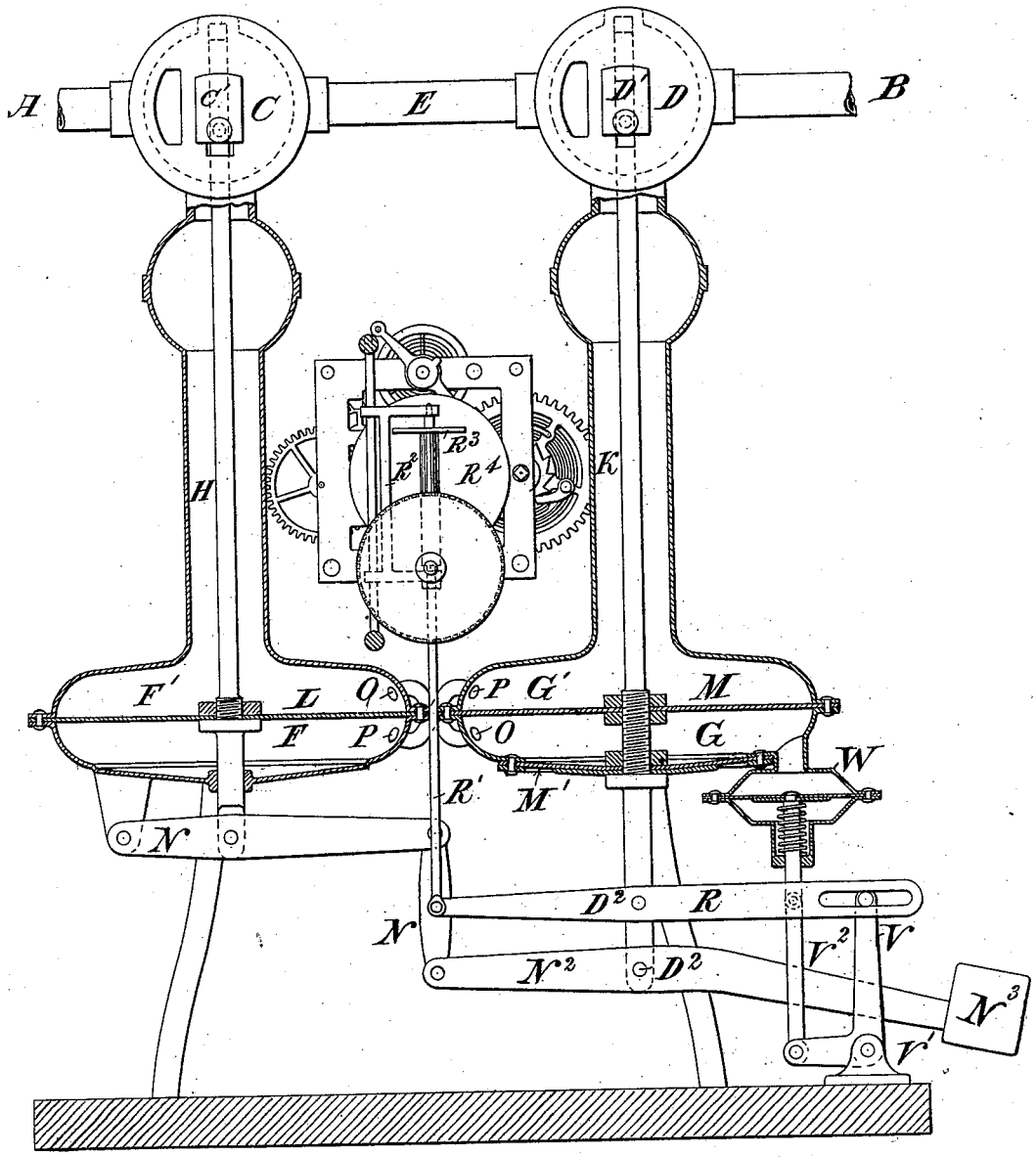
2 Sheets—Sheet 1.

C. HOLLY.

Steam Diaphragm Meter.

No. 209,048. **Patented Oct. 15, 1878.**

FIG. 1.



WITNESSES:

E. D. Mackintosh.

Saml. F. Hay

INVENTOR:

Carlos Holly

2 Sheets—Sheet 2.

C. HOLLY.

Steam Diaphragm Meter

No. 209,048. Patented Oct. 15, 1878.

