

R. BURNHAM.
STEAM METER.
APPLICATION FILED NOV. 21, 1907.

1,145,860.

Patented July 6, 1915.
2 SHEETS—SHEET 1.

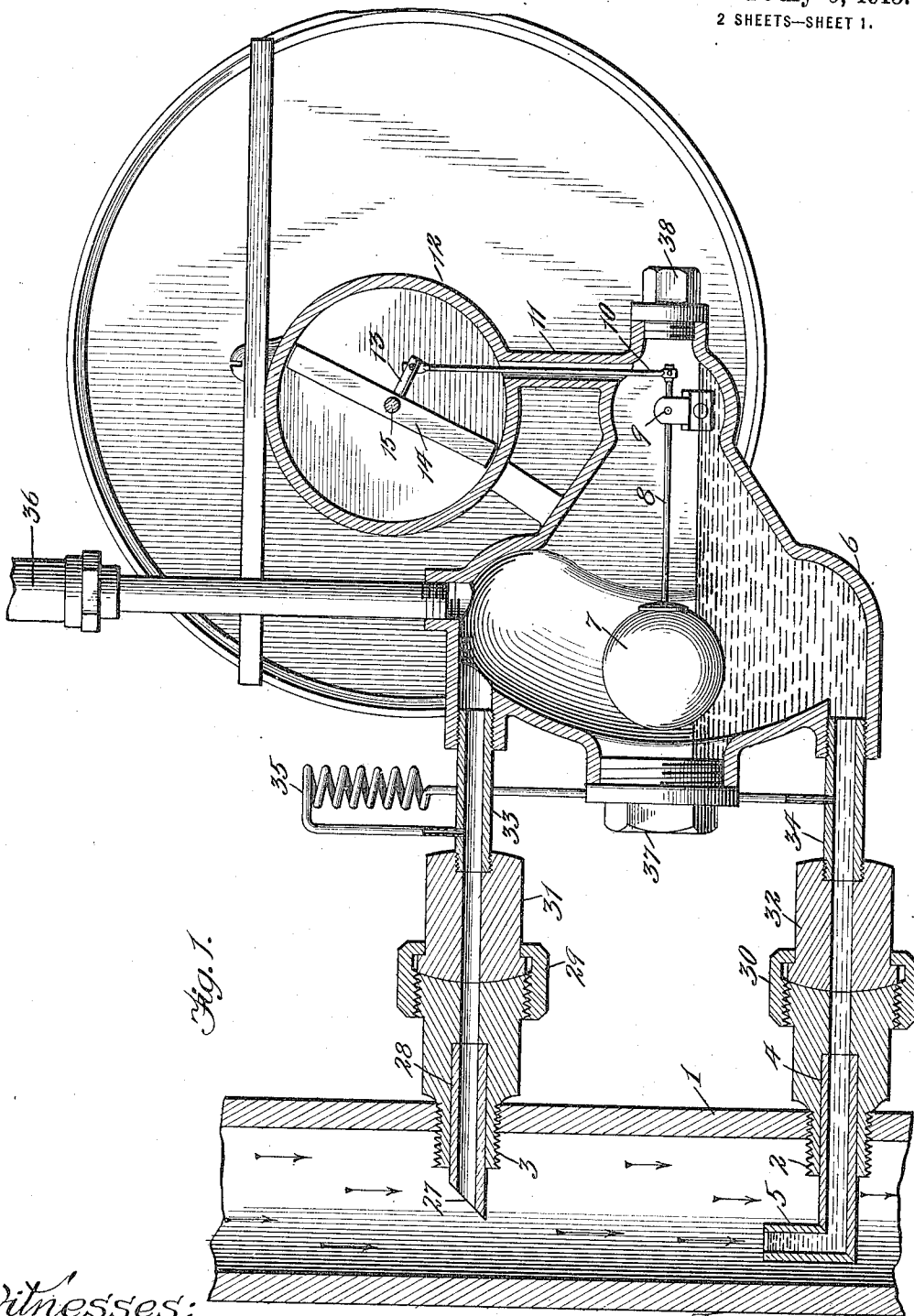


Fig. 1.

