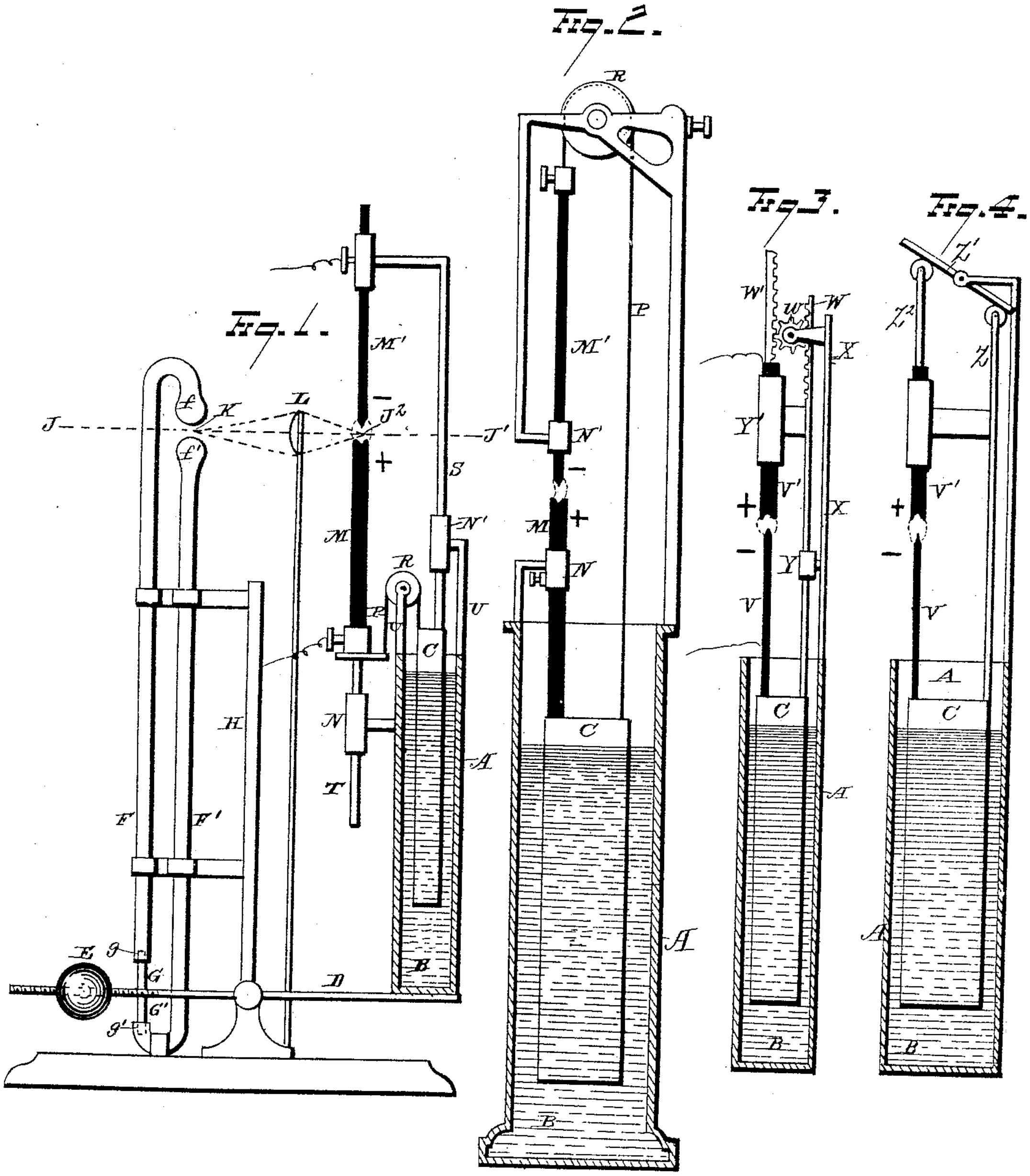
E. J. MOLERA & J. C. CEBRIAN.
Regulator for Electric-Lights.

No. 214,514. Patented April 22, 1879.



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EUSEBIUS J. MOLERA AND JOHN C. CEBRIAN, OF SAN FRANCISCO, CAL.

IMPROVEMENT IN REGULATORS FOR ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. **214,514**, dated April 22, 1879; application filed December 26, 1878.

To all whom it may concern:

Be it known that we, EUSEBIUS J. MOLERA and JOHN C. CEBRIAN, of San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Electric-Light Regulators; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

Our invention relates to electric-light regulators, and is designed to provide such a construction of the same as will be simple and few in the constituent parts thereof, while at the same time it will accurately and quickly adjust the electrodes, so as to maintain the latter at a constant height.

