3 Sheets--Sheet 1.

W. W. GOODWIN.

Electrical Photometers.

No. 157,962. Patented Dec. 22, 1874.

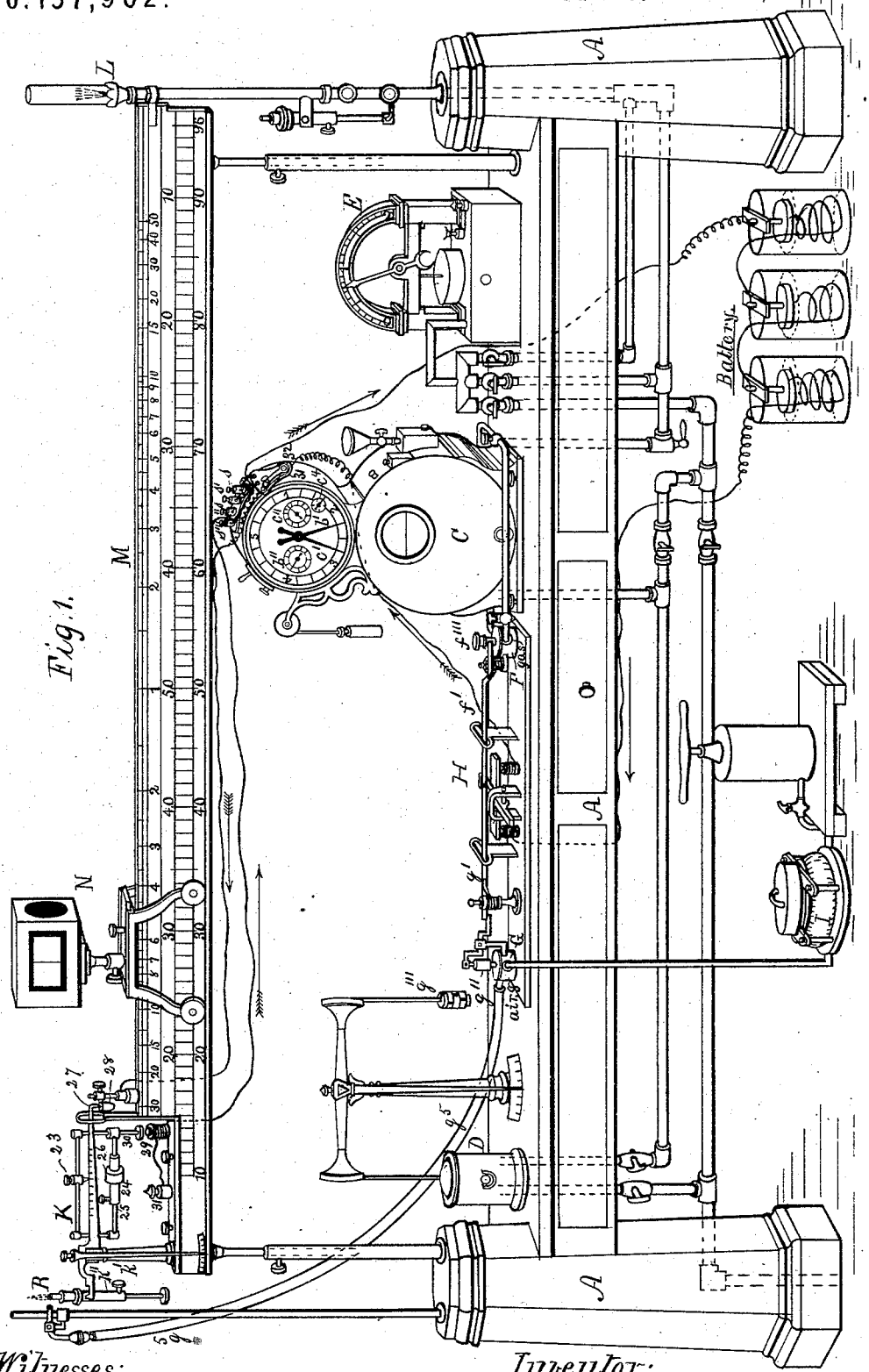

Fig. 1.