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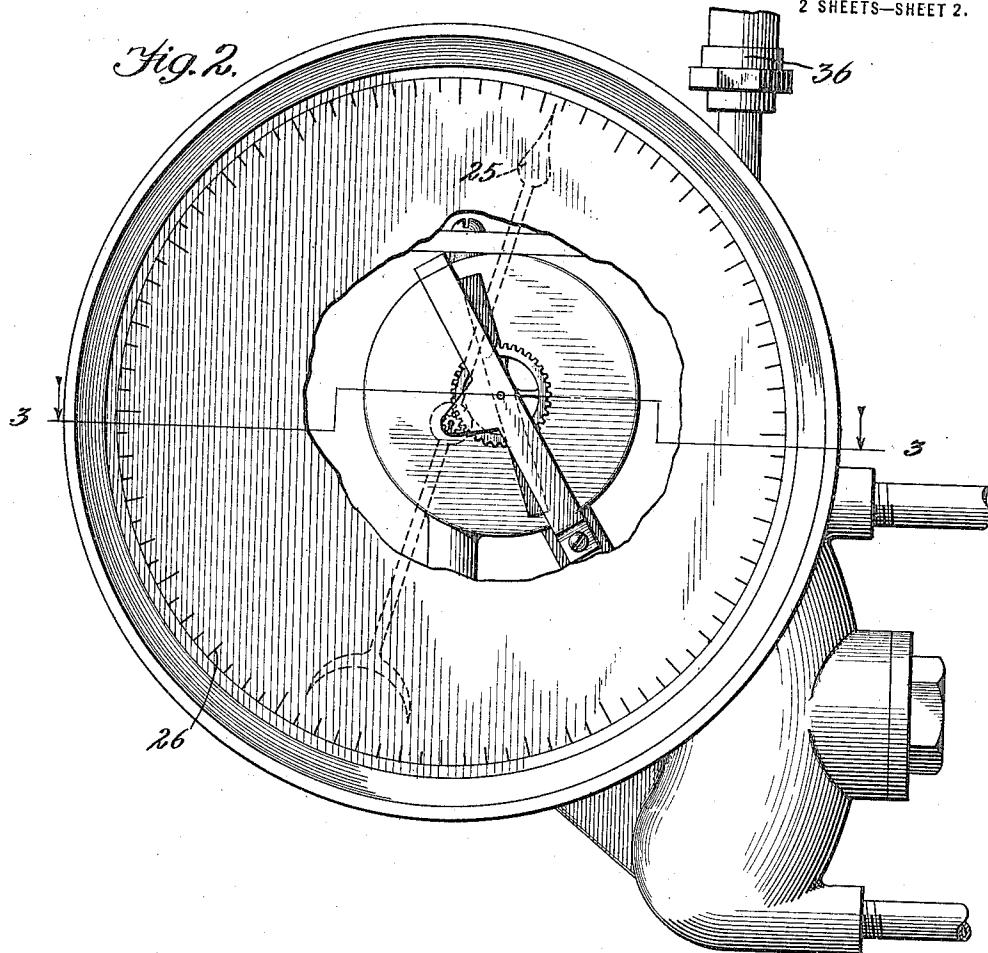
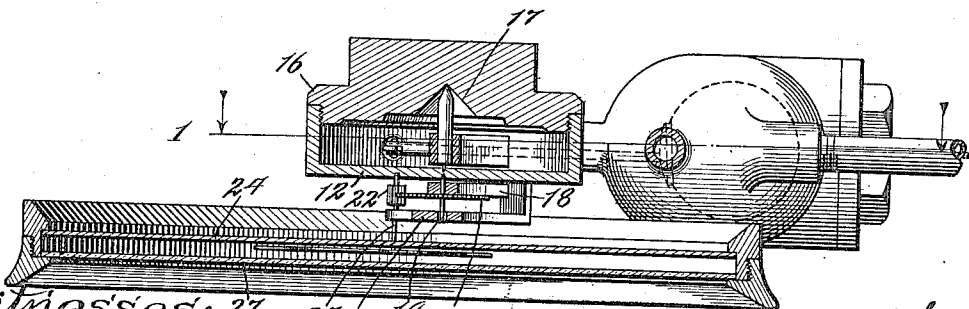


Fig. 3.



