(No Model.) 2 Sheets—Sheet 1.

B. WILLIAMS.

Steam Meter and Reducing Valve.

No. 243,025. **Patented June 14, 1881.**

Fig. 1.

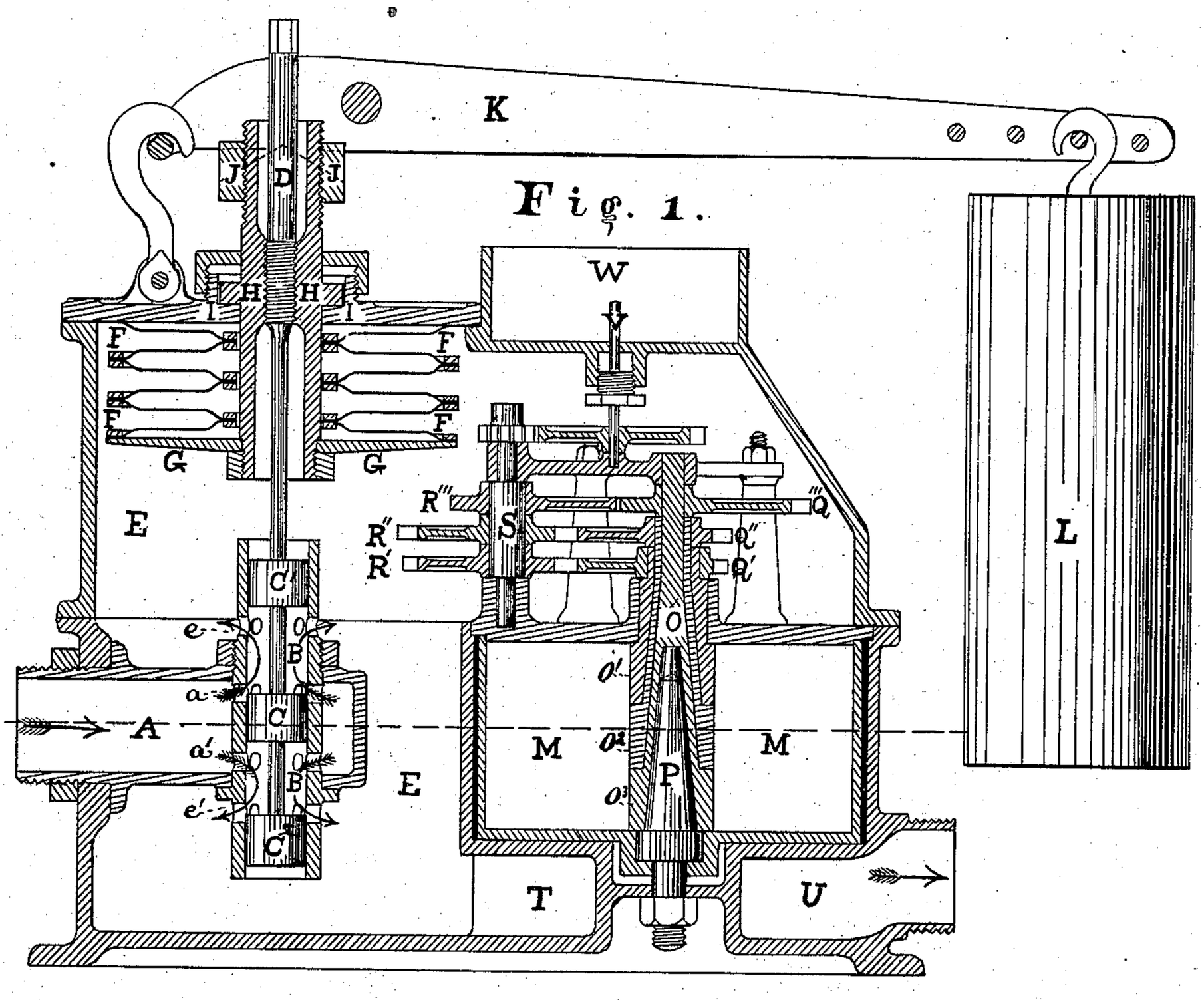
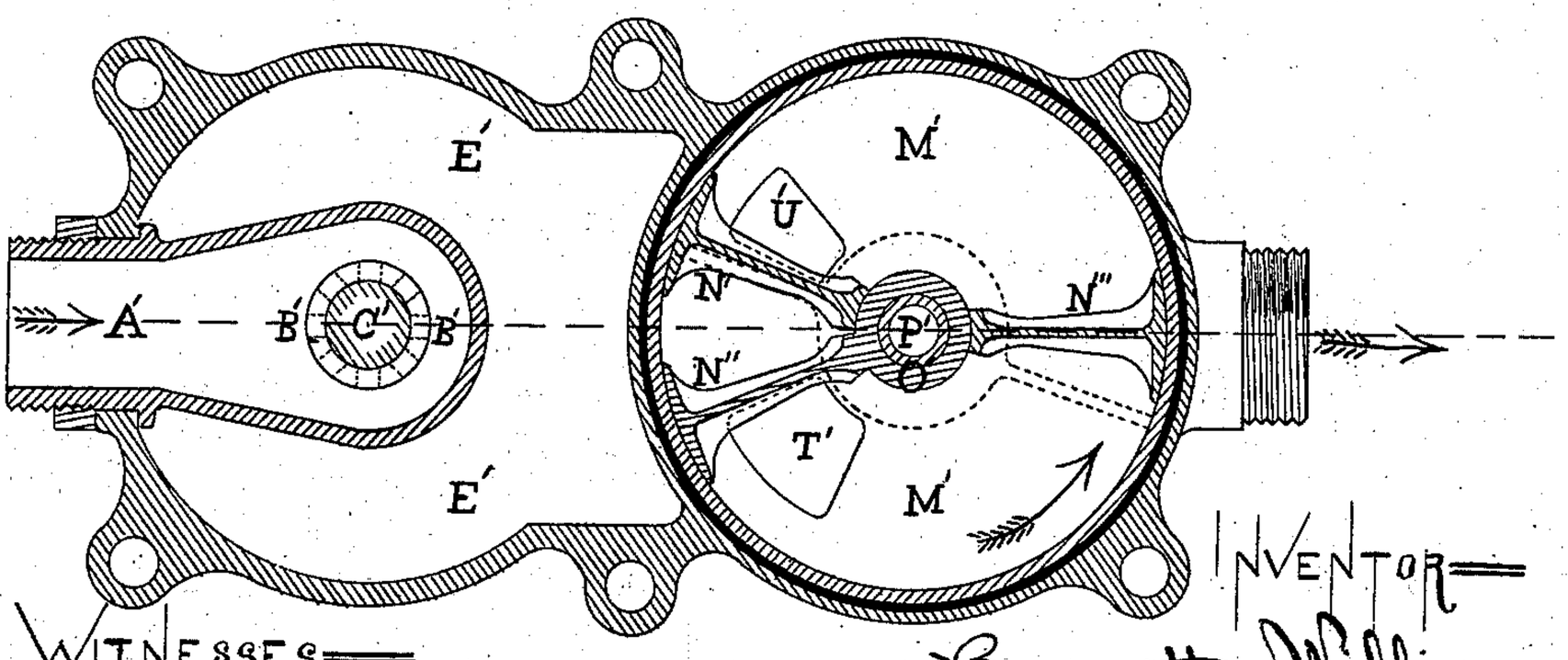


