2 Sheets—Sheet 1.

L. DUNNE & E. T. C. RICHMOND.

Rain Gage.

No. 200,443. **Patented Feb. 19, 1878.**

Fig. 2.

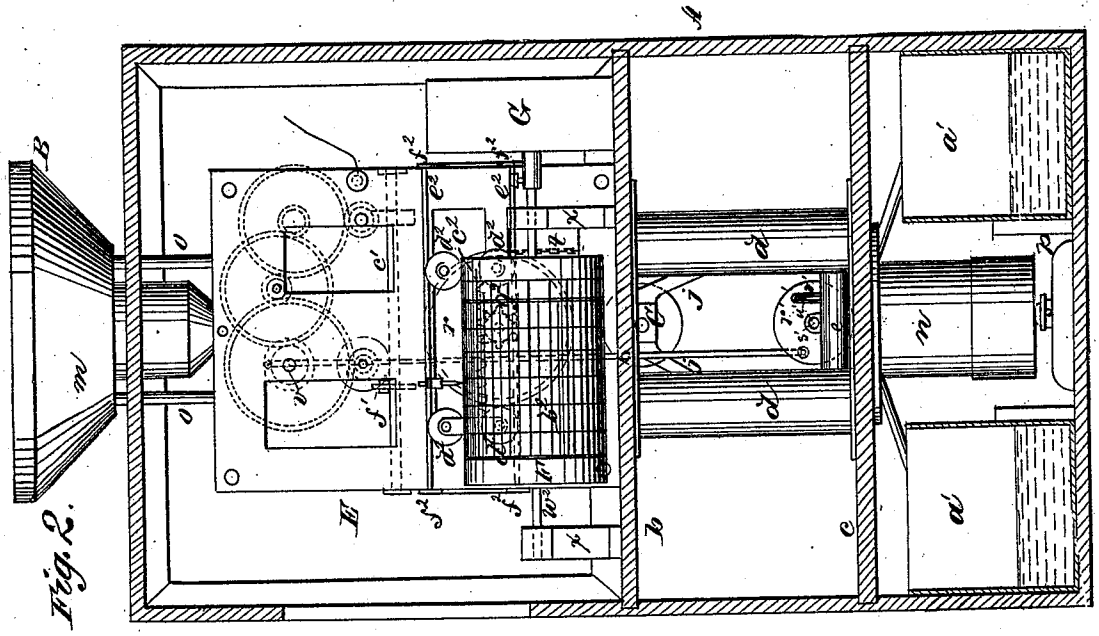
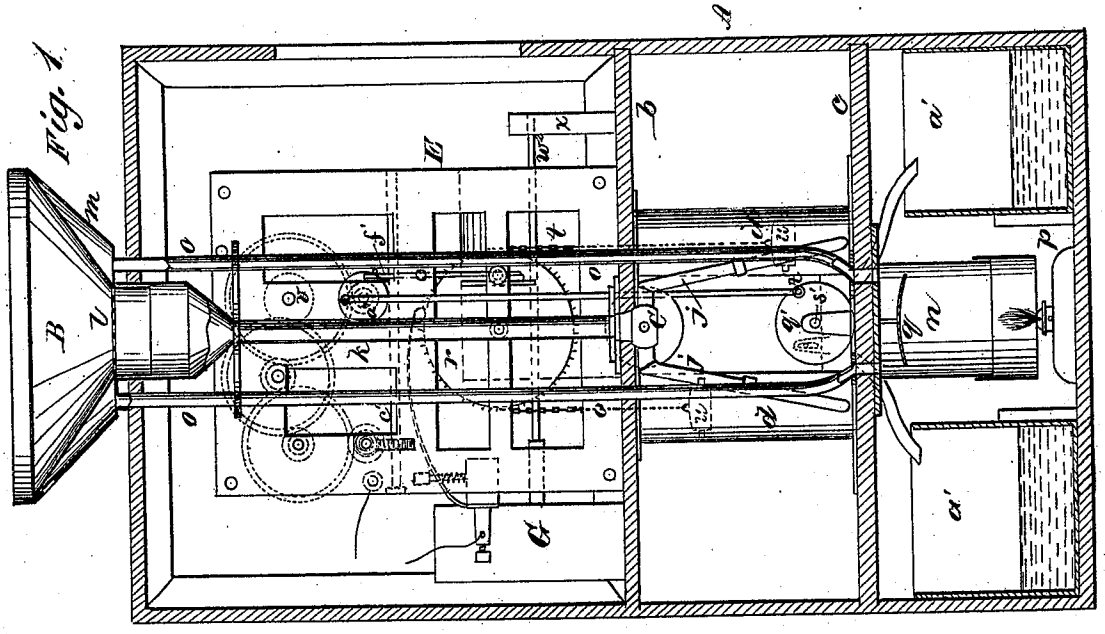