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UNITED STATES PATENT OFFICE.

RAYMOND BURNHAM, OF CHICAGO, ILLINOIS.

STEAM-METER.

1,145,860.

Specification of Letters Patent.

Patented July 6, 1915.

Application filed November 21, 1907. Serial No. 403,126.

To all whom it may concern:

Be it known that I, RAYMOND BURNHAM, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Meters, of which the following is a full, clear, and exact specification.

This invention relates more particularly to that class of steam meters which depend for their operation upon the displacement or elevation of a column of fluid, by the dynamic force of the steam, and the invention has for its primary object to provide an improved and efficient form of apparatus especially adapted for the described purposes.

A further object of the invention is to provide an improved device of the described character in which the column of fluid aforesaid may be supplied by the water of condensation of the steam, and such water allowed to accumulate automatically as required.

With a view to the attainment of these ends and the accomplishment of certain other objects which will hereinafter appear, the invention consists in the features of novelty which will now be described with reference to the accompanying drawings, and more particularly pointed out in the claims.

In the said drawings—Figure 1 is a vertical longitudinal sectional view of a steam meter embodying this invention, taken on the line 1—1, Fig. 3. Fig. 2 is a front elevation thereof with a part of the casing and dial broken away, and Fig. 3 is a horizontal section on the line 3—3, Fig. 2.

1 is a pipe, passage or conduit through which the steam to be measured or gaged passes and to which the improved meter is attached by any suitable means, but preferably by plugs or bushings 2, 3. The connection means for the lower end of a water column receptacle forming a part of this meter, comprises a bushing 2 and Pitot tube within said bushing and comprising a neck 4 and an elbow 5, which latter is arranged fully within the pipe 1 and has its mouth turned squarely against the current of steam therein. The neck 4 is in communication with a float chamber 6 in which the water of condensation accumulates and which serves to constitute a column of liquid. In this exemplification of the invention the pipe or

passage 1 to which the device is attached is shown in a vertical position, but this is not essential. In any position of the pipe or passage 1, however, the float chamber 6 should be upright, and hence, in this exemplification, both the elbow 5 and the chamber 6 project upwardly, with the mouth of the elbow 5 above the lower end or bottom of the column constituted by the said float chamber 6 and the connections between the elbow 5 and said chamber, so that the water of condensation will not entirely discharge from the chamber 6 when there is no steam in the pipe 1, or the velocity thereof is not sufficient to resist such discharge. If, therefore, there is a drop in the dynamic pressure of the steam flowing through the pipe 1, some of the condensed steam will flow from the elbow 5 until there is a balance between the pressure exerted by the condensed steam in receptacle 6 and the pressure of the condensed steam in the elbow 5 plus the dynamic pressure of the steam flowing through the conduit 1. When, however, the dynamic pressure of the steam in conduit 1 begins to increase again, the condensed steam in the elbow is driven back from the opening into said elbow, whereupon condensation takes place in the elbow 5 until said elbow is filled again. It will thus be seen that the elbow 5 is automatically supplied with fluid to keep the elbow filled, so that the level of the condensed steam in receptacle 6 will be higher or lower, according as to whether the dynamic pressure of the steam in the conduit 1 is greater or less. Moreover, the fluid level in the receptacle 6 will always be the same for the same dynamic pressure in the conduit 1. A float 7, which may be secured or otherwise operatively related to an arm 8, is pivoted to a support 9, and also has pivotal connection with the lower end of a rod 10, whose upper end passes through a liquid and steam tight neck 11 into a liquid and steam tight chamber 12, where it is pivotally secured to a crank arm 13 arranged to rotate a bar magnet 14 pivoted in the chamber 12 on a shaft 15. The chamber 12, if desired, may be provided with a steam tight cap 16, rendering the parts in the chamber accessible when desired, and this cap, if preferred, may also be recessed, as at 17, to form a bearing for one end of the shaft 15, the other end of said shaft being pointed and supported in the opposite wall