Fig. 2.



WITNESSES—

Charles C. Stetson

Charles R. Searle.

INVENTOR—

Benezette Williams

by his attorney

Thomas D. Stetson

(No Model.)

2 Sheets—Sheet 2.

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Fig. 3.

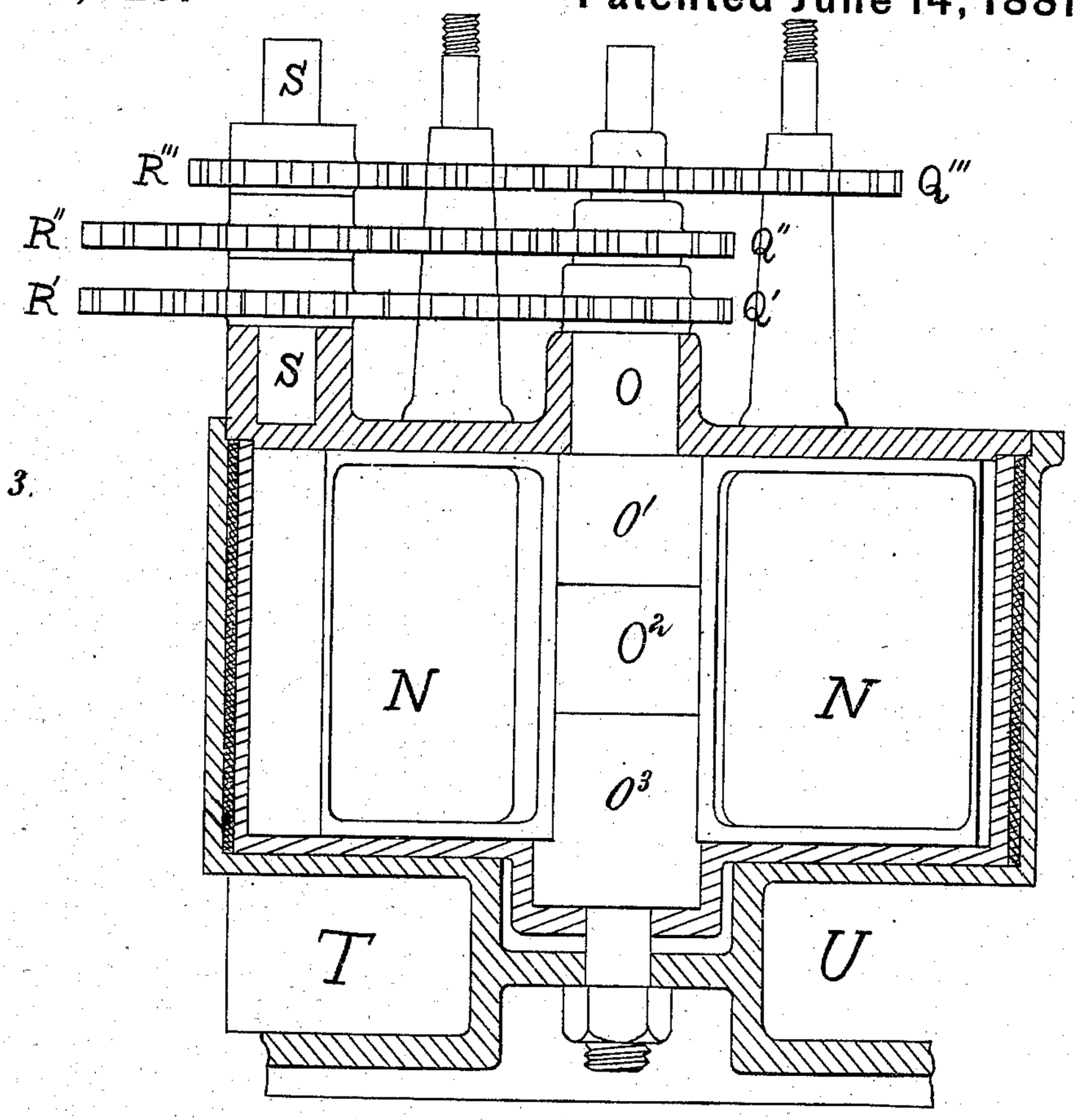
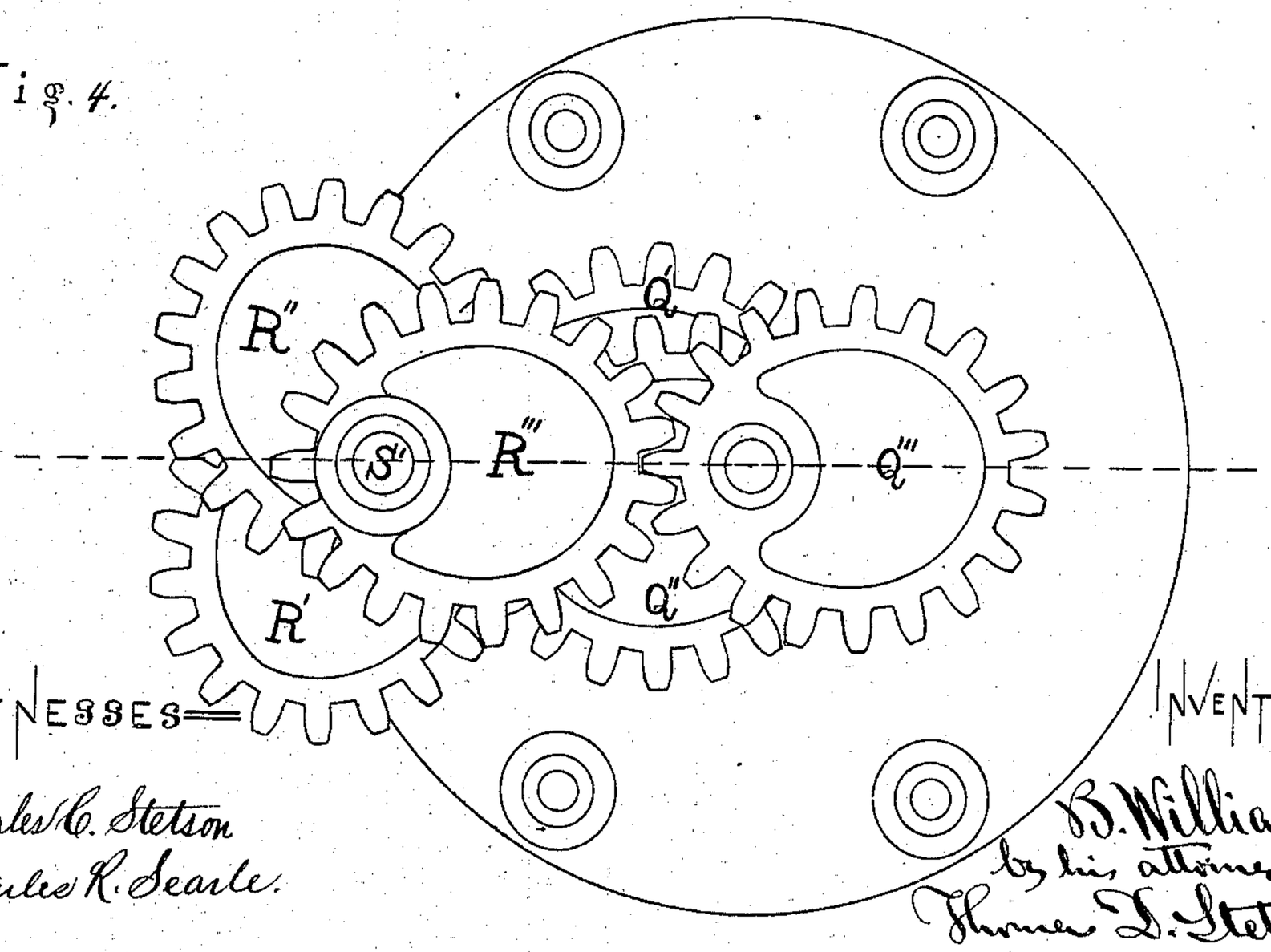