The invention consists, first, in the combination, with a float-regulator which adjusts the electrodes in burning position, of an optical regulator adapted to move the electric lamp in compensation for any change in position of its electric arc; second, in the combination, with a float-regulator capable by means of a single float to adjust the electrodes in burning position, of an optical regulator adapted to move bodily the electric lamp, so as to compensate for any change in location of the center of its electric arc; third, in the combination, with two electrodes located one above the other, of a single float buoyed in liquid and adapted to maintain said electrodes in burning position; fourth, in the combination, with mechanism capable of adjusting the lamp by means of the expansion of suitable substance when subjected to heat, of a lens, or its equivalent, which concentrates light upon said mechanism as the center of the electric arc may vary in its position, the same being adapted to maintain said arc-center at a practically constant point; fifth, in the combination, with a lever adapted to adjust the lamp, and lever-actuating mechanism which operates by means of the expansion of suitable substance when subjected to heat, of a lens, or its equivalent, which converges light upon said mechanism as the center of the electric arc may change its position, thereby causing the lamp to move in compensation for any such arc movement; sixth, in the combination, with a lever which supports an electric lamp on one arm, and mechanism adapted by means of the expansion of suitable substance when subjected to heat to actuate the other arm of the lever, of a lens, or its equivalent, which directs the light of the varying arc-center upon said lever-actuating mechanism, and thereby adjusts the lamp in compensation for the change in position of its electric arc; seventh, in the combination, with a lever which supports an electric lamp on one arm, and adjusting devices, which, by means of the expansion of suitable substances when subjected to heat, actuate the other arm of the lever, respectively, in opposite directions, of a lens, or its equivalent, which directs the light of the varying center of the electric arc, respectively, upon said adjusting devices, the same being adapted to move the lamp in direction opposite, but in degree equal, to the movement of said electric arc; eighth, in the combination, with a horizontally-pivoted lever which supports an electric lamp on one arm, while the other arm is suitably counterbalanced, together with upper and lower pistons and piston-rods which move the latter arm in opposite directions, of independent tubes filled with liquid which expands when subjected to heat, and in the lower extremities of which said pistons and piston-rods have actuating movement, the same being, in connection with a stationary lens, or its equivalent, adapted to focus light from the center of the electric arc as the latter may vary in position, respectively, on the upper or opposite extremities of said tubes.

Referring to the drawings, Figure 1 is a view of one form of float-regulator in combination with a device illustrating the principle of our optical regulator. Figs. 2, 3, and 4 represent different forms of float-regulator.

The vessel A, which contains the liquid B in which the single float C is buoyed, is supported upon one arm of a horizontally-pivoted lever, D, the other arm of which latter is provided with a counterbalancing-weight, E, adjustable thereon. Suitable tubes F F′ are filled with some liquid which is readily expanded by heat, mercury being preferable, the lower extremities thereof having pistons g g' working therein, the piston-rods G G′ of which are adapted to have end bearing, respectively, against the upper and under sides of the counterbalanced arm of the lever, and thereby actuate the latter in its movement. The upper extremities, $f\,f'$, of said tubes are formed bulbed or swelled, and are located at equal distance one above and the other below the horizontal line J J^1, which latter passes through the focus K of the light of the lamp.

Any suitable stand or frame-work H may support the several parts of the device.

It will be observed that when the center J^2 of the electric arc is in the line J J^1, the focus K of the stationary lens or other equivalent device, L, does not touch the swelled heads $f\,f'$ of the respective tubes; but should the light be lowered, for instance, in its point of position, the focus K will rise and strike f, the liquid in tube F will expand, piston-rod G will bear down upon the lever, and the lamp, together with its electric arc, will be raised an equal and corresponding distance, so as to resume its previous location. On the other hand, should the electric arc be moved upward so as to rise above the line J J^1, the focus K would strike f', and then G′ would bear against the under side of the lever, and the lamp, together with its electric arc, would correspondingly be moved downward a distance equal to the previous upward movement of the center of the electric arc.

In substitution for the tubes filled with liquid, as shown, we may use suitable metallic pieces, such as rods or thin strips of metal; but the action of the same would not be as quick as if a proper liquid were employed in tubes.

The pistons or piston-rods may be substituted by elastic bodies, or they may be provided with elastic coverings.

It will be observed that this optical regulator device is adapted to be used in connection with nearly all kinds of other regulating devices.

