(No Model.)

G. C. ST. JOHN.

STEAM METER.

No. 599,746. Patented Mar. 1, 1898.

Fig. 1.

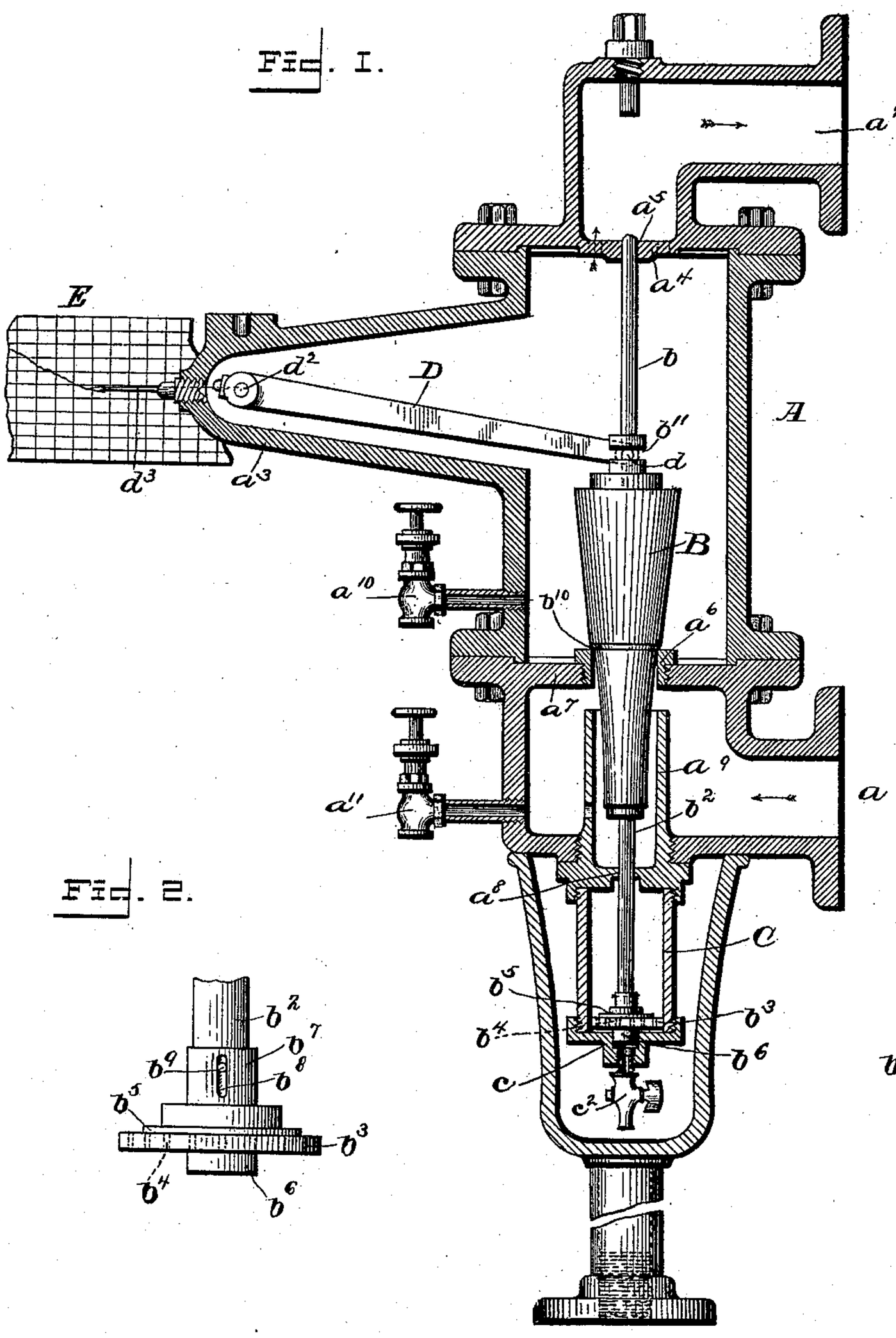
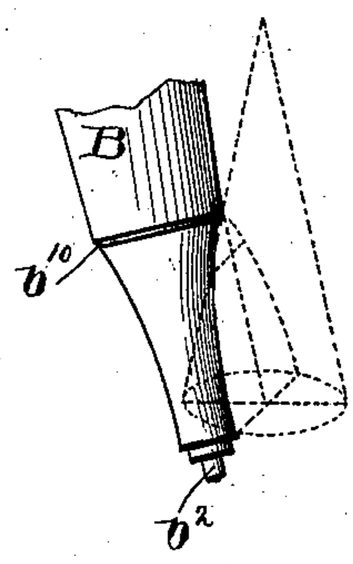


Fig. 2.