Fig. 4.



WITNESSES—

Charles C. Stetson
Charles R. Searle.

INVENTOR—

B. Williams
by his attorney
Thomas D. Stetson

UNITED STATES PATENT OFFICE.

BENEZETTE WILLIAMS, OF CHICAGO, ILLINOIS.

STEAM-METER AND REDUCING-VALVE.

SPECIFICATION forming part of Letters Patent No. 243,025, dated June 14, 1881.

Application filed August 26, 1880. (No model.)

To all whom it may concern:

Be it known that I, BENEZETTE WILLIAMS, a citizen of the United States, residing in Chicago, county of Cook, and State of Illinois, have invented a Steam-Meter and Reducing-Valve, which can be used, in combination with apparatus belonging to a system of public steam-heating, to measure the quantity of steam delivered to consumers, or that can be used in combination with any steam machinery when the quantity of steam is to be determined; and I do hereby declare the following to be a full and correct description of what I consider the best means of carrying out the invention.

The accompanying drawings form a part of this specification.

Figure 1 of the drawings illustrates a longitudinal section vertically made through the center of the machine, while Fig. 2 shows a section horizontally made through the machine at the point indicated by the broken line in Fig. 1. Fig. 3 shows an elevation of the working parts and meter-chamber, and Fig. 4 a plan view of the gearing and the top of the meter-chamber.

Similar letters of reference indicate like parts in all the figures.

Steam being an elastic fluid, in order that it may be correctly measured by volume it is essential that it be maintained during measurement at a known constant pressure. This pressure must be less than the minimum pressure in the supply pipe or reservoir furnishing the steam, in order that fluctuations in the supply shall not extend to the steam being measured. Hence the first requisite of any method of measurement is a reducing-valve which will receive the steam at a greater variable pressure and deliver it at a less constant pressure to the measuring-machine. This operation I accomplish in the following manner:

A, Figs. 1 and 2, is a steam chest or chamber which supplies the reducing-valve. It is really a prolongation or projection of the supply-pipe into the valve-chamber E.