The several forms of regulator illustrated in the three modification-views of the drawings are intended, respectively, as modifications of the float-regulator in Fig. 1, with which said optical regular is there shown merely by way of example.

Referring now exclusively to the principle involved in all of the four forms of float-regulator represented in the drawings, the construction and operation of the latter are as follows: In both Figs. 1 and 2, A represents the vessel containing the liquid B, in which the single float C is buoyed. The electrodes or electrode-stems have free sliding movement in guides N N′. The cord or other connection, P, passes over the pulley R, and fastens the corresponding electrode to the float, while the other electrode is supported by rigid connection with the same float.

In Fig. 1 an arm, S, rigidly connects M′ to C, while rod T insures a constant guide through N as M is rising.

u are suitable supports.

In describing the operation of the regulator, it should be remembered that the positive electrode is consumed twice as fast as the negative one. For the sake of illustration, we presume that the electrodes in this instance are of equal length, but of such relative transverse sectional dimensions that they both will burn equal lengths of their respective dimensions in the same time.

In Fig. 2, it will be observed that the weight of the negative electrode M′, which latter is on the left side of R, must counterbalance the weight on the right side of the same, said latter weight consisting of the weight of M plus the weight of C minus the weight of the liquid displaced by the said float.

As the electrodes burn, the left side of the pulley loses a certain weight, while the right side loses twice that weight; therefore the equilibrium will be lost, and the system M P M′ will be set in motion toward M′, which is becoming the heavier side. By that motion the float will begin to rise and the electrodes to get nearer; as the float rises the buoyancy will decrease, and said right side will get heavier until the equilibrium be re-established. This will happen when this right side has gained a weight equal to the difference of the weights lost by M and M′, this difference being equal to the weight lost by M′. Now, if the float is such that the weight of the liquid displaced by any length of it be equal to the weight of an equal length of the negative electrode, it is evident that said right side will have gained said difference of weight as soon as the float has risen a distance equal to the length burned away by M′, or as soon as M′ has fallen a distance equal to the length lost; and as M loses an equal length in the same time, and rises together with C, the consequence is that while the lamp burns and the electrodes are in motion, their burning-points will remain constantly at the same height and at the same distance apart.

Fig. 1 shows a different disposition. In Fig. 2 the negative electrode is suspended from the pulley; and in Fig. 1 the negative electrode is solidly attached to the float, and the positive electrode is suspended from the pulley. In this case the positive electrode M, on the left side of pulley R, must balance the weights of the negative electrode M′ and the float less its buoyancy, which are on the right side of R. As soon as the burning away begins, the left side loses twice the weight lost by the right side, the left side becomes lighter than the other, and the motion will commence toward C, which will cause the float to sink down and the electrodes to get nearer together. This motion will cause the right side to get lighter, and it will continue until the float displaces an additional volume of liquid, the weight of which equals the difference of weights lost by M and M′—that is, the weight lost by M′. Therefore, if the float in this case is made as in Fig. 2, the float will always be sinking down distances equal to the length burned away by M or M′, and therefore the burning-points of M and M′ will be constantly kept at the same height and at the same distance apart, as in Fig. 2.

If in both figures we take into account the small friction of R, the volume of C has to be slightly modified, so as to enable the buoyancy to overcome said friction also. If the electrodes are not made so as to burn equal lengths in the same time, neither the conditions of equilibrium nor the direction of the motions of M C M′ in Figs. 1 and 2 will change; but in order to make the regulator operative, it will be necessary that the two electrodes travel at two different speeds, whose relation will be known. This will be easily attained, substituting two proper blocks of pulleys for pulley R, the construction of which blocks will be determined by the above-mentioned known relation.

In Figs. 3 and 4 we represent instances wherein the positive electrode is on top and the negative one below, whereas in Figs. 1 and 2 the reverse holds true. In Fig. 3, A is the vessel containing the liquid B. V is the negative electrode, supported by the float C, which carries an upright rack, W. This rack acts upon the toothed wheel *w*, which is supported by X, or otherwise, as long as its axis is stationary. Said wheel transmits its motion to the rack W′, parallel to and rigidly connected to electrode V′. Thus, when the rack W rises a certain distance the rack W′ will fall an equal distance. V′ or its stem must run in a groove, collar, or guide of any kind, with a friction such that it will not fall down, and that a very small strain on wheel *w* will move W′ V′.

Proper guides, Y Y′, and supports may, of course, be inserted, so as to steady effectively the apparatus.