Fig. 3.



Witnesses:
F. S. Belt.
Belle C. Ewing.

Inventor:
Gamaliel C. St. John,
by R. L. Dyer & Son
his attorney

UNITED STATES PATENT OFFICE.

GAMALIEL C. ST. JOHN, OF NEW YORK, N. Y.

STEAM-METER.

SPECIFICATION forming part of Letters Patent No. 599,746, dated March 1, 1898.

Application filed September 28, 1896. Serial No. 607,232. (No model.)

To all whom it may concern:

Be it known that I, GAMALIEL C. ST. JOHN, a citizen of the United States, residing at New York, in the county of New York and State of New York, 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.

This invention relates to steam-meters.

The object is to produce a steam-meter presenting in a few number of parts and in compact form a device that will accurately register the amount of steam used in a given time and in which the parts will be so constructed and assembled as to present the highest possible range of usefulness with a minimum degree of danger of derangement from long-continued use.

With these objects in view the invention consists in the novel construction and combination of parts of a steam-meter, as will be hereinafter fully described and claimed.

In a patent granted to me September 1, 1896, No. 567,054, for a steam-meter I show, among other details of construction, a valve or spindle for controlling the flow of steam through the meter, composed of two cones, each being a true taper, but of different sizes, the difference in the diameters of the two cones forming a base or circumferential flange to rest upon a seat to limit the downward movement of the valve, the lower or smallest cone constituting the valve proper, as it is on this portion of the spindle that the steam exerts its direct lifting force. I have found by experiments that a valve constructed on this principle is defective in operation and will not produce invariably satisfactory results, for the reason that the flow of steam will not be in direct proportion to the lift of the valve—that is to say, the ratio between the flow of steam and the increase in the size of the steam-escape space between the valve and the valve-seat as the valve lifts will not coincide, resulting in a failure of the meter accurately to register the amount of steam used according to one formula for the entire height the valve lifts or for the range of the meter. As a result of my experiments I have discovered that in order to obviate this defect the spindle will have to be increased from a true taper to a parabola, the curve of which will be in accordance with the differential results attained by the height of the lift of the valve; and, further, that the proportion between the top and the bottom of the valve should be a fixed one, the ordinate of the parabola being determined by the difference in cross-diameter of the spindle at these points. This increase in the cross-diameter of the lower portion of the spindle by a parabolic curve offsets the tendency of the steam to flow faster than the ratio that would result from the use of a true taper, and enables me by knowing the flow when the spindle or valve has been raised—say, one inch—to calculate the flow at any height, thereby giving me a formula by which to standardize the meter. Without this curve I would be compelled to have a formula for every height at which the meter will register, and consequently would be involved in an endless amount of calculation, as every different opening of meter would require a separate formula, a difficulty entirely obviated by the employment of the curve. Generally stated, the sharper the taper of the valve and thus the greater the inward inclination of the abscissa the greater will be the ordinate of the parabola, the reverse being of course understood. Specifically stated, the curve of any valve is to be such as to be capable of overcoming the tendency of the steam to flow in a greater ratio of increase as the steam-escape space surrounding the valve becomes larger as the valve lifts, or, in other words, the ratio between the flow of steam and the increase in the size of the steam-escape must always remain constant.