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Wm. H. Morrison

Inventor:
William W. Goodwin

THE GRAPHIC CO. PHOTO-LITH. 39 & 41 PARK PLACE, N.Y.

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W. W. GOODWIN.

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Fig. 2.

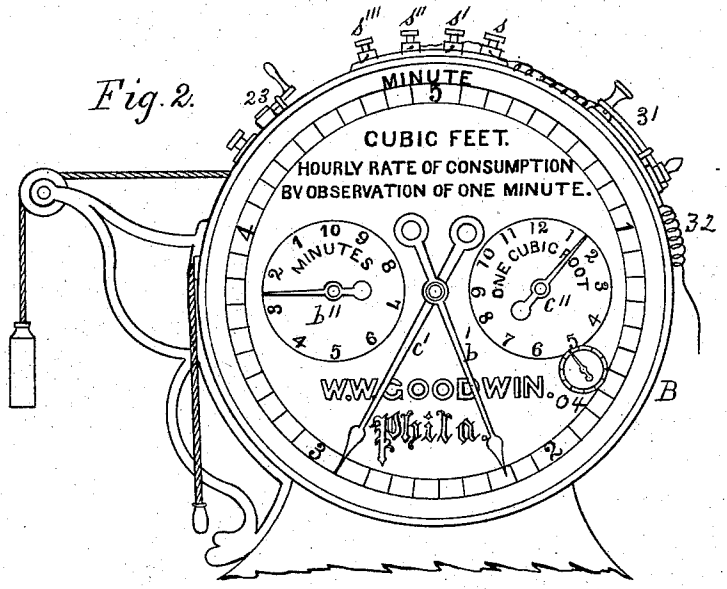

Fig. 3.

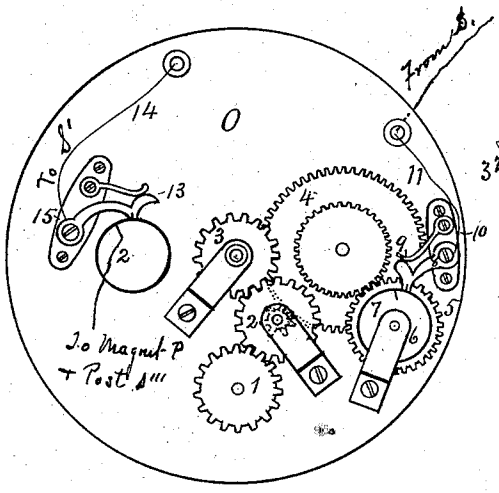

Fig. 4.

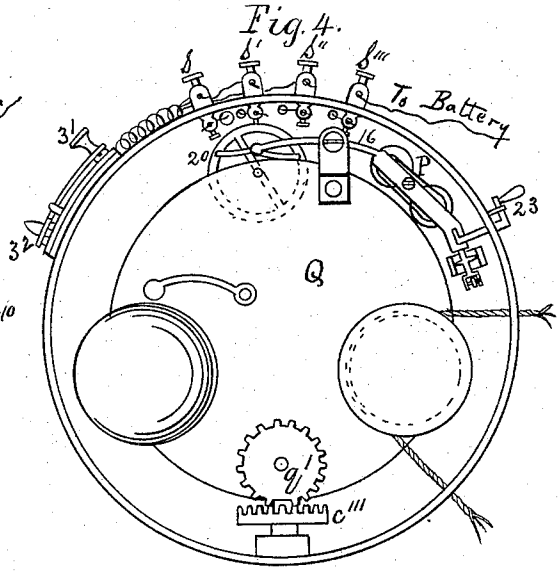

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Fig. 5.