Fig. 1.



WITNESSES:

G. Neveux

J. W. Scarborough.

INVENTORS

L. Dunne.

E. T. C. Richmond.

BY Munn & Co

ATTORNEYS.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets—Sheet 2.

L. DUNNE & E. T. C. RICHMOND.

Rain Gage.

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Fig. 1.

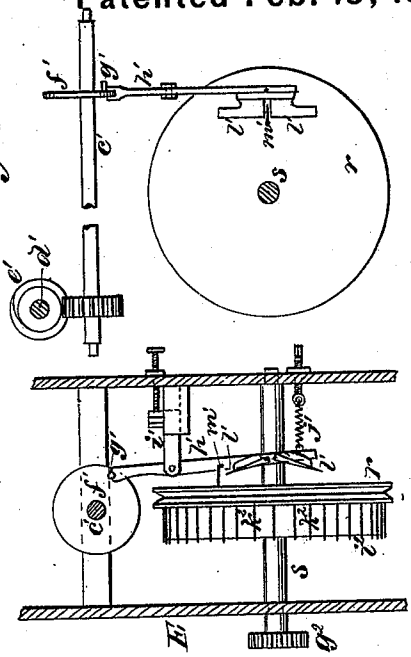


Fig. 2.

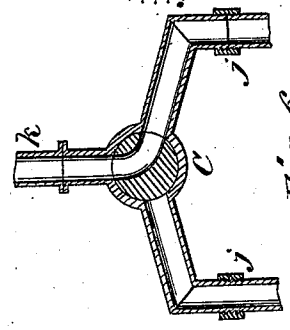


Fig. 3.