Let us also suppose, as premised in Figs. 1 and 2, that the electrodes are such that they will burn away equal lengths in the same time. When the electrodes begin to burn, C will be subjected to an upward force equal to the weight lost at V; but at the same time, as it has to perform some work in moving *w*, it will be also subjected to a downward pressure represented by said work, and which can easily be estimated, and be represented by a second weight. Therefore the float will be subjected to an upward force represented by the difference of said two weights. Then, if the float is such that the weight of the liquid displaced by a certain length of it be equal to the difference of the weight of an equal length of V and the corresponding second weight above mentioned, it is evident that every time V burns away a certain length the float will rise that same distance, and consequently the burning ends of V and V′ will be kept constantly at the same distance apart, the same as in Figs. 1 and 2.

We may substitute for the wheel *w* of Fig. 3 a lever, having its fulcrum where the axis of *w* is, as shown in Fig. 4, in which the rack W of Fig. 3 is substituted by a simple rod, (represented by letter Z,) which lifts the right arm of the lever Z^1, the left arm of which will be pushing the rod Z^2 downward. The operativeness and results of the device shown in Fig. 4 will be like that of Fig. 3. In both figures we may also reverse the positions of the electrodes, which cannot be done in Figs. 1 and 2. The upper ends of Z and Z^2 in Fig. 4 may be of any convenient shape. They are represented as having little rollers, so as to make the operation free from friction. If, in Fig. 3, we insert two or more wheels, with or without pinions, between W and W′, or if, in Fig. 4, we change the relative distances from Z and Z^2 to the fulcrum of Z^1, we will obtain different speeds for V and V′, and in any proportion required. This will be necessary when the electrodes are such that they do not burn equal lengths at the same time.

The different parts of our regulators may all be made of good conductors or bad conductors of electricity; but care should be taken to have the two electrodes properly isolated from each other, so that the current cannot pass except between their free ends.

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

1. The combination, with a float-regulator which adjusts the electrodes in burning position, of an optical regulator adapted to move the electric lamp in compensation for any change in position of its electric arc, substantially as set forth.

2. The combination, with a float-regulator, capable by means of a single float to adjust the electrodes in burning position, of an optical regulator adapted to move bodily the electric lamp, so as to compensate for any change in location of the center of its electric arc, substantially as set forth.

3. In an electric-light regulator, the combination, with two electrodes located one above the other, of a single float buoyed in liquid, and adapted to maintain said electrodes in burning position, substantially as set forth.

4. An optical electric-light regulator, consisting essentially in the combination, with mechanism capable of adjusting the lamp by means of the expansion of suitable substances when subjected to heat, of a lens, or its equivalent, which concentrates light upon said mechanism as the center of the electric arc may vary in its position, the same being adapted to maintain said arc-center at a practically constant point, substantially as set forth.

5. In an optical electric-light regulator, the combination, with a lever adapted to adjust the lamp, and lever-actuating mechanism which operates by means of the expansion of

suitable substance when subjected to heat, of a lens, or its equivalent, which converges light upon said mechanism as the center of the electric arc may change its position, thereby causing the lamp to move in compensation for any such arc movement, substantially as set forth.

6. In an optical electric-light regulator, the combination, with a lever which supports an electric lamp on one arm, and mechanism adapted by means of the expansion of suitable substance when subjected to heat to actuate the other arm of the lever, of a lens, or its equivalent, which directs the light of the varying arc-center upon said lever-actuating mechanism, and thereby adjusts the lamp in compensation for the change in position of its electric arc, substantially as set forth.

7. In an optical electric-light regulator, the combination, with a lever which supports an electric-lamp on one arm, and adjusting devices which, by means of the expansion of suitable substances when subjected to heat, actuate the other arm of the lever, respectively, in opposite directions, of a lens, or its equivalent, which directs the light of the varying center of the electric arc, respectively, upon said adjusting devices, the same being adapted to move the lamp in direction opposite, but in degree equal, to the movement of said electric arc, substantially as set forth.

8. The combination, with a horizontally-pivoted lever, which supports an electric lamp on one arm, while the other arm is suitably counterbalanced, together with upper and lower pistons and piston-rods which move the latter arm in opposite directions, of independent tubes filled with liquid which expands when subjected to heat, and in the lower extremities of which said pistons and piston-rods have actuating movement, the same being, in connection with a stationary lens, or its equivalent, adapted to focus light from the center of the electric arc as the latter may vary in position, respectively, on the upper or opposite extremities of said tubes, substantially as set forth.

In testimony that we claim the foregoing, we have hereunto set our hands this 9th day of December, 1878.

EUSEBIUS J. MOLERA.
JOHN C. CEBRIAN.

Witnesses:
F. O. WEGENER,
THOMAS D. GRAHAM.