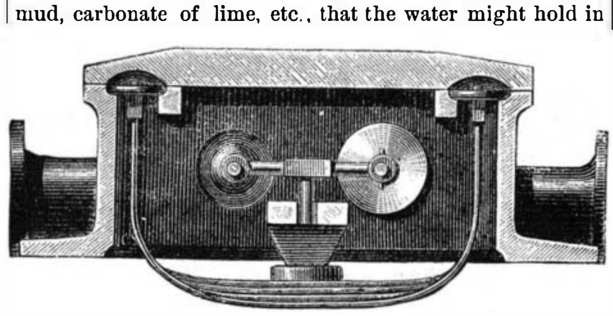

Fig. 4.—TRANSVERSE SECTION.

Finally, the knife, which, with the spring, is the delicate part of the meter, is made of bronze of a hardness equal to that of steel. Moreover, although the great elasticity of the spring might compensate for the wear on these parts, the inventor desired to obtain certain data in regard to this point. So, with a file, he executed the work of time on the knife, and, with thirteen pieces worn away each a half millimeter more than the other, he undertook a series of experiments on meters of 0·02 of a meter orifice. The subjoined table shows the results of these trials under a pressure of water, at the inlet, of 30 meters:

Height of Knife in Millimeters.	Power of Spring in Kilogrammeters.	Discharge in liters per hour.	Observations.
23 (Normal).	4k.(Normal).	8,000	Operation good
22.5	3.7 k.	8,000	"
22	3.6 k.	8,000	"
21.5	2.25k.	8,000	"
21	1.8 k.	8,000	"
20.5	1.4 k.	8,000	"
20	1.2 k.	8,000	"
19.5	0.9 k.	8,000	"
19	0.75k.	8,000	"
18.5	0.65k.	8,000	"
18	0.4 k.	8,000	Expansion less free.
17.5	0.3 k.	8,000	"
17	0.2 k.	8,000	Meter stops; the water does not flow.

These proofs are conclusive, and the more so in that these same experiments, repeated with a pressure of 3 meters of water, led to the same results. In practice, the meter under trial at the City Laboratory has already registered 4,000,000 liters without the least evidence of its giving out, and it is to be presumed that, as regards duration, this apparatus may be classed among the best.—*Revue Industrielle.*

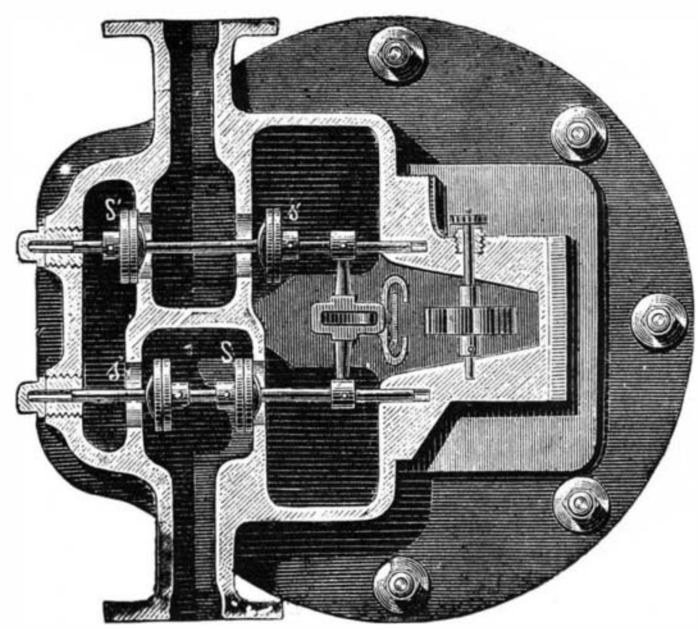

Fig. 3.—HORIZONTAL SECTION.

Explosions without Fire and with Fire.

Two interesting cases of explosion are described by Herr Pfaundler in a recent number of Wiedemann's *Annalen*:

A closed glass tube, two-thirds filled with liquid carbonic acid, was inserted a few centimeters deep in a bath of carbonic acid and ether, brought to a temperature of —100° C., in order to get crystallized carbonic acid. Beautiful crystals were soon formed in the immersed part of the tube, and a layer of the liquid acid remained above. The tube was then raised by its upper part into the air, and in a few minutes it exploded violently. This tube had often before borne a rise of temperature to 31°. The explosion is attributed to thermal expansion of the solid carbonic acid (as a more likely cause than vapor-pressure on glass rendered brittle by a low temperature).

In the second case, a large sheet zinc bell-gasometer, used exclusively for keeping oxygen gas, was concerned. It had stood about six months unused, containing a little of the gas. When the issuing gas was being tested with a glowing match, an explosion occurred, shattering the apparatus. Any entrance of hydrogen or coal gas is out of the question. It is supposed that the water had gradually absorbed acid vapors from the air of the laboratory, and that the zinc had been thus attacked, yielding hydrogen. The zinc was in fact somewhat corroded. It is recommended that the zinc in such cases be coated with a lac.

Pure Hydrochloric Acid.

Giudice prepares the *pure* acid, whether gas or liquid, for experimental purposes, by the action of sulphuric acid on sodium chloride, but adds to the former some oxidizing substance like potassium bichromate or permanganate, or the black oxide of manganese. The gas is passed through mercury, contained in a Liebig's potash bulb, or other suitable apparatus, before it is passed into water or used.