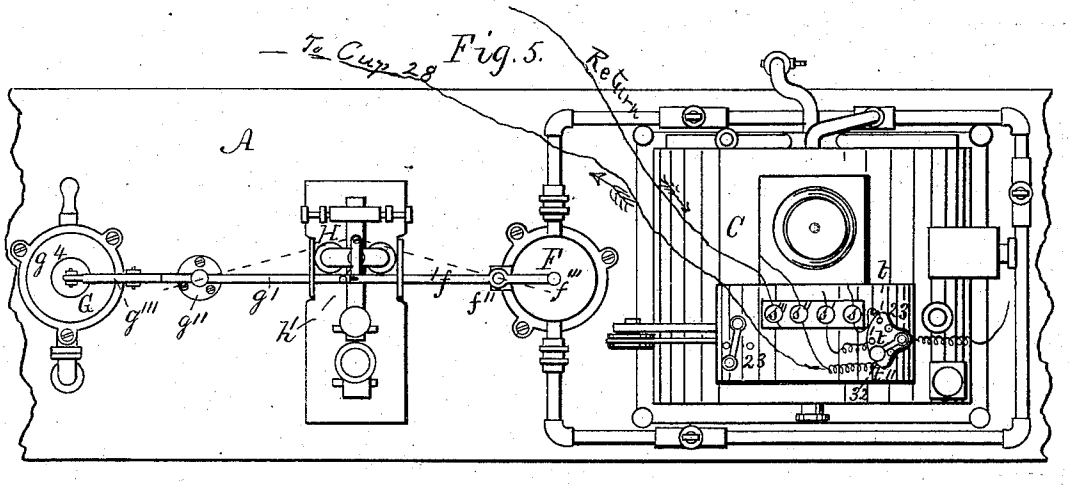


Fig. 6.

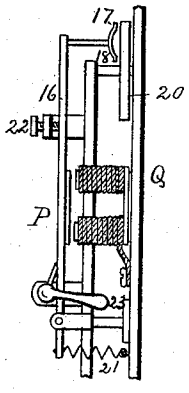


Fig. 7.

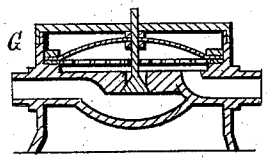
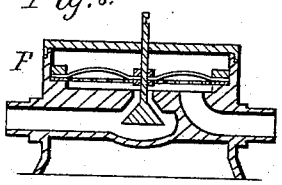


Fig. 8.



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Inventor:

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UNITED STATES PATENT OFFICE.

WILLIAM W. GOODWIN, OF CAMDEN, NEW JERSEY.

IMPROVEMENT IN ELECTRICAL PHOTOMETERS.

Specification forming part of Letters Patent No. **157,962**, dated December 22, 1874; application filed May 13, 1874.

To all whom it may concern:

Be it known that I, WILLIAM W. GOODWIN, of the city of Camden, in the State of New Jersey, have invented an Improvement in Electrical Photometers, of which the following is a specification:

My invention relates to the well-known Bunsen photometer for ascertaining the illuminating quality of any illuminating-gas tested thereby; and the object of my invention is to render the apparatus automatic in its operation, and absolutely correct and reliable in showing the quantity of the gas consumed, the weight of the consumed portion of the test-candle, and the time occupied in the consumption.

These results I obtain either simultaneously or separately, as may be desired, by means of electro-magnets, in combination with certain mechanical devices connected with said photometer, as will hereinafter be fully described with reference to the accompanying drawings, in which—

Figure 1 is a front side elevation of a Bunsen photometer embodying my invention; Fig. 2, an enlarged front view of the clock shown in Fig 1; Fig. 3, a like view of the front plate of the clock, showing a vulcanite wheel operated by the latter, and certain geared wheels operated by the meter, the dial of the clock being removed; Fig. 4, a like view of the rear plate and certain attachments of the clock, together with two gear-wheels operated by the meter, the back part of the casing of the clock being removed; Fig. 5, an enlarged plan view of the meter, clock, air-governor, gas-governor, and an electro-magnet, connected together and fixed upon a section of the bench or supporting-frame of the photometer; Fig. 6, a sectional edge view of the upper portion of the clock, showing the devices for stopping the latter; Fig. 7, an enlarged vertical central section of the air-governor closed; and Fig. 8, a like section of the gas-governor open.

Referring to Fig. 1, A A A is the bench or supporting-frame of the photometer; B, the clock; C, the gas-meter; D, the pressure-regulator of the gas; E, the pressure-indicator; F, the gas-governor; G, the air-governor; H, the electro-magnet for operating the governors F and G; I, the air-forcer; K, the candle-balance; L, the gas-burner; M, the scale-bar; and N, the sight box thereon.

