

UNITED STATES PATENT OFFICE.

WILLIAM W. GOODWIN, OF CAMDEN, NEW JERSEY.

IMPROVEMENT IN ELECTRICAL PHOTOMETER-BALANCES.

Specification forming part of Letters Patent No. **158,636**, dated January 12, 1875; application filed August 21, 1874.

To all whom it may concern:

Be it known that I, WILLIAM W. GOODWIN, of Camden, in the county of Camden and State of New Jersey, have invented an Improved Balance, of which the following is a specification:

The object of my invention is to produce a more readily adjustable and accurate balance for determining the number of grains of the sperm of a candle consumed in a given time, in testing the quality of any illuminating-gas by a photometer, and especially when the said photometer is in connection with an electric battery.

The peculiarities of my invention will be readily understood by the following description, with reference to the accompanying drawings, in which—

Figure 1 is a perspective view of the balance in equipoise, supporting a test-candle, and also attached thereto a mercury-cup, a pair of electric coils of wire, and an armature, whereby the said balance can be made part of a circuit of an electric current at any time, if so desired. Fig. 2 is a vertical central longitudinal section of the adjusting device for bringing the balance-lever, and the candle suspended therefrom, into equipoise.

The lever A, being of the first order, vibrates on its fulcrums and bearings in the usual manner, supported on the post B, while its weight-points support the candle and its pendulous socket D. The said socket is provided with an adjustable ring, *d'*, with the bearings for the weight-points attached, and has also a slot, an inner slide, and a binding-screw, *d'*, whereby the height of the candle C can be readily adjusted to correspond with the height of the usual gas-burner of a photometer. The rimmed or flanged disk *d''*, which is fixed by a stem to the lower end of the socket D, is intended to serve the double purpose of keeping said socket plumb, and at the same time affording a suitable receptacle for shot or other weights, if at any time the lever A, with its attachments, should be too heavy to allow the lever to be brought into equipoise. The said power-arm of the lever is made about three times the length of the weight-arm, and its extreme end passes through a roomy slot, *e'*, in an upright, *e''*, which is fixed

upon the base-plate E of the balance—the post B being fixed to rest upon the opposite end of said base-plate, which latter is insulated and fixed in a horizontal position upon any suitable part of the photometer to which it may be applied, and the long index-pointer *a'* is fixed to the lever A so that its point will coincide with the middle mark of the small scale *a''* on the supports when the lever is horizontal or in equipoise, as shown in Fig. 1.

Each of the two sides of the longer arm of the lever A is divided from 0 to 50 into ten equal spaces, and each space numbered from 0 to 50, inclusive, as shown, and subdivided into twenty equal parts, each indicating a half grain. Above the straight upper edge of the longer arm of said lever, and parallel thereto, is a stiff rod, *a'''*. Supported rigidly by and in posts 4 4 at about half an inch above the straight upper edge of A, and so as to slide freely though accurately on said bar *a'''*, there is secured a small weight, 5, having a thin blade projecting downward therefrom on each side of the lever A, so as to correspond with the grain division-mark thereon beneath said weight 5 at whatever position the said weight may be between 0 and 50, inclusive.

About an inch below the longer arm of A, and parallel with the upper straight edge of the same, there is fixed another rigid bar, 6, by means of two posts, 7 and 8. On this bar 6 a micrometrical adjusting device, F, is placed, consisting of a sleeve, *f'*, which has fine screw-threads cut around on its outer surface, and a traversing weight, *f''*, applied thereon. One end of the sleeve has a head, *f'''*, which is fitted with a small binding-screw, 9, so that the whole device F can be slid along in either direction upon the bar 6, and by means of said screw 9 fixed at any point on the bar between the posts 7 and 8, for the purpose of bringing the lever and its attachments into equipoise.

Directly below the post 8 there is fixed upon the base E a pair of electro-magnets, G, one end of the coil-wire being connected to said base E by the binding-screw *g'*, while the other end of said coil-wire is intended to serve as the return-wire to a battery, (not shown,) while the armature *g''* of the coil-cylinders is

fixed to a projection of the post 8, so as to be at a short distance from the top of the electro-magnets G when the lever A is horizontal, substantially as shown in Fig. 1.

Projecting downward from the under side of the extreme end of the longer arm of lever A, there is fixed a platinum stem, 10, and adjustably secured directly below said stem 10 is a glass mercury-cup, H, having a platinum wire extending down from the inner side of the same, through its bottom, into contact with adjustable supports, and thence into connection with a wire coming from a battery, (not shown;) and this cup H being nearly filled with mercury, a complete electric circuit will be formed between the balance and the battery whenever the platinum stem 10 comes down into contact with the mercury in the cup, the lever A, post B, and base E forming a part of said circuit.