In addition to the objectionable features above noted in connection with the old form of valve I have found also by experiment that in measuring steam for an engine the vibratory motion caused by the action of the valves in the engine has a tendency to make the meter register higher than the amount at which I find it will standardize when using steam at a constant flow. By passing steam from the engine through the meter and condensing it I find that the registration is about ten per cent. higher than the amount of the water received at the condenser, this being due to the fact that the positive action of the

steam carries the valve upward with strong force, and when the demand for steam ceases it falls back by gravity, which is not so potent a force as the force that drove it upward. Therefore to overcome this I provide the piston-head of the dash-pot with numerous perforations, and on the piston-rod of this head I place a plate adapted to rest on and to close the openings of the head when the piston is raised. This plate constitutes a check-valve which prevents the water from passing through the openings in the piston-head when the same rises, but compels it to go to the sides thereof, where there is a proper clearance provided, thus tending to retard the upward movement of the valve; but when the piston-head drops this check-valve will lift and allow the water to escape freely above the head. To prevent any impact or jar between the valve and its seat, I employ a supplemental or sub dash-pot which comes into action just as the valve is about to seat itself, and this subdash-pot is engaged by a projection provided on the lower end of the piston-rod of the dash-pot piston-head. The water in the subdash-pot takes the shock and moves out in accordance with the pressure of the projection of the piston when it enters the pot. In order to prevent the piston from contacting with the sides of the cylinder in which it is contained, I provide a guide at the top of this cylinder in which the piston-rod works.

Further and more specific details of construction will be hereinafter more fully described.

In the accompanying drawings, forming a part of this specification and in which like letters of reference indicate corresponding parts, I have illustrated one form of embodiment of my invention, although it is to be understood that other forms of embodiment thereof may be employed without departing from the spirit of the same.

In the drawings, Figure 1 is a view in vertical transverse section showing the parts of the meter as they appear when assembled for use. Fig. 2 is an enlarged detail view of the lower portion of the valve-stem, showing more clearly the peculiar arrangement of the check-valve for retarding the upward movement of the valve and for permitting free downward movement. Fig. 3 is a view in the nature of a diagram illustrating one manner of determining the curve of the parabola of the lower portion of the valve.

Referring to the drawings, A designates a suitable casing provided with an ingress-opening a, an egress-opening a^2, and a hollow projection a^3, the function of which will appear farther on. The casing is provided at its upper portion with an internal guide a^4, having an opening a^5, located, preferably, at its center, and with a valve-seat a^6, arranged in a diaphragm or partition a^7, located below the guide.

Fitting within the valve-seat is a tapered or conical valve or spindle B, having its upper end provided with a stem b, preferably one that is removable from the valve, the said stem being designed to engage the opening a^5 in the guide a^4, and at its lower end with a second stem or projection b^2, carrying a piston-head b^3, which works in a dash-pot C, located at or near the lower end of the casing, a guide-opening a^8, formed in the top of the dash-pot casing, in conjunction with the guide a^4, serving to cause the valve to move in a vertical line. The piston fits loosely within the dash-pot, in order that when the valve starts to rise the movement will be as free from friction as possible and also gradual as possible, the accomplishment of this latter result being due to the fact that the water in the dash-pot surrounding the piston has to pass between the walls of the dash-pot and the periphery of the piston and thus presents resistance to the lifting force of the steam to prevent the valve from being thrown upward with great violence and thereby cause the indicator to register improperly. The piston b^3 is provided with numerous orifices b^4, (indicated by dotted lines,) and resting upon the top of this piston and freely working vertically upon the stem b^2 is a plate b^5, constituting a check-valve for closing the said orifices when the valve rises and for opening them when the valve drops, the object of this arrangement being to retard the upward movement of the valve and not retard its downward movement. To allow free vertical movement of the plate b^5 on the stem b^2, the upper face of this plate is provided with a boss or extension b^7, having therein vertical slots b^8, (one only being shown,) through which projects a pin b^9, extending through the said stem, as clearly shown in Fig. 2. To prevent any jar or impact between the valve and its seat, I provide a second or sub dash-pot c, formed in the removable bottom of the casing of the dash-pot C, the sub dash-pot being engaged when the valve is seated by a teat b^6, projecting below the piston. This sub dash-pot is of course filled with water and does not come into action until the valve is about to seat itself. When the teat enters the pot c, the water therein receives the shock of the drop of the valve and allows the latter gently to resume its seat. It will be seen that the dash-pot C subserves the function of retarding the upward movement of the valve and that the sub dash-pot subserves the function of preventing any jar or impact between the valve and its seat which might result in injury to one or both.