of the chamber 12, as shown in Fig. 3, or any other details of construction may be employed for operatively connecting the float 7 with the bar magnet 14 in a manner to rotate said magnet by fluctuation of the column of liquid in the chamber 6 without permitting the liquid or the steam to escape.

The rotation of the magnet 14 effects a corresponding rotation of a similar magnet 18 mounted outside the casing 12, but adjacent to the wall thereof, so as to be within the magnetic influence or field of the magnet 14, the two magnets being arranged to rotate in parallel planes. The bar magnet 18 is mounted upon an arbor 19 having one end supported in the wall of the casing 12, and the other end in a bracket 20. This arbor carries a gear wheel 21, which engages a considerably smaller pinion 22 mounted on an arbor 23, which is journaled at one end in the back of the casing 12, and at the other end in the bracket 20, and it projects through the back plate 24 of the dial case and carries an index or pointer 25 arranged in reading relation to the graduations 26 on the dial 27, so that a very slight movement of the magnet 14 will, by virtue of the multiplying gears just described, impart a considerably exaggerated movement to the index 25, and as a consequence, the device is rendered very sensitive to the least fluctuation of the column 6. The upper part of the float chamber 6 is also connected with the steam pipe or passage 1, so as to equalize, or substantially equalize, the pressure therein above and below the column of water, but it has been found in practice that where this connection terminates at the pipe 1 in a square ended tube, or a tube having its end face arranged in line with the current of steam, the latter produces more or less suction or an entraining effect, tending to reduce the pressure above the float, whereas, if made like the end of the Pitot tube 4, 5, it would have the opposite effect to an objectionable degree. In order, therefore, to avoid both of these results and to render the effect of the steam in passing the end of the upper passage substantially neutral, the end or extremity of such passage is shifted at an angle to the line of the current of steam, as shown at 27. The exact degree of this angle might vary under different conditions, but ordinarily I have found that an angle of 43° is approximately what is required. In thus connecting the upper part of the float chamber with the pipe 1, I employ a section of tubing 28, on which the angular end 27 is formed and turned toward the current of steam, and which tube is arranged in the bushing or plug 3. As constructional features of the apparatus, the two bushings or plugs 2, 3, are made as parts of unions or nuts, which are shown at 29, 30, and the companion members of which

are shown at 31, 32. These latter are connected respectively by tubes 33, 34, with the upper and lower inlets of the float chamber 6, thus making it possible to quickly detach the meter from the plugs 2, 3, when desired, and also affording ready means of attachment to the pipe 1.

The elbow 5, float chamber 6, and the conduit through the members connecting said elbow and float chamber form a receptacle for condensed steam. This receptacle retains the condensed steam and the condensed steam serves as a medium for registering the dynamic pressure of the steam in the conduit.

It is of course understood that the water in the float chamber 6 is the result of water of condensation from the steam striking directly into the mouth or elbow 5 of the Pitot tube, and in order that there may be an abundance of this water, a special condensation coil 35 may be employed, if desired. This has its extremities connected to the tubes 33, 34, as shown in Fig. 1 so as to balance the pressure at both ends of the coil and allow the water of condensation to run back into the tube 34.

In order that the air or gases accumulating in the chamber 6 may be allowed to escape automatically without permitting the steam to escape, it is preferable to provide the chamber 6 with an automatic relief valve 36, such as is commonly employed on radiators for steam heating systems, for permitting the air to escape while preventing the escape of the water and steam.