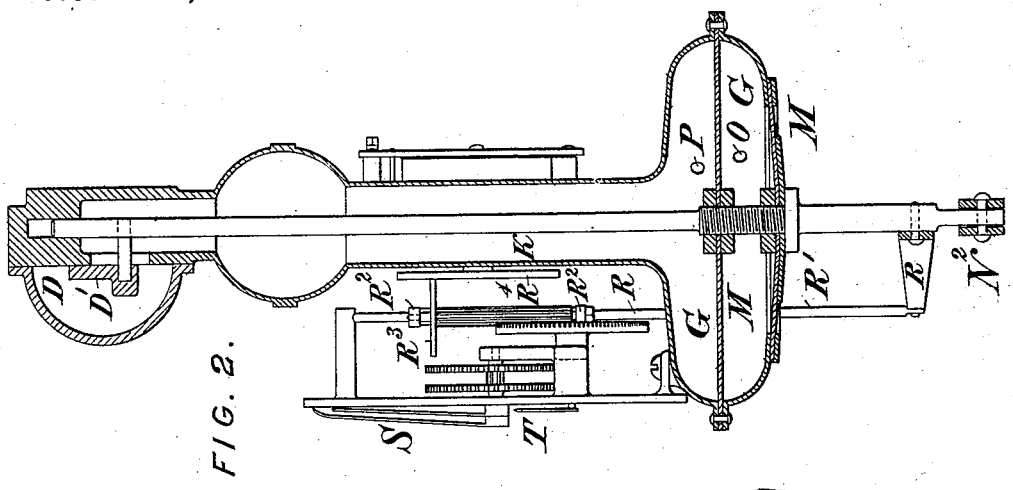


FIG. 2.

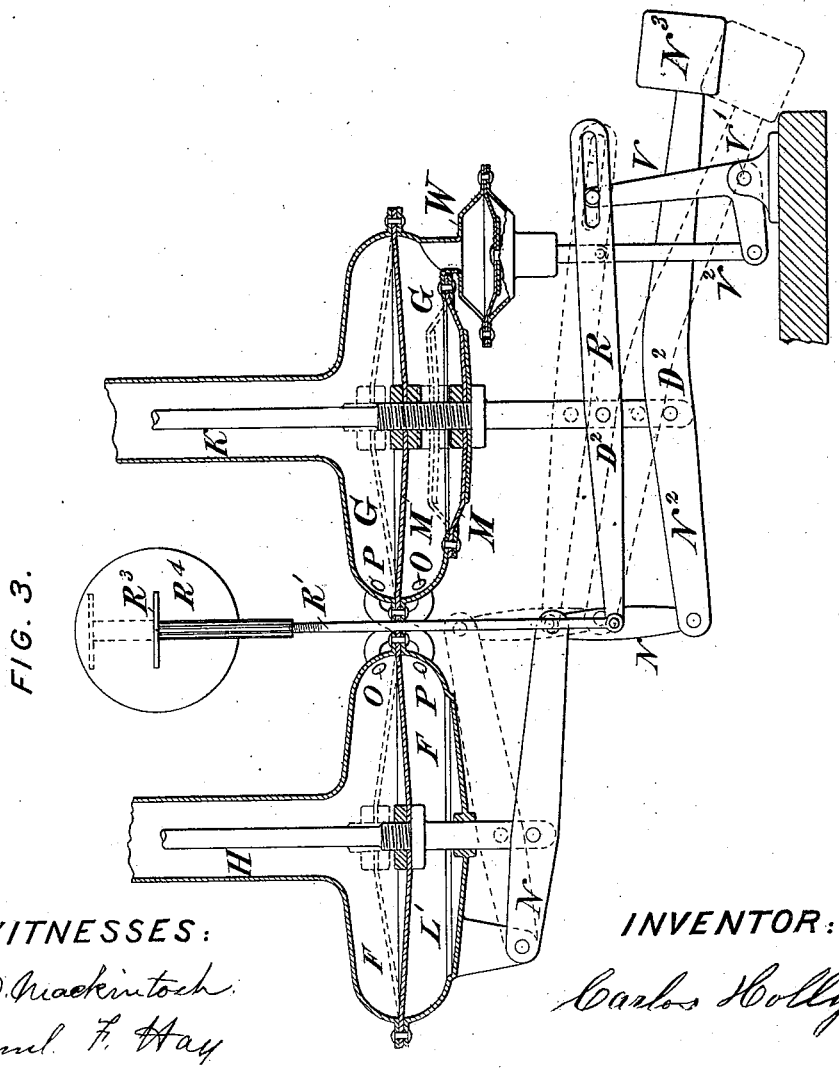


FIG. 3.

WITNESSES:

E. D. Mackintosh.

Saml. F. Hay

INVENTOR:

Carlos Holly

UNITED STATES PATENT OFFICE.

CARLOS HOLLY, OF LOCKPORT, NEW YORK.