The several devices B C D E F G H K L M are fixed securely upon the bench A, substantially in the relation to each other shown in Fig. 1, the current of gas being effected through a series of intercommunicating pipes beneath the said bench, and the current of air through the valve G to the candle on the balance K by a special pipe leading from the forcer I, which rests upon the floor. The meter C supports the clock B, and communicates with its two index-hands c' and c'' through crown-wheel c''' on the meter-shaft, which gears into a spur-wheel, q', (see Fig. 4,) the shaft of which latter passes through plate Q, and carries another spur-wheel, 1, that gives motion to a series of wheels on plate O, (see Fig. 3,) two of which, 3 and 4, move the said index-hands c' c'', respectively, of the meter, and a wheel on 4 gives motion to a spur-wheel, 5, to the one side of which latter, and within the circle of its teeth, is secured by friction a vulcanite disk, 6, which has a slender platinum wire, 7, closely attached thereto, and leading from its perimeter toward the center of the disk, and thence through it to metallic wheel 5. A small brass dog, 8, is kept with its nose in contact with the perimeter of the said disk 6 by means of a small spring, 9, and both the dog and spring are insulated from the main plate O by an intermediate layer of vulcanite, 10. A small thread of platinum wire extends from the point of the nose of the said dog 8, and the insulated metallic point upon which the dog turns is connected to one end of the conducting-wire 11, which passes through an insulated hole in the plate O, so that an electric current will pass between the said wire 11 and the metallic wheel 5 only when the platinum wire of the disk 6 is brought into contact with the platinum wire in the nose of the dog 8 by the rotation of the vulcanite wheel 6. The index-hands b' and b'', for time, each receive their motions from the clock B. The shaft which carries the minute-hand b' passes through the shaft which carries the meter-index hand c', and the shaft which carries the minute-counter or index-hand b'', passing through the same plate O, (see Fig. 3,) carries a vulcanite disk, 12, which periodically con-

nects by platinum wire with a dog, 13, essentially in the same manner as just described in reference to disk 6 and dog 8.

The conducting-wire 14, which extends through the plate O, connects with an electro-magnet, P, which is secured to the plate Q of the clock, (see Figs. 4 and 6,) and the armature of the said magnet is fixed to the side of a lever, 16, the longer arm of which is branched and bent so as to bring the two branches 17 and 18 directly opposite to the rim of the balance-wheel 20 of the clock B, and so arranged that, when the armature of the magnet is in contact with the wire-coil cylinders thereof, the ends of the branches 17 and 18 of the lever 16 will just sufficiently touch the rim of the said balance-wheel 20 to arrest its motion, and when the armature is released from the wire-coil cylinders the action of a spiral spring, 21, which is attached to the shorter arm of the lever, instantly releases the balance-wheel from the contact of the said lever by throwing and holding the longer arm of the latter back against a stop-screw, 22, which can be readily adjusted so as to keep the branches of said lever P just sufficiently out of contact with said balance-wheel, to allow free motions to the latter. On the face of the clock B there is also a small index-hand, and scale e^4, (see Fig. 2,) the former of which is connected by its shaft to the vulcanite disk 6, (see Fig. 3,) whereby the operator can move the said vulcanite disk around freely to any position he may desire. Near the top of the clock-case there is also a small independent stop-lever, 23, which connects with the lever 16, (see Fig. 6,) and enables the operator to readily stop the clock at any time. The electro-magnet H (see Figs. 1 and 5) is fixed between the two governor-valves F and G, and is connected by a wire directly with the battery, (not shown.) Across the armature there is fixed a catch-bar, h', which alternately holds and releases the connecting ends of two horizontal levers, f' and g', of the first class, the fulcrum of f' being a post, f'', and the fulcrum of g' being a post, g''. The connecting ends of the said levers are secured together in a lapping manner by a slot in one and a headed screw in the other, so as to allow the one to slide upon the other without becoming disconnected when they are being moved into or out of alignment. These levers are supported upon their respective posts f'' g'', so as to remain in the same horizontal plane with the top of the catch-notch in the cross-bar h' when the armature of the magnet H is in contact with the coil-cylinders, and with the bottom of said catch-notch when the said armature is out of contact with the said coil-cylinders of the magnet. Around the post g'' there is a spiral-coil spring, the lower end of which is fixed to the foot of the post, and the upper end to the lever g', so as to constantly tend to throw the lever g' and, consequently, the lever f' also, out of alignment, as indicated by the dotted lines in Fig. 5, when the catch-notch in the bar h' is brought down by the descent of the armature of the electro-magnet H. The two governors F and G are alike in construction, as shown in Figs. 7 and 8, but are operated differently. The stem of the gas-governor F has a notch in its side, into which the short end of the lever f' is slipped to hold it down, and thus keep the valve of the said governor open for the passage of the gas through its ports as it comes from the supply-pipes. The valve of the air-governor G is kept closed by the pressure of the air from the forcer I until by the descent of the armature of the electro-magnet H, which releases a weighted lever, g''', and the weight g^4 thereof in its descent knocks the valve open, and lets a puff of air from the forcer I escape through the pipe g^5 to the candle-flame, and instantly extinguishes or "blows out" the latter, and immediately afterward the pressure of the air in the forcer I closes the valve again. To better prevent the continuous passage of any air through the pipe immediately after the puff, a small ball-valve in the upper end of the pipe g^5 will serve the purpose. To return the levers f' and g' to their normal condition in relation to the two governors for a subsequent test operation, the operator will find it convenient if he place his little finger on the valve-stem of governor F, and his thumb upon the inner end of lever g''', and pressing them downward slip the ends of the short arms of the two levers f' g', respectively, into connection with the same, as before, thus again closing the air-governor and opening the gas-governor. The gas passes from the left-hand foot of the bench A into the pipes which are beneath the latter, and in communication with both the pressure-regulator D and pressure-indicator E, as well as with the governor-valve F and meter C to the gas-burner L. (See Fig. 1.)