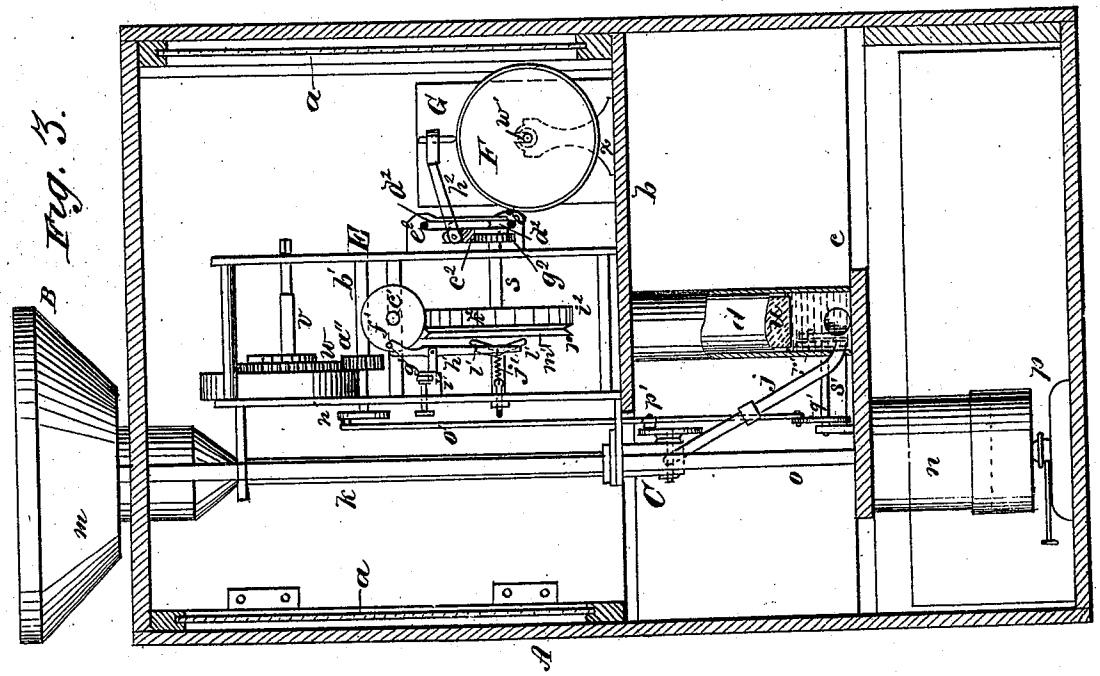


Fig. 4.

Fig. 5.

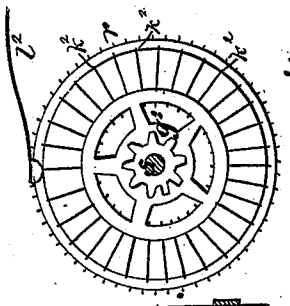
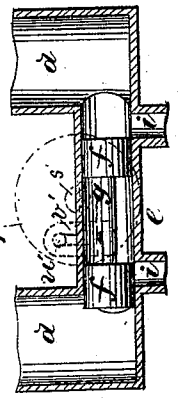


Fig. 6.

Fig. 7.



WITNESSES:

C. Neveux

J. H. Scarborough.

INVENTORS

L. Dunne.

E. T. C. Richmond.

BY Munn & Co

ATTORNEYS.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

LAWRENCE DUNNE AND EPHRAIM T. C. RICHMOND, OF MORGANTOWN, WEST VIRGINIA.

IMPROVEMENT IN RAIN-GAGES.

Specification forming part of Letters Patent No. **200,443**, dated February 19, 1878; application filed December 3, 1877.

To all whom it may concern:

Be it known that we, LAWRENCE DUNNE and EPHRAIM THOMAS CARROLL RICHMOND, of Morgantown, in the county of Monongalia and State of West Virginia, have invented a new and Improved Rain-Gage, of which the following is a specification:

Figure 1 is a rear elevation of our improved rain-gage. Fig. 2 is a front elevation. Fig. 3 is a side elevation. Fig. 4 is a detail view of the valve for directing the water to the float-cylinder. Fig. 5 is a detail of the electrical current-closing wheel. Fig. 6 is a side elevation of the chain-wheel and let-off mechanism. Fig. 7 is a front elevation of the let-off mechanism. Fig. 8 is a detail view of the discharge-valves of the float-cylinders.

Similar letters of reference indicate corresponding parts.

The object of our invention is to provide a rain-gage which will automatically fill and discharge, and will continuously and accurately record, both at the instrument and at a distant point, if desired, the exact amount of rain-fall.

The invention consists in two cylinders containing floats which are connected by chains running over a chain-wheel that controls a spring-actuated train of gearing that operates the supply and discharge valves of the float-cylinders, and also controls the electrical recording apparatus.

It also consists in a device for warming the apparatus and for melting snow or hail.

Referring to the accompanying drawings, A is a casing provided with doors upon two opposite sides, and having inner glass doors *a* for covering the finer parts of the mechanism. The case A contains all of the apparatus with the exception of the receiver or funnel B. The casing contains two reservoirs, *a'*, for receiving the water discharged from the apparatus; also two shelves, *b c*.

Upon the shelf *c* two similar cylinders, *d*, are placed, which are connected at their lower ends by a tube, *e*, in which are placed two piston-valves, *f*, connected by the rod *g*. There are two discharge-openings, *i*, in the tube *e*, one near each end, which may be opened alternately by the longitudinal movement of the valve; but both cannot be opened simultaneously.

Pipes *j* connect the lower end of the cylinders *d* with a three-way valve, C, which is connected with the funnel B at the top of the apparatus by a pipe, *k*.