The valve or spindle B is composed of two truncated substantially cone-shaped parts, integral or otherwise, the difference in the diameters of the two parts forming a base or circumferential flange b^{10}, which is designed to rest upon the seat a^6 and thereby limit the downward movement of the valve. The lower or smallest part constitutes the valve proper, as it is on this portion of the spindle that the steam exerts its direct lifting force. The ex-

ternal area of this valve is not a true taper, but is paraboliform, the parabola curving inward from the top to the bottom thereof. The proportion between the top and the bottom of the valve or spindle should be a fixed one, so that to compute the ordinate of the parabola the difference in the cross-diameter of the spindle at these two points is all that is necessary to be known. One manner of determining the curve of the parabola of the lower section of the valve is demonstrated in diagram in Fig. 3, wherein a cone is shown in dotted lines with the parabola indicated thereon, one-half of the parabola constituting one limb or curve of the lower portion of the valve. The advantage of this improvement will be obvious. Where the valve is a true taper, the flow of steam will not be in direct proportion to the lift of the valve—that is to say, the ratio between the flow of steam and the increase in the size of the steam-escape space formed between the valve and its seat as the valve lifts will not coincide—resulting in a failure of the meter accurately to measure and register the amount of steam used according to one formula for the entire height the valve lifts or range of the meter. By the employment of the parabola this objectionable feature is entirely obviated, for it will be seen that as the valve rises the space between the valve-seat and the valve is gradually lessened, the ratio of this decrease being proportionate to the increase of the size of the steam-escape space when the spindle or valve is a true taper.

Projecting upward from the dash-pot C or from the lower portion of the casing to a point near the valve-seat a^6 is a deflecting and pressure-equalizing shield a^9, which is to protect the valve from the direct impact of steam when it enters the casing and thereby prevent such impact from tilting the valve and causing it to bind in its seat and thus work unevenly, and also serves to deflect the steam and bring it uniformly toward and up to the seat a^6, where by its force it raises the valve and escapes between the seat and the valve and thence to the egress-opening a^2, the guide a^4 being so constructed as to obviate the presentation of an obstruction to the free escape of the steam.

The registering mechanism comprises a rod or lever D, pivoted near the outer portion of the projection a^3 and within the same, the inner free end of the rod having a stud or projection d, which engages a groove b^{11}, provided at the upper portion of the valve, so that movement of the valve will cause the rod to rock on its pivot d^2, and thus move a hand or pointer d^3, located externally of the casing and traversing a strip of paper E, moved by clockwork, (not shown,) whereon the movements of the valve are recorded and the amount of steam used and the amount of time of its use are thus rendered ascertainable.

To free the casing and dash-post from water of condensation, petcocks a^{10}, a^{11}, and c^2 are provided, the operation of which will be obvious.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A steam-meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve-seat, in combination with a paraboliform valve operating to compensate for the differential results attained by the varying heights of the lift of the valve, whereby the ratio between the flow of steam and the increase in the size of steam-space between the valve and its seat will remain constant, substantially as described.

2. A steam-meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve-seat, in combination with a paraboliform valve operating to compensate for the differential results attained by the varying heights of the lift of the valve, whereby the ratio between the flow of steam and the increase in the size of the steam-space between the valve and its seat will remain constant, and registering mechanism operated by the movements of the valve, substantially as described.

3. A steam-meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve-seat, in combination with a valve engaging the seat, the upper portion of the valve being approximately cone-shaped and the lower portion paraboliform, substantially as described.

4. A steam-meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve-seat, in combination with a paraboliform valve engaging the seat, and means for retarding the upward movement and for permitting free downward movement of the valve, substantially as described.

5. A steam-meter comprising a suitable casing provided with an ingress and an egress opening and with an internal valve-seat, in combination with a paraboliform valve engaging the seat, means for retarding the upward movement and for permitting free downward movement of the valve, and a shield for protecting the valve from the direct impact of the steam, substantially as described.

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

GAMALIEL C. ST. JOHN.

Witnesses:
GUSTAV SAUER,
FRANK SLEVIN.