The valve consists of a hollow cylinder, B, extending up and down through the chamber A, and secured thereto by a nut, as shown, or in any suitable manner, in which a tripart or three-part piston works. The piston consists of three close-fitting cylinders, C C′ C², attached to the piston-rod D. Through the shell of the hollow cylinder D four horizontal rows of holes are made, two rows, *a e*, falling inside of and connecting with the chamber A, and two, *a′ e′*, falling inside of and connecting with the valve-chamber E. These holes form the ports through which the steam passes from the chamber A to the valve-chamber E, as indicated by the bent arrows in Fig. 1. It is evident that the quantity of steam which will pass with a given loss of pressure will be determined by the position of the piston C C′ C². If pushed low enough, it will open the ports entirely, while if raised high enough it will close them so that no steam will escape. Between these limits it is possible to secure an operation of the piston, so that any quantity of steam may pass while keeping the pressure constant in the chamber E. This is done by connecting the piston-rod D with a compound metallic diaphragm, F, which is so constructed that with a decrease of pressure in the valve-chamber the piston is lowered, and with an increase it is raised, thus opening and closing the ports of the valve to a greater or less extent as occasion requires.

The diaphragm is composed of one or more pairs of circular disks of elastic sheet metal with a circular hole in the center of each. These annular disks are riveted or fastened together in some other way, the two constituting a pair, being joined at their inner edge or circumference. If more than one pair is used, the pairs are joined in the same way at the outer edge of the disks, as shown, thus forming a series of pairs. The disks may be either flat and attached by interposing rings between them, or they may be bent into the shape shown or into any other desired shape.

To the lower disk of the diaphragm is fastened, at its outer edge, a stiff vibrating plate, G, while the upper disk is attached to the top of the valve-chamber E.

Attached to the vibrating plate G, and passing loosely through the hole in the center of the diaphragm, is a hollow cylinder, H, into which the piston-rod D is screwed. A collar on the cylinder H works loosely in a box on the top plate or cylinder-head, I, which gives an adjustable limit to the movement of the diaphragm, and thus also to the play of the piston C C′ C². The piston-rod D is also adjustable by the screw in the cylinder H.

On the upper end of the cylinder H a nut,

J, is screwed, the top of which is a knife-edge, which furnishes an adjustable bearing for the lever K. The lever K is held at the short end to the top of the valve-chamber by a hook, I, and is loaded at the end of the long arm by the weight L to any desired amount.

When steam is admitted to the valve-chamber E, so that the pressure acting upon the diaphragm F is in excess of the balancing force of the weight L, the piston of the valve is raised and the discharge-ports partially closed. If the pressure is reduced in the chamber E, the reverse operation occurs.

Modifications may be made in some of the details.

In the drawings the vibrating plate G is attached to the lower part of the diaphragm and steam is admitted to its outside, the inside being exposed to the atmosphere. The same end may be attained by placing the vibrating plate on the top and admitting the steam to the inside of the diaphragm.

It is also evident that the diaphragm may be placed in any position with reference to the reducing-valve. It may be underneath, at the side, or removed to a distance from the valve, and act upon it through the medium of levers. In short, the intention of this part of my invention is fulfilled when one or more pairs of elasic metallic disks are connected in a manner similar to the one shown for the purpose of securing a greater or freer movement of the reducing-valve, without regard to the relative position of the diaphragm and valve.

A constant pressure being maintained in the valve-chamber E by means of the apparatus described, the steam is measured on passing through the meter proper. This latter consists of a cylindrical meter-chamber, M, in which a continuous rotary motion is communicated by the steam to three wings, N' N^2 N^3. Each wing is attached separately to its respective part O' O^2 O^3 of the compound axle, and is made to fit the meter-chamber M with or without metallic packing. The compound axle O' O^2 O^3 turns upon a hardened-steel pivot, P. The compound axle extends through the top plate of the meter-chamber into a gear-chamber above, which may or may not be a part of or in communication with the valve-chamber E. Each of the three parts O' O^2 O^3 of the compound axle carries an elliptical gear-wheel. Each wing, with its respective part of the axle and gear-wheel attached, is free to move independently of the other wings within certain limits. The gears Q' Q^2 Q^3, attached to the compound axle, are geared respectively with corresponding duplicate elliptical wheels, R' R^2 R^3, set upon the axle S, so that their major axis makes an angle of one hundred and twenty degrees, or one-third of a circumference, with each other. Steam is admitted to the meter-chamber from the induction-chamber T beneath through the induction-port T′, and presses with an equal pressure upon each of the two wings N^2 and N^3, with which it comes in contact first. But since the elliptical wheel Q^3, corresponding to the wing N^3, acts with a shorter arm upon the longer arm of its companion R^3, while the elliptical wheel Q^2, corresponding with the wing N^2, acts with a longer arm upon the shorter arm of its companion R^2, the revolution of the wings will take place with different velocities in the direction indicated by the arrow toward the eduction-port U′. After the wing N^3 has reached the eduction-port U′ the steam will press against the wings N^2 and N′, one or more of the wings always remaining between the induction and eduction ports.