The funnel B is much larger in diameter than the float-cylinders, so that a given amount of rain, which, falling in the funnel, would fill a vessel having the same diameter as the funnel; but the fraction of an inch would, when conveyed to the smaller cylinders, fill them to a greater depth—that is, to a depth inversely proportionate to the difference in the area or diameter of the two vessels. For example, suppose the funnel to have an area of two hundred square inches, and the float-cylinders an area of twenty square inches each, then a fall of one-hundredth of an inch of water would be represented by one-tenth of an inch of water in one of the cylinders.

There is a strainer, *l*, over the discharge of the funnel, which prevents the entrance of solid substances into the apparatus. A jacket, *m*, surrounds the funnel, and is placed in communication with a heating-drum, *n*, in the lower part of the apparatus by pipes *o*, which extend from the drum to the jacket of the funnel.

The drum *n* is made in two parts, the lower being fitted to a lamp, *p*, and arranged to slide over the upper part. The drum contains a deflector, *q*, which throws the heat toward the sides of the drum. The upper portion of the jacket that surrounds the funnel is perforated to allow the smoke generated by the lamp to escape.

A frame, E, is secured to the shelf *b*, which contains a train of gearing and a chain-wheel, *r*, which is secured to the shaft *s*.

A chain, *t*, passes over the wheel *r*, and is attached at its ends to floats *u* in the cylinders *d*. The floats are provided with three projecting points or pins placed equal distances apart around the periphery of the floats, to prevent contact of the floats with the cylinders, and thus avoid capillarity between the surfaces of the float and the inner surface of the cylinder.

The chain-wheel is roughened or provided with teeth to prevent the chain from slipping.

The latter may be provided with two adjusting-swivels for shortening and lengthening the same. The circumference of the chain-wheel r is equal to the distance through which the floats rise and fall, so that a complete stroke in one direction of either of the floats produces an entire revolution of the wheel.

The train of gearing consists of the spring-shaft v, having attached to it a spur-wheel, w, which meshes into the pinion a'' on the shaft b^1. The spur-wheel w also actuates the shaft c^1 through wheels and pinions that rotate the shaft d^1, on which is placed the worm e^1. This worm engages a worm-wheel on the shaft c^1. A disk, f^1, is secured to the shaft c^1, and a pin, g^1, projects from its face and is engaged by a detent-lever, h^1, which is fulcrumed in an adjustable support i^1. The detent-lever is provided at its lower end with a spring, j', which holds it into engagement with the pin g^1.

Two oppositely-disposed inclined planes, l^1, are secured to the lower end of the detent-lever h^1, and are arranged a small distance apart, with their adjacent ends farther from the chain-wheel than their outer ends.

A finger, m', projects from the face of the wheel, and is capable of engaging one or the other of the inclined planes l^1, as the wheel is rotated.

Upon the end of the shaft b^1 there is a crank, n', that is connected by a rod, o', with a crank, p', placed on the end of the cylinder or plug of the three-way valve C.

Disks q' r' are secured to opposite ends of a shaft, s', which is journaled near the tube e. A crank-pin, t', projects from the disk q', and is connected with the crank p' on the three-way valve C, and a pin, u', projects from the disk r', and moves in a slot in a head, v', that is attached to the rod g that connects the valves f, the head v' being bent so as to pass through a slot in the side of the tube e.

In front of the frame E a drum, F, is supported by the shaft w', which is journaled in standards X that project from the shelf b. The shaft w' is connected with a clock-movement, G, so as to be rotated once in twenty-four hours.

Upon the drum F, a graduated or ruled piece of paper, b^2, is secured by suitable fastenings.

A rack, c^2, having at each end two grooved rollers, d^2, is supported and guided by a track consisting of two bars, e^2, which are sustained by brackets f^2 attached to the frame E. The rack e^2 is engaged by a pinion, g^2, on the end of the shaft s, so that the rack is carried back and forth by the rotation of the chain-wheel r.

An arm, h^2, is pivoted to the rack c^2, and has at its outer end a screw-clamp for carrying a pencil for marking on the paper carried by the drum F. The rotation of the drum and the longitudinal movement of the pencil produces a line on the paper, which indicates the rate of falling, and also the total rain-fall for the whole or a portion of a day.