The balance K is an unequal-armed lever of the first class, supported by its fulcrums in its bearings on the top of a post, k', which is fixed to rest upon the left-hand end of the graduated scale-bar M. (See Fig. 1.) The shorter arm of the balance-lever supports a candle, R, in a socket, k'', from which is suspended a small dished plate for balancing the lever.

Either the top edge or the face side of the longer arm of the lever is accurately divided into equal spaces, indicating grains, and there is a sliding pointer, 23, which travels on a round wire rod, the ends of which are fixed so as to hold the rod securely above and parallel with the upper edge of the lever; and below said lever there is another parallel rod, upon which slides a balancing-weight, 24, on a sleeve which has, near one end, a set-screw, 25, for fixing the same at any part of the bar, and said sleeve is screw-cut with fine threads for a small micrometrical adjusting-nut, 26. Projecting from the end of the longer arm of said lever there is a slender pointed stem, 27, of platinum, which is bent downward at a right angle at a short distance from its pointed end,

so that when the lever of the balance is in equipoise the point will be about a quarter of an inch above the surface of the mercury contained in a small glass cup, 28, which is adjustably supported on a post fixed on the graduated bar M of the photometer. A slender wire of platinum, attached to the inner surface of the cup 28, extends down, through its bottom, into connection with a conducting-wire leading from the clock. A small electro-magnet, 29, is fixed upon the base of the balance, with an insulating-block between; and projecting downward from the balance-lever is a stem, 30, which reaches down, and carries the armature of said magnet, so as to hold it about a quarter of an inch above the same when the balance-lever is in equipoise. One end of the wire of the electro-magnet 29 is fixed to the binding-post 31 on the base of the balance, and the other end of said wire (which may be extended along under the bar M) back to the clock; and, consequently, when the point of the stem 27 comes in contact with the mercury in the cup 28 a circuit will be completed between the clock and the balance K. The sight box N and the graduated-scale bar M are constructed and operated together between the gas and the candle lights, as heretofore. The conducting-wire from the battery connects with the electro-magnet H, and thence extends to, and connects with, the pivot end of a small metallic switch-bar, 32, which is pivoted to a vulcanite plate, 33, fixed upon another insulating-plate of vulcanite attached to the outside upper part of the case of the clock B. In the vulcanite plate 33 there are three separate and independent metallic plugs, *t t' t''*, inserted from one side to the opposite, and so that the free end of the switch-bar 32 may be brought into direct contact with either of said plugs. On the top of the clock B there are also fixed four independent posts, *s s' s'' s'''*, provided with binding-screws for the attachment of respective conducting-wires. The posts extend down, through the shell of the case, to the interior space of the clock, and are insulated from the case by a vulcanite plate fixed thereon, through which they pass, and to which they are all firmly fixed. A conducting-wire connects plug *t* with the upper end of post *s'*, and a like wire connects plug *t'* with the upper end of post *s'*, and another wire connects plug *t''* to the mercury-cup 28 of the balance K, passing from post 31 through electro-magnet 29, while a return-wire from said balance connects it with the upper end of post *s''*, and the lower end of said post is connected by a wire to the plate of the clock. The upper end of post *s'''* is connected by a wire to the battery, while its lower end is connected by another wire to the electro-magnet P within the clock, and from the said magnet, by another wire, to the plate of the clock.