IMPROVEMENT IN STEAM DIAPHRAGM-METERS.

Specification forming part of Letters Patent No. **209,048,** dated October 15, 1878; application filed September 9, 1878.

To all whom it may concern:

Be it known that I, CARLOS HOLLY, of Lockport, county of Niagara, State of New York, have invented a new and useful Improvement in Steam Reducing and Recording Meters, which improvement is fully set forth in the following specification and accompanying drawings, in which—

Figure 1 is a vertical section and partial elevation of the apparatus. Fig. 2 is a vertical section and partial elevation at a right angle to Fig. 1. Fig. 3 is a diagram, illustrating the arrangement and operation of the diaphragms and their lever-attachments with the registering apparatus.

This invention pertains to a certain improved apparatus for determining the amount or quantity of steam used in a given time in a steam circulating apparatus, and for recording the same automatically.

In a system of apparatus where steam is generated at a certain point, and is thence conducted through mains and various pipes to consumers who wish to use it for heating purposes and power, as running engines, &c., it is important, both for the consumer and the vender, that they should be able to determine and have estimated or summed up the total amount of the steam so used at a given point in the system and during a given time, in order that the proper payment may be made for the steam thus consumed. To furnish such an apparatus is the object of this invention; but it may be remarked that, in all systems of steam-circulating apparatus known to me prior to my invention, the various gages under the best conditions only indicated and recorded the varying pressures of the steam at the points where they were attached, and discharging through a given aperture, thus leaving the estimates to be made afterward of the amount of steam passing said point.

An apparatus has also been contrived and patented by B. Holly, July 17, 1877, wherein the variable openings of the apertures were connected with registering mechanism in such a manner that said variations of the openings, according to the amount of consumption, were indicated; but in this arrangement the varying pressures of the steam were not reduced to a constant pressure or compensated for, and therefore a record of the opening did not represent or indicate correctly the amount of steam passing through said opening in a given time. The arrangement of the said apparatus was also such that when there was no steam in the pipes the said governing-valve stood wide open, and would be so recorded, thereby constituting a very serious objection to such devices.

Now, this invention consists in combining with any portion of the steam circulating or distributing system an arrangement of valves connected with pressure-chambers and compensating mechanism, in such a manner that the varying pressures of the steam are reduced to a fixed or predetermined pressure, and then, by connecting said mechanism to a chronometer movement provided with suitable recording devices, the actual amount of steam used, or that passing through the aperture of the governing-valve, will be ascertained during any given period of time and without the trouble of any calculations whatever.

At A is represented the inlet end of the steam pipe leading from the boiler or steam-generator, and at B is the outlet or continuation of the steam-conductor.

At C and D are two valve-chambers, connected by an intermediate pipe, E, of the same size as the pipes A and B, so that the pipes A, E, and B may be considered as one pipe, but having the valve-chambers C and D inserted between them. Said valve-chambers are so constructed that the steam, after entering the chamber from the pipe A into the chamber C, must pass a valve or through a valve-opening to the pipe E, and so on through another valve-opening to the outlet or continuing pipe B. Each of the said valve-chambers are connected with pressure-chambers, as at F′ and G′, by tubes H and K, and through which the stems of the valves are passed, connecting the valves to flexible diaphragms L and M, clamped between the two shells which form the pressure-chambers.

The diaphragm L is held against the pressure of the steam on its upper side by a lever, as at N, pivoted at one end to the shell and at the other end, by a link, N^1, connected to a second lever, as at N^2, which has a fulcrum on the stem at D^2, attached to the other valve, and then to have a weight, as at N^3, suspended

on it, so that one weight will answer for both valves in the chambers C and D; or the lever N may be pivoted near its center to the shell of chamber F, having one of its ends pivoted to the valve-stem and the other provided with a weight. The lever N^2 may be attached to a stationary fulcrum, or omitted altogether.

The valves C′ and D^1 themselves are merely plates of metal arranged to slide over the openings, which are rectangular, and are attached to the diaphragms by rods which extend through the tubes H and K, and have pins at their upper ends extending through the openings in the valve-seats, and thus connect with the faces of the valves, and thereby avoid the use of stuffing-boxes.

The valve C′ in the first chamber, at C, is closed more or less by the pressure of steam on the diaphragm L, the weight always acting on the opposite side to open it; and the valve D^1 in the second chamber, at D, is closed more or less by the pressure of steam upon the diaphragm M, and by the weight at N^3, and also by the weight of the valve itself. Consequently, to open it for the passage of the steam to the point where it is used, there is a steam pipe, as at O, leading from the pressure-chamber F′, above chamber G, below the diaphragm M, and thus whatever steam-pressure is acting in the first chamber to close the valve C′ is also acting in chamber G to open the valve D^1 through the pipe O.

