

(No Model.)

2 Sheets—Sheet 1.

H. D. BURNETT & S. E. DOANE.
APPARATUS FOR TREATING FILAMENTS FOR INCANDESCENT
ELECTRIC LAMPS.

No. 508,678.

Patented Nov. 14, 1893.

FIG. 1.

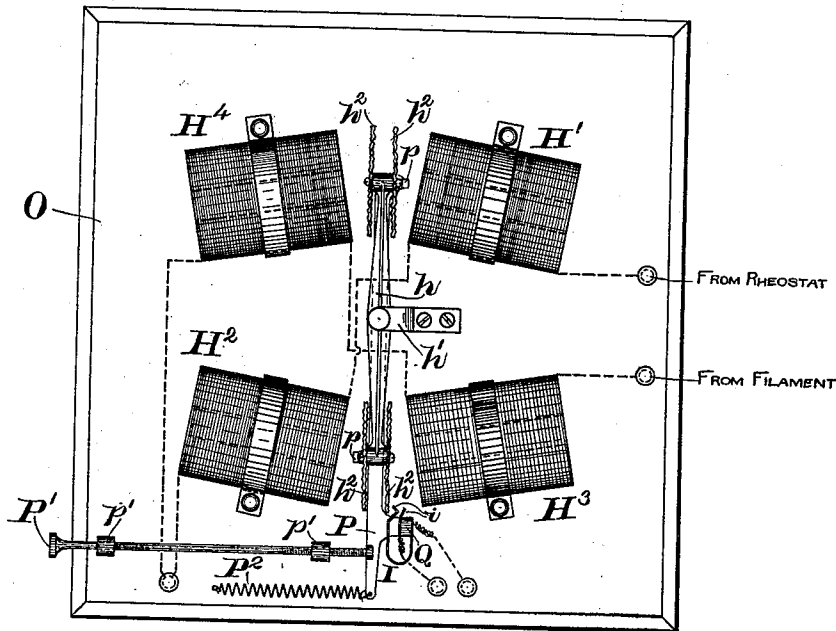


FIG. 2.

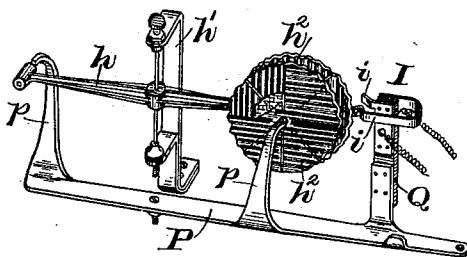


FIG. 3. h^2

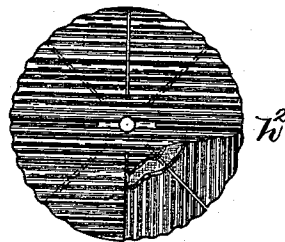


FIG. 4.

WITNESSES.

Henry D. Burnett
John W. Libbey

INVENTORS

Henry D. Burnett
and Samuel E. Doane,
By Bentley & Blodgett
Attys.