The adjustable weight K, above the line of the bearing-points of the lever A, is fixed by the manufacturer at the proper height to bring the center of gravity of the lever and its fixed appendages at a point a very little below the center of its motion, to produce delicacy in the vibratory motions of the said lever, as is well known to manufacturers of such apparatus.

The mercury-cup and its supports are insulated, in respect to the balance, by means of a layer of vulcanite between the same and its supporting-bracket 11; and the whole balance is insulated upon its support by means of a layer of vulcanite between the latter and the base E of the balance.

The adjustable support for the mercury-cup H consists of a post, I, on the bracket 11, (with a layer of vulcanite, 12, between,) and a post, *i'*, having a stem which enters a socket-hole in the post I, and can be raised, lowered, and turned around, as occasion may require, and can also be fixed at either position by means of a binding-screw, 13. The movable post *i'* carries the mercury-cup H by means of a bent arm, 14, which is attached to said post *i'* by means of a rotary thumb-and-finger stem, 15, which passes horizontally through the said post and screws into connection with the arm 14, and is held in any required fixed position by means of a binding-screw, 16. By means of this adjustable support the mercury-cup H can be readily raised, lowered, or swung around, as occasion may require.

The wire coming from the battery (not shown) enters a hole in the lower part of post I, and is secured therein in the usual manner by a binding-screw, 17, and the posts, arm, and platinum wire through the bottom of the cup, all being made of conducting metal, will form, with the mercury, part of the electric circuit which is to pass from the battery to and through the balance, as will be explained.

In the upper end of the post *e''* there is a sliding stem, 18, the lower end of which is fixed to a cross-bar, 19, which also slides in the opening *e'* above the arm of the lever,

which projects through said opening. The object of this is to hold the lever-arm firmly down after a test has been completed and the mercury-cup withdrawn from the platinum stem 10, a binding-screw, 20, serving to hold the sliding stem 18 down upon the arm of the lever.

The whole balance, including its base E and its connections, except the mercury-cup and the insulating vulcanite layers, is made of conducting metal, so that when the platinum stem 10 comes into contact with the mercury in the cup H an electric current will pass from a battery through the mercury, balance, and the electro-magnet G, back again to said battery.

In testing as to the number of grains of the sperm of a candle that will be consumed in, say, ten minutes' time after the candle has been ignited, the operator places the indicating-weight 5 at 0, moves the mercury-cup aside, ignites the candle, and then slides the adjusting device F along on the bar 6 until the lever A of the balance comes to nearly a horizontal position, and fixes the said device F by means of the binding-screw 9. He now rotates the micrometrical weight *f''* on the screw-cut sleeve *f'*, until the index-pointer *a'* nearly coincides with the middle mark on the scale *a''*, and thus indicates that the lever A is in nearly a horizontal position; then brings the mercury-cup H directly under the platinum stem 10, and adjusts its height so that the surface of the mercury therein will be, say, the twentieth of an inch below the point of stem 10. The candle having assumed its normal burning condition when the index-pointer *a'* coincides with the middle mark of scale *a''*, he slides the weight 5 to 20, starts the clock of the photometer, and the test proceeds to the end of the ten minutes' test.

The wires leading from and to the battery through the balance, it will readily be seen that, at the instant twenty grains of the sperm of the candle C have been consumed, the point of the platinum stem 10 will come into contact with the mercury in the cup H, and an electric current be produced through the balance, and that the said contact will be steadily maintained by the armature *g''*, which has at the same time been brought into contact with the electro-magnetic coil-cylinders G.

It will readily be seen that, if the circuit-wire returning from the balance be put in connection with a valve which will be opened thereby, so as to cause a puff of air to blow out the candle at the instant the platinum stem touches the mercury in the cup H, the exact amount of the sperm of the candle consumed in the ten minutes specified will be accurately known.

The said connection and air-valve arrangement is shown and described in a separate specification and drawings, and will be understood by a reference thereto.

I claim as my invention—

1. The combination, in a balance for pho-

tometers, substantially as described, of the micrometrical adjusting-weight F and the bar 6 with the power-arm of the lever A.

2. The electro-magnet G and the armature-bar *g'*, in combination with the power-arm of the lever A, arranged as described, for the purpose of holding down the lever A, with its

platinum stem 10 in contact with the mercury in the cup H, as set forth.

WILLIAM W. GOODWIN.

Witnesses:

BENJ. MORISON,
WM. H. MORISON.