In place of attaching pipe O to the chamber F′ and leading to the chamber G, it is evident that a like result may be obtained by attaching it to the pipe E for the same purpose. But on the stem of the second valve, D^1, there is attached a second diaphragm, as at M′, which has about half the area of the diaphragm M; and between these two diaphragms M′ and M the steam-pressure from the first chamber at F, through the pipe O, enters, and in consequence of the addition of diaphragm M′, the lifting action of the steam to open the valve D^1 is reduced to about one-half of that exerted to close the valve C′ in the first chamber, F′.

At P is shown another pipe, which leads from above the diaphragm M to the chamber F, below its diaphragm, so that another balancing and compensating action of the pressures is effected, whereby a definite difference of pressure is maintained between that exerted upon the valve D^1 and upon the discharge-pipe B, at the same time requiring a less amount of weight at N^3.

According to such an arrangement of the valves and their diaphragms and the connections between the pressure-chambers, the steam, after passing valve C′, acts upon the diaphragm L to close the valve, while the reduced pressure under L, together with weight N^3, acting through the levers N N^1 N^2, tends or operates to open it. The same pressure acting on the diaphragm L to close valve C^1 acts upon the under side of the diaphragm M through pipe O to open valve D^1; but the pressure acting upon the under side of the diaphragm M to open valve D^1 is subject to the reduced pressure upon the diaphragm M to close valve D^1, and this reduction of pressure upon diaphragm M is in ratio to the reduction of the diaphragm itself caused by the introduction of the diaphragm M′. Consequently, as the steam is used or drawn off after it has passed the valve D^1 at the outlet-pipe B, and thereby reduces the pressure above the diaphragm M, the pressure below it (the said diaphragm M) will instantly act to open the valve D^1, and thereby supply the increased demand. If no other force were employed to open valve C′ except the weight N^3, operating through levers N N^1 N^2, it is evident that the pressure in chamber F′ would be at all times the same, without regard to the pressure in the discharge-pipe B and chamber G′. But by the arrangement of the pipe P, connecting the steam-pressure above the diaphragm M with the space under the diaphragm L of the chamber F, it will be seen that as the pressure above the diaphragm M is reduced, the pressure below the diaphragm L will be correspondingly reduced, and the valve at C′ will be correspondingly closed, so that a definite difference of pressure is maintained between that exerted upon the valve D^1 and upon the discharge-pipe B.

Now, this second governing or reducing valve is connected with the registering or recording devices in the following manner: A lever, as at R, is pivoted to the valve-stem at D^2, and one end of said lever is attached to a rod at R^1, the upper end of which supports a sliding frame, as at R^2, which carries a friction-wheel, R^3, the periphery of which presses against the face of a radial wheel, R^4, whose face is at a right angle to the plane of the friction-wheel R^3, so that as one revolves it drives the other. The radial wheel R^4 is driven by a chronometer-movement or clock-work set in motion by a spring or weight, in the usual manner, and it thereby sets in motion the friction-wheel R^3, which has a long pinion on its hub, that gives motion to a set of wheels that move the hands over the dials, as seen at S and T, Fig. 3.

The other end of the lever R is fulcrumed upon a pin in the end of a bell-crank arm, as at V, the angle of the said crank being pivoted upon the base, as at V^1. The other arm of the crank is connected by a rod, V^2, to a diaphragm in a pressure-chamber at W, which is attached by a pipe to the pressure-chamber G below the diaphragm M, or where the steam from the pressure-chamber F′ is taken through the pipe O, so that whatever the pressure of the steam may be in the first chamber, as at F′ and E, it will be the same in the chamber W, and, as it exerts a force downward, will tend to force the upper end of the bell-crank at V to the left, or toward the point where it is pivoted to the valve-stem of D^1, there being a long slot in the end of the lever R for its fulcrum-pin on the arm V of the bell-crank to work in; or the bell-crank arm V^1 may be

placed between pivot D^2 and rod R^1, its fulcrum-pin traversing a slot made in the lever R between the said pivot D^2 and the rod R^1, and extending to the center of the pivot by which said lever R is secured to the rod R^1. In that case the rod R^1 must be shortened, in order to move the friction-wheel R^3 below the center in place of above. The result of such a movement will be to shorten that arm of the lever R, and thereby produce a greater motion on the friction-wheel R^3, or to carry its point of contact with the surface of the radial wheel R^4 farther from the center. Consequently, in the case of any excessive draft of steam from the pipe at B, or such a draft as to reduce the pressure below the normal pressure to which the weight is set and calculations made, the pressure-chamber, with its attachments, will instantly change the position of the fulcrum of the lever R, and thereby correctly locate the friction-wheel R^3 upon the driving disk or wheel R^4 and give the proper registration. In other words, if the valve D^1, by any excessive draft of the steam from pipe B, may be fully opened, and is still unable to maintain the pressure for which calculations were made, then the inaccuracy which would otherwise occur by reduction of steam below its normal pressure will be corrected by the action of diaphragm in chamber W. An excessive steam-pressure, from any cause, will be corrected in substantially the same manner.