The eduction-port U′ communicates with the eduction-chamber U, which, in turn, connects with a discharge-pipe, which transmits the steam to its destination. At each revolution of the wings a given quantity of steam is discharged. Hence it is only necessary to multiply the number of revolutions by the capacity of discharge to determine the volume of steam discharged in a given time. The record is kept by means of a pinion on the axle S, which communicates motion to the axle V, which passes through a stuffing-box into a register-chamber, W, where it works a set of ordinary recording-gears. (Not shown.)

A similar motion to that given by the elliptical wheels described can be secured by means of gears made on any form of true rolling curves in which the arm operating during a part of the revolution is longer than the one operating during another part. The ellipse, however, furnishes an easier and steadier motion than can be obtained with other curves.

The invention avoids the necessity for the movable abutment commonly required. The principle will be readily understood by mechanics. There is always a wing interposed in the short space between the induction-orifice T′ and the eduction-orifice U′, which the motion of the meter requires shall be moved against the pressure of the steam. This taxes the machinery of the meter to maintain the motion; but there is always another wing sweeping around on the opposite side of the compound axis, which the motion of the meter causes to be moved with the pressure of the steam, or, in other words, in obedience thereto. These wings are of equal area, and if they moved with equal velocity the pressure on one would neutralize that on the other; but inasmuch as the wing which is moving in the short space between the two orifices moves against the pressure of the steam very slowly, while the wing which is on the other side of the compound axis moves with the pressure of the steam much more rapidly, it follows that the meter works continuously and successfully, measuring the volumes of steam very accurately.

The volume of steam delivered at each revolution may be determined mathematically from the relative motions of the wings; or it may be determined by trial in any given machine. It may be relied upon as uniform.

The gearing should be made sufficiently strong to allow for the occasional existence of considerable difference of pressure in the induction and eduction passages. In the ordinary working a difference of pressure in passing through the meter will be scarcely appreciable, and the strain through the gearing will be correspondingly slight.

My meter as here shown may be allowed to run at a very high velocity without injury. In such case the gearing is somewhat taxed to overcome the inertia in alternately increasing and diminishing the speed of the respective wings.

The diaphragm and reducing-valve can be separated entirely from the meter without departing from the novelty or nature of my invention. The advantage of combining them, however, is very great, as it secures compactness, reduces the radiating-surface, and renders the machine easily incased in a closed box that can be thoroughly protected from loss of heat.

My invention is especially adapted to use, under any and all conditions, where steam is to be measured to small consumers.

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

1. The diaphragm F of one or more pairs of elastic metallic disks, in combination with the vibrating plate G, the cylinder H, the adjustable piston-rod D, the adjustable bearing-nut J, the lever K, and the weight L, for the purpose of working a valve which controls the admission of steam from one chamber or reservoir into another, substantially as shown and set forth.

2. The combination of the diaphragm F, the vibrating plate G, the cylinder H, the piston-rod D, the adjustable nut J, the lever K, the weight L, the piston C, the hollow cylinder B, and the chamber A, forming a reducing-valve, by means of which steam is admitted from a supply-pipe at higher and variable pressure to another chamber or reservoir, as E, at a lower and constant pressure, substantially as shown and set forth.

3. The meter-chamber M, having the induction and eduction chambers T U and ports T′ U′, in combination with the compound axle $O' O^2 O^3$, wings $N' N^2 N^3$, pivot P, and elliptical gears $Q' Q^2 Q^3$ and $R' R^2 R^3$, and suitable connections from the shaft S, as herein specified.

4. The combination of a pressure-reducing device serving to maintain in the chamber E a uniform pressure, notwithstanding variations in the pressure in the chamber A, and a meter serving to measure and indicate the volume of such reduced steam passing through the apparatus, as herein specified.

In testimony whereof I have hereunto set my hand, at Chicago, Illinois, this 20th day of August, 1880, in the presence of two subscribing witnesses.

BENEZETTE WILLIAMS.

Witnesses:
JAS. H. CUNNINGHAM,
CHARLES MACRITCHIE.