The chain-wheel r carries a disk, i^2, upon the periphery of which there are a number of transverse wires, k^2, which are placed an equal distance apart, and are in metallic communication with the shaft s. The distance between the wires represents a fractional part of an inch of rain-fall or melted snow.

One terminal of an electric current in which a recording instrument is placed is connected with the shaft s, and the other terminal is connected with a spring, l^2, which is attached to an insulated bar in the frame E, and bears constantly on the periphery of the disk i^2. The recording apparatus placed in the electrical circuit consists of a drum carried by a clock movement and a pencil moved by electro-magnets.

The operation of our improved rain-gage is as follows: The rain falling in the funnel or receiver B is conveyed by the pipe k to the three-way valve C, by which it is directed into one of the pipes j, which conveys it to one of the float-cylinders d. Supposing the other float-cylinder to have been discharged, there is no impediment to the falling of the float in the empty cylinder or the rising of the float in the cylinder being filled. As the float rises the wheel r is turned, and the pencil is moved along on the surface of the drum F. The electrical current is alternately established and broken by the disk i^2 so as to operate the distant recording apparatus.

When the disk i^2 and chain-wheel r have made a complete revolution the finger m' strikes one of the inclined planes l^1 and moves the detent h^1 so as to disengage it from the pin g^1, permitting the disk f^1, which is actuated by the train of gearing, to make a single revolution, when the pin g^1 is again engaged by the detent.

When the detent is tripped by the means described, and the disk f^1 makes its rotation, the crank n^1 is turned through a half-revolution. This operation results in turning the three-way valve so as to shut the water off from the float-cylinder already filled and direct it into the empty one. It also shifts the valves f so as to discharge the full cylinder d and stop the discharge-opening of the empty one. The discharge-water is led by the pipes n^2 into one of the reservoirs a'. As the water enters the empty cylinder, the movement of the float and apparatus connected with it is reversed, and the wheel r moves in the reversed direction until the fingers m' strike one of the inclined planes l^1, and again disengages the disk f^1, and sets in operation the valve-reversing mechanism.

The advantages claimed for our improved rain and snow gage are that it may be used in freezing as well as in warm weather. It may be used for snow or rain. It gives an exact and permanent record of the amount of rain or snow fall, and also records the time of the beginning and ending of such fall, both at the instrument and in a recording apparatus at a distance from the instrument. Its capacity for measuring is unlimited, and it will re-

cord with accuracy a light or heavy rain or snow. It may be placed in an open field, or on a roof, or in an office. In the latter case the receiver would be placed on the roof, and the water led to the instrument by a pipe.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. The combination, in a rain-gage, of a heating-lamp and jacketed receiving-funnel, substantially as herein shown and described.

2. The combination, in a rain-gage, of two float-cylinders, each containing a float, a chain for connecting the two floats, and a chain-wheel for transmitting the motion of the floats to the recording apparatus, substantially as herein shown and described.

3. The combination, with the float-cylinders, of a receiving-funnel and a three-way valve for directing the water into the float-cylinders, substantially as herein shown and described.

4. A spring-actuated train of gearing, controlled by the floats, in combination with the receiving and discharge valves of the float-cylinders, substantially as herein shown and described.

5. The combination of the float-cylinders *d*, the tube *e* having discharge-openings *i*, the piston-valves *f*, and connection for moving the said valves simultaneously with the valve C, as herein shown and described.

6. The detent-lever h^1, having two oppositely-disposed inclined planes, l^1, the chain-wheel *r*, having the finger m^1, and the disk f^1, having the pin g^1, in combination, substantially as and for the purpose specified.

7. The movable rack c^2, the pencil-arm h^2, and the paper-carrying drum F, rotated by clock-work, as described, in combination with the floats *u* and intermediate mechanism for conveying motion from the floats to the movable rack, substantially as herein shown and described.

8. The disk i^2 carrying electrical conducting-wires k^2, in combination with the float chain-wheel *r*, substantially as herein described.

9. The floats *u*, having pins or projections on their peripheries, substantially as and for the purpose specified.

LAWRENCE DUNNE.
EPHRAIM THOMAS CARROLL RICHMOND.

Witnesses:
D. H. CHADWICK,
J. C. WALLACE.