37 is a plug in the chamber 6 arranged opposite the float for closing the aperture through which the float is introduced, and affording access to the float chamber when desired, and 38 is a similar plug in the opposite side of the float chamber adjacent to the end of the arm 8 for affording access thereto.

In order that the invention may be understood by those skilled in the art, the details of an exemplification thereof have been thus specifically described; but

What I claim is:

1. In a device for the purpose described, the combination with a conduit for a current of fluid under pressure containing condensable vapor or gas, of an upright column or chamber for receiving condensation, means at the upper end of the column connecting it with said conduit, a tube, and means connecting the tube at one end with the lower end of the column or chamber, the other end of the tube extending lengthwise of and situated within said conduit with its free end toward the advancing current of fluid therein, the mouth of said tube being at a higher level than the lower end of said receptacle, but at a lower level than the upper end of said receptacle, whereby a por-

tion of the water of condensation will remain permanently within the said receptacle.

2. In an apparatus for the purpose described, the combination of a steam passage, 5 a Pitot tube projecting into said passage with its mouth presented against the current of steam, a float chamber, means connecting said Pitot tube with said chamber, said float chamber being further provided with a connection with the steam passage independent 10 of said Pitot tube, a float in said chamber, a movable magnet, means operatably connecting said magnet to said float, a steam-tight chamber communicating with the float chamber and inclosing said magnet, a second magnet arranged opposite said steam-tight 15 chamber within the magnetic field of and adapted to be moved by the first said magnet, and an index or pointer operatably connected to said second magnet. 20

3. In an apparatus for the purpose described, the combination of a steam passage, a Pitot tube projecting into said passage and having its mouth presented toward the 25 current of steam therein, a float chamber, means connecting said Pitot tube with said chamber, a float in said chamber, a movable magnet hermetically sealed from the external atmosphere, means operatively connecting 30 said float with said magnet, a second movable magnet disconnected from the first said magnet and arranged within the magnetic field of and adapted to be moved by the first said magnet, an index or pointer, and 35 means operatively connecting the said index with the second said magnet.

4. In an apparatus for the purpose described, the combination of a passage for the fluid whose velocity is to be measured, a 40 Pitot tube extending into said passage and having its mouth presented toward the current of the fluid therein, a float chamber, means connecting said Pitot tube with said chamber, a float in said chamber, a movable 45 magnet hermetically sealed from the external atmosphere, means operatively connecting said magnet with said float, an external movable magnet disconnected from the first said magnet and arranged in the magnetic 50 field of and adapted to be moved by the first said magnet, an index or pointer, and multiplying gears connecting the second said magnet with said index or pointer.

5. In an apparatus for the purpose described, the combination of a passage for the fluid whose velocity is to be measured, a Pitot tube extending into said passage with its mouth presented toward the current of the fluid therein, a second tube projecting 60 into said passage at a distance from the said Pitot tube and provided with an end opening presented against the current and in a plane transversely inclined to the direction of flow of the fluid therein, means connecting 65 said tubes whereby a column of liquid

may be formed, and means controlled by said column of liquid for indicating fluctuation in the level thereof.

6. In an apparatus for the purpose described, the combination of a steam passage, 70 a Pitot tube extending thereinto, means for accumulating a column of water, connected with said Pitot tube, means for connecting the first said means and the steam passage independently of the Pitot tube, a condenser 75 connected with the first and last mentioned means above and below the level of the column of liquid therein, and means for indicating the fluctuations in the level of said column. 80

7. In an apparatus for the purpose described, the combination with a conduit for steam, of a receptacle for condensed steam embodying a Pitot tube with a mouth disposed above the bottom of the receptacle to 85 retain condensed steam within the receptacle, the condensed steam in said Pitot tube and receptacle constituting a self adjusting water column adapted to gage a steam flow through said conduit, and means for connecting 90 said receptacle with said conduit.