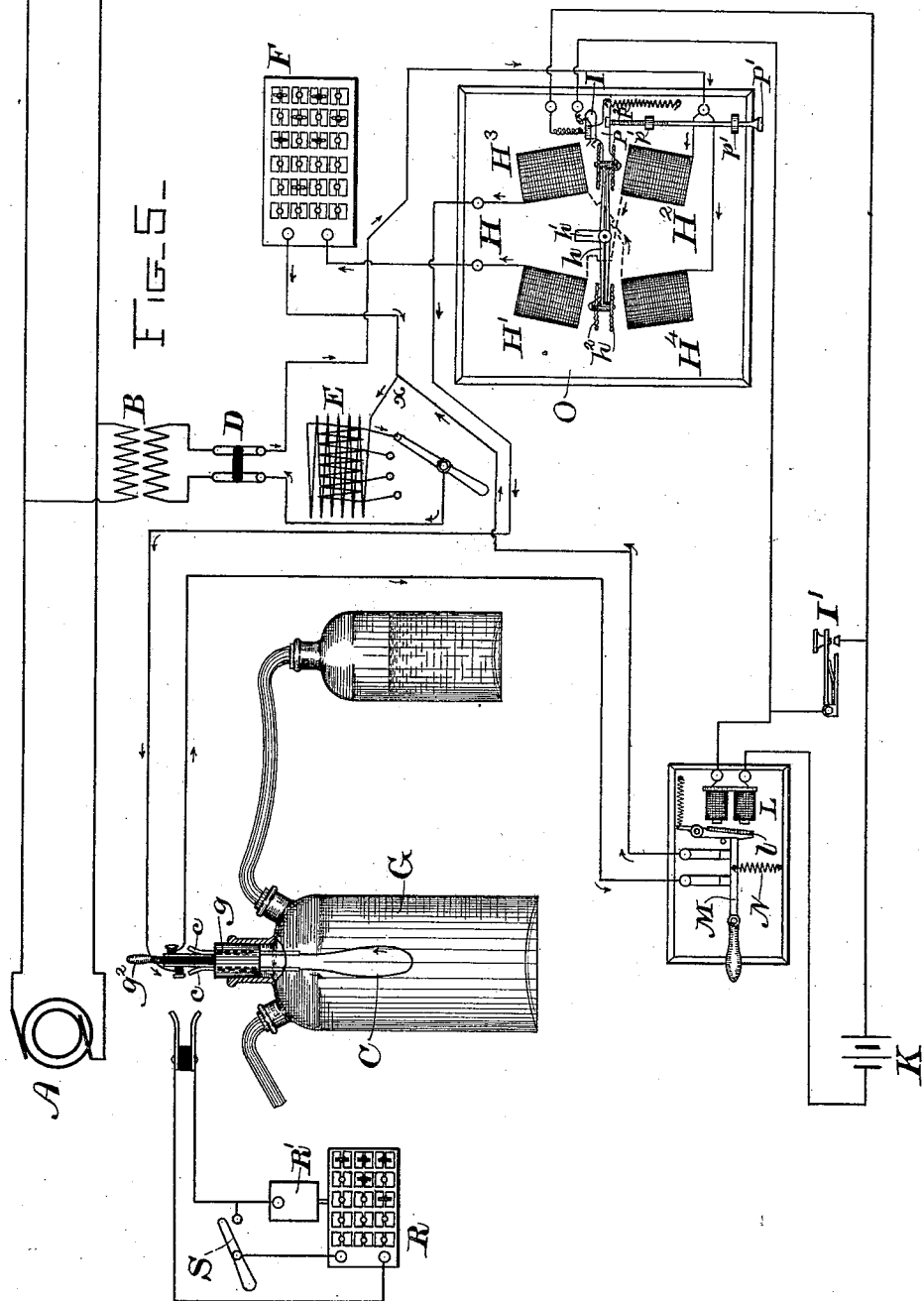
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WITNESSES.

Henry Westendorp
John W. Gibbons

五五五

INVENTORS

Henry D. Burnett,
and Samuel E. Doane,
By Bentley Woodgett,
Atty.

UNITED STATES PATENT OFFICE.

HENRY D. BURNETT, OF LYNN, AND SAMUEL E. DOANE, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNORS TO THE GENERAL ELECTRIC COMPANY, OF NEW YORK.

APPARATUS FOR TREATING FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS.

SPECIFICATION forming part of Letters Patent No. 508,678, dated November 14, 1893.

Application filed August 23, 1893. Serial No. 483,795. (No model.)

To all whom it may concern:

Be it known that we, HENRY D. BURNETT, residing at Lynn, and SAMUEL E. DOANE, residing at Swampscott, in the county of Essex and State of Massachusetts, citizens of the United States, have invented certain new and useful Improvements in Apparatus for Treating Filaments for Incandescent Electric Lamps, of which the following is a specification.

Our invention relates to the manufacture of filaments for incandescent electric lamps, and its object is to produce large quantities of filaments all having the same electrical resistances.