It will therefore be seen that when the swinging end of the said switch-bar 32 is put into contact with either of the plugs *t t' t''* a metallic connection will be produced between the battery-wire and the respective platinum wires in the noses of the dogs 8 and 13, and that at the moment when the platinum wire in either of the vulcanite disks upon which the noses of the said dogs rest is brought, by the rotary motion of the disk, into contact with the platinum nose of the dog, a circuit will be produced between the battery and the several mechanical devices to be affected thereby, and instantly the desired results will be produced—*i. e.*, the candle will be blown out, the gas shut off, and the clock stopped. The current, in all cases, passes through the electro-magnet H'; and if it be desired to test for weight of sperm of candle consumed in any specified time by the clock the switch 32 must be put into contact with plug *t''*; and the instant that the platinum point 27, at the end of the balance-lever, shall be caused, by the combustion of the intended number of grains of sperm, to come down into contact with the mercury in the cup 28, a current will pass from the battery—say, through the electro-magnet H, switch 32, and conducting-wire—to the mercury in the cup 28; thence through the balance-lever and its supporting-post and base to binding-screw 31 and the wire of the electro-magnet 29, (which draws the armature on the end of stem 30 of balance-lever into firm contact therewith, and thus prevents any vibratory motion in the balance-lever, which might disconnect it with the mercury, and thus break the current;) thence, by a conducting-wire, arranged, say, along under the wooden graduated bar M, and through post *s''*, to plate of clock Q; thence by a short wire to electro-magnet P, and from said magnet P to post *s'''*, and then to battery.

If it be desired to test for time, the said switch 32 must be put in contact with the middle plug *t'* of the insulated plate 33; a metallic connection will be produced between the battery—say, through the electro-magnet H, switch 32, to post *s'*; thence, by a wire, to dog 13; and the instant that the platinum wire in the vulcanite disk 12 is brought by the motion of the clock into contact with the nose of the said dog a current will be produced between the battery and the clock, whereby the armature of the electro-magnet P will instantly move the lever 16, so that its arms 17 18 will come into contact with the rim of the balance-wheel 20, and instantly arrest the motion of the clock, the current returning to battery.

If it be desired to test for gas, the said switch 32 must be put in contact with the plug *t*, and thus a metallic connection will be produced to post *s*; thence, by a wire, to the dog 8; and the instant that the platinum wire in the vulcanite disk 6 is brought by the motion of the meter into contact with the nose of said dog a current will be produced between the battery and the gas-valve, and the latter closed.