8. In an apparatus for the purpose described, the combination of a conduit for steam, a Pitot tube having its mouth situated in the conduit and presented toward 95 the current of the steam therein so as to catch and receive the steam and the water of condensation thereof, a passage having its lower end connected with said Pitot tube with its lowest point situated at a level below 100 the mouth of the tube so that a given quantity of the water of condensation caught by the tube will remain in the passage when the pressure in the conduit ceases, and means 105 connecting the upper part of said passage also with the conduit.

9. In an apparatus for the purpose described, the combination with a conduit for steam, of a chamber for a water column which indicates the dynamic pressure of the 110 steam in the conduit, and means for operatively connecting said water column chamber to the said conduit, said means embodying a Pitot tube with its mouth presented against the flow of the steam and above the 115 bottom of the chamber.

10. In an apparatus for the purpose described, the combination with a conduit for steam, of a receptacle for condensed steam embodying a Pitot tube by means of which 120 said receptacle communicates with said conduit, the mouth of said Pitot tube being disposed higher than the bottom of the receptacle to retain condensed steam, a float in said receptacle, means for indicating the 125 dynamic pressure of the steam, and means operably connecting said indicating means with said float.

11. In an apparatus for the purpose described, the combination with a conduit for 130

steam, of a chamber for a water column to indicate the dynamic pressure of the steam in the conduit, means connecting the water column chamber with said conduit, said
5 means embodying an elbow with the free end of one arm thereof directed toward the current of flow and with said end of said arm above the lower end of the chamber whereby water is automatically introduced
10 into and drawn from the chamber to correspond with the variations in the dynamic pressure.

12. In an apparatus for the purpose described, the combination with a conduit for
15 condensable fluid, of a condensed fluid receptacle provided with an end opening disposed within said conduit, means to connect the other end of the receptacle to, and affording another end opening in, the conduit,
20 the said openings being directed to receive unequal pressure due to the fluid's flow, said receptacle being provided intermediately of its ends with a portion at a lower elevation than either end opening, the condensed fluid
25 within said receptacle constituting a self-adjusting fluid column to gage the flow of fluid through said conduit.

13. In an apparatus for the purpose described, the combination with a conduit for
30 steam, of a receptacle for holding condensed fluid and provided with an overflow discharge into said conduit, and means connecting the upper end of the receptacle with the conduit, said receptacle being provided
35 with a portion intermediate its ends below the level of the overflow opening.

14. In an apparatus for the purpose described, the combination of a passage for a
40 condensable fluid, a Pitot tube projecting into said passage and having its mouth projecting into said passage, a second tube at a distance from said Pitot tube with an end opening presented on a slant against the cur-

rent, a chamber for condensed fluid, means to connect the chamber with said tubes, and
45 means operated by the rise and fall of the condensed fluid in said chamber for indicating the fluctuation in the level thereof.

15. In an apparatus for the purpose described, the combination of a vertically dis-
50 posed passage for a downwardly moving condensable fluid, a Pitot tube projecting into said passage and having its mouth presented upwardly against the current therein, a second tube projecting into said passage
55 at a distance from said Pitot tube with an end opening inclined upwardly against the current, a chamber for condensed fluid, means to connect the chamber below with one of said tubes and above with the other
60 of said tubes, and means operated by the rise and fall of the condensed fluid in said chamber for indicating the fluctuation in the level thereof.

16. The combination with a steam pas-
65 sage, of a float chamber, a Pitot tube with one end in the passage connected between said float chamber and said steam passage, a static tube in the steam passage also connected with said float chamber, a float in
70 said float chamber, a movable magnet connected to said float and occupying a space hermetically sealed from the atmosphere but in communication with said float chamber, a
75 second magnet outside of said float chamber but in the effective magnetic field of said first-named magnet, and an index connected to said second magnet.

In testimony whereof I have signed my name to this specification, in the presence of
80 two subscribing witnesses, on this 19th day of November, A. D. 1907.

RAYMOND BURNHAM.

Witnesses:

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."