In the process of depositing carbon upon incandescent electric lamp filaments by electrically heating them in a hydrocarbon fluid, it is necessary that the deposit be stopped at a certain point, in order that the potential necessary to bring each finished lamp to a given candle power, may be the same with all the lamps. There are practically two methods in use at the present time, one being known as the hot resistance method, and the other as the cold resistance method. We regard the former as preferable, since the hot resistance is the important factor in determining the voltage to which the finished lamp will run, and furthermore, the ratio between the hot and the cold resistance of different lamps is not the same, although they may have been made by similar methods, from the same material, and of the same size.

In carrying out the hot resistance method, two ways may be followed. The current may be kept at a constant potential, cutting off when a certain current strength is reached; or it may be kept at a constant strength, cutting off when it reaches a certain potential. The former method is the one most generally used, and the operation of the apparatus has been controlled by automatically opening the circuit when the resistance of the filament has reached a given point. Variations in the potential or the current have been avoided by placing the filament and the standard or fixed resistance in parallel circuits, and including the circuit controller in both circuits, so that its action is due to the balancing or

overbalancing of the currents in the two branches.

The apparatus which we have invented is designed to carry out this latter process, and it consists in certain details of construction and arrangement as hereinafter set forth and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a plan view of our circuit controller. Fig. 2 is a perspective view of the armature thereof and its connections. Fig. 3 is an edge view of an armature disk. Fig. 4 is a side elevation of the same. Fig. 5 is a diagram of the circuits, and Fig. 6 is a diagram of a testing circuit.

Let A represent a generator of alternating electric currents, feeding a transformer B, the secondary of which is connected in a closed circuit with the filament C to be treated. A double pole switch D controls this circuit. The current from the secondary flows through a rheostat E to the point *x* where it divides, one branch leading to a rheostat F and the other to the filament C. The filament is shown as connected with contacts *c* on an insulating stopper *g*, which closes the mouth of the jar G containing a hydrocarbon fluid. The terminals of the line are on a plug *g*² which is adapted to enter between the contacts *c*. The branch circuit containing the rheostat F also includes one or more helices or coils of a circuit controller H, which has other coils opposed thereto, and in circuit with the filament C. The armature of this circuit controller is arranged to close a switch I controlling a circuit from a battery K through an electromagnet L, which, when energized attracts the armature, *l*, and releases the switch lever M. A spring N pulls the switch open and thereby opens the branch circuit containing the filament. A key *I*¹ enables the battery circuit to be closed at will when desired. By reason of the opposing attraction of the coils of the circuit closer, the movement of its armature depends not upon an absolute current strength, but upon a given ratio of current strength in the two branch circuits containing the opposing coils; while the resistance to which the filament is treated depends upon the ratio between the

current and the potential, since the armature is adjusted to move when the resistance of the filament circuit has been reduced to a predetermined point, irrespective of the absolute current strength in the system. In other words, the only absolute element is the resistance F , to which the resistance of the filament must have a certain ratio in order to permit a sufficient flow of current in the filament circuit to render the magnetic field of the filament circuit coils strong enough to overbalance the field of the opposing coils and this ratio of magnetizing effect is independent of any absolute current strength or potential. In order to limit the increase of current which flows through the filament as its resistance decreases when undergoing treatment, the rheostat E is placed in series with the two branch circuits. For the best condition of working the current flowing through the filament must not be allowed to increase proportionately to its decreasing resistance, and the function of the rheostat E is to oppose more and more the flow of current as it tends to increase, due to the decrease of resistance in the filament undergoing treatment. But to obtain a reasonably rapid deposition of carbon upon the filament it is necessary that it should have a rather high temperature during treatment. If the potential is sufficient at the start to raise the filament to incandescence and no resistance is in circuit the filament is very liable to be destroyed, owing to the enormous increase of current as the resistance falls. If the potential at the start is sufficient to raise the filament to incandescence, with no resistance in circuit, and the potential is then gradually automatically reduced during the treatment of the filament it will be required to employ mechanically moving parts somewhat difficult