In proceeding to test the quality of any illuminating-gas, by this photometer, the operator aligns the two levers *f'* and *g'*, (see Fig. 5,) by placing their connected ends in the notch

of the catch-bar h' on the armature of the electro-magnet H, and at the same time connects the opposite end of one lever, g', with the weight-lever g''' of the air-governor G, and the opposite end of lever f' with the notch in the stem of the gas-governor valve F, thus holding the air-valve closed and the gas-valve open, whereby he admits the gas from the meter. The sperm candle is then adjusted in the socket of the balance-lever, and the lever brought into exact horizontal equipoise by means of the movable adjusting devices 24 25 26, the movable pointer 23 being at zero. He then adjusts the top of the candle to correspond in height with the height of the gas-burner L, and also adjusts the outlet of the air-pipe g^5 to such a height, or as near as may be, as will be directly opposite to the flame of the candle when it shall have been burning the intended length of time. He now adjusts the two small pointers on the face of the clock (which, respectively, connect with the two vulcanite disks 6 and 12, and indicate, by their points, the position of the respective platinum wires in the perimeters of the said disks,) at a position indicating that they have just passed the platinum points in the respective noses of the dogs, and places the indicator 23 of the balance-lever to the number which will indicate the number of grains of the candle intended to be consumed in a given time—say, ten minutes by the clock. At the moment when the number of grains of the test-candle have been consumed, the point of the platinum stem 27, at the end of the balance-lever, comes into contact with the mercury in the cup 28, and instantly establishes a current which, passing through the three electro-magnets H, P, and 29, instantly and simultaneously shuts off the gas, blows out the flame of the candle, closes the air-valve, and holds the balance-lever firmly down in connection with the mercury in the cup.

The operator, through the above-described means, is enabled to arrive at the exact quantity of the gas, and of the candle consumed, by noting, in the first case, the change in position of the gas-pointers from that of their positions at commencement, and, in the second case, by placing the balance-lever in equipoise by moving the pointer-weight 23 from zero, and noting the number of grains indicated thereby on the scale. If a test for quantity of gas consumed be desired—say, in ten minutes—he changes the switch to gas, balances the candle, places the dog-indicator c^4 at zero, notes the clock-time, and when said dog-indicator has made one complete revolution (which indicates ten-twelfths of a cubic foot—the standard for ten minutes' consumption—) the same results follow as in the former test, *i. e.*, the cessation of all the movements in the photometer. The sight box N and the scale M, shown between the candle and the gas-jet, being long in use and well known, the construction and operation of the same need not be given.

I claim as my invention—

1. The combination, with a photometer, of a battery, conducting-wires, and electro-magnets, substantially as described, for the purpose of instantly and simultaneously arresting the operation of every part of the said photometer in testing the quality of the gas.

2. The combination in a photometer, substantially as described, of the electro-magnet 29 with the balance K, for the purpose described.

3. The combination of the mercury-cup 28, platinum-point 27, balance-lever K, electro-magnet H, and conducting-wires, with the air-puffing apparatus, substantially as and for the purposes set forth.

4. The combination, in a photometer, substantially as described, of the electro-magnet H and the catch-bar h' on the armature, with the levers f' and g', for the purposes set forth and described.

5. The combination, consisting of the valve G, weight g'', and levers g' and g''', liberated by the descent of the armature of the electro-magnet H, substantially as set forth, for the purpose of extinguishing the flame of the candle R by liberating a puff of air from the reservoir I, as described.

6. The combination of the notched stem f''' with the gas-valve F, arranged in combination with the lever f' and electro-magnet H, substantially as and for the purpose described.

7. The combination in a photometer, substantially as described, of the dog 13 and the vulcanite disk 12, with the lever 16, operated by the armature of the electro-magnet P, as set forth, for the purpose of arresting the motion of the balance-wheel 20 of the clock, as described.

8. The combination in a photometer, substantially as described, of the vulcanite disk 6 and dog 8 with the meter-gear and battery, for the purpose of arresting the motion of said meter, as set forth.

9. The combination in a photometer, substantially as described, of the stationary posts s s' s'' s''', and their respective conducting-wires, with the insulated posts t t' t'' and switch 32, for the purpose of changing the direction of the electric current, as described.

10. The combination in a photometer, substantially as described, of the electro-magnetic coils 29 with the return-wire from the balance K, for the purpose of retaining the contact of the platinum-point 27 of the balance with the mercury in the cup 28, as described.

11. In combination with a Bunsen photometer, substantially as described, the connecting-wires or their equivalent mechanical devices, whereby the instant and simultaneous extinguishment of the candle-flame and arrest of all the moving parts of the photometer are produced.

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