The diagram at Fig. 3 shows the action of these diaphragms as connected to the various levers and as affecting the recording-pinion R^3.

Whenever the point of contact of the pinion R^3 is at the center of the radial or driving wheel R^4, then no movement of the recording-hands will be produced; but as the diaphragm M moves to open the valve D^1, as indicated by the dotted lines, Fig. 3, then the point of contact with the driving-wheel R^4 is moved proportionally farther from the center, and the indicating or recording hands will also be moved proportionally faster or slower, as the case may be.

When it is desirable to keep a daily record or for any given period of time, a paper and recording-pencil may be used in place of the dials and hands, or it may be combined with them by merely adding reels for carrying the paper and attaching the pencil to the rod or frame that supports the friction-wheel R^3.

By the use of the hereinbefore-described mechanism in connection with a system of steam-distributing apparatus, the sum total of the various openings of the governing-valve, as at D^1, will be obtained, and at the same time the proper compensations for the varying pressures of the steam passing through said valve will be determined, so that a correct record of the actual amount of steam used may be ascertained, and without the necessity of any calculations whatever.

Of course, it is evident that in the use of such an apparatus it will be necessary to have determined beforehand what amount of steam under a certain pressure will pass through a given opening in a certain length of time.

It is also evident that various forms of clock-work, dials, &c., may be used in connection with the governing-valves herein set forth, and also that other forms of valves may be used, as also pressure-chambers having pistons instead of diaphragms, &c., without departing from the nature of my invention; but

I claim—

1. In a steam-distributing apparatus, the combination of two reducing governing-valves and registering mechanism, as herein specified, to correctly register the actual amount of steam passing through the meter.

2. In a steam-distributing apparatus, the combination of two reducing governing-valves with pressure-chambers and intermediate mechanism, substantially as herein specified, whereby the inlet-valve is partially closed by the steam-pressure and the outlet-valve is partially opened by same steam-pressure, as and for the purposes specified.

3. In a steam-distributing apparatus, the combination of the inlet-valve C' and its pressure-chamber F' with the outlet-valve D^1 and its pressure-chamber G, and pipes for the purpose of connecting the two pressure-chambers, and an indicating or registering mechanism, as and for the purposes herein set forth.

4. In a steam-distributing apparatus, the combination of the inlet and outlet valves and their pressure-chambers with the pipes O, P, and E and an indicating or registering mechanism, substantially as described, and for the purpose set forth.

5. In a steam-distributing apparatus, the combination of the inlet and outlet valves, their pressure-chambers, and compensating-levers having an adjusting-fulcrum controlled by the steam-pressure, substantially as described, and for the purposes set forth.

6. In a steam-distributing apparatus, the combination of the inlet and outlet valves, the pressure-chambers, and intermediate chamber W, as and for the purposes set forth.

7. The combination of the adjusting-chamber W with the outlet-valve and indicating or registering mechanism, substantially as described, and for the purposes set forth.

8. The combination of the outlet-valve D^1, connecting-levers, substantially as shown, friction-wheel R^3 and driving-wheel R^4, operated by clock-work, and diaphragm M, substantially as specified.

9. The combination of the outlet-valve, a variable pressure-chamber having diaphragms or pistons of different areas acted upon by the inlet-pressure of the steam, with the adjusting-chamber W and indicating or registering devices, as and for the purposes set forth.

10. The combination of the two valves C' and D^1 by suitable levers operated by a single weight, as at N^3, as and for the purposes described.

11. In a steam-distributing apparatus, the

combination of the inlet and outlet valves and their pressure-chambers with the pipes P and E and an indicating or registering mechanism, substantially as specified.

12. The combination of the valve D^1 and its connecting rod or stem attached to lever R, having an adjusting-fulcrum operated by suitable connections, with the adjusting-chamber W, substantially as described.

13. In a steam-distributing apparatus, the combination of the inlet and outlet valves and their pressure-chambers with the pipes O and E and an indicating or registering mechanism, substantially as specified.

CARLOS HOLLY.

Witnesses:
BOYD ELIOT,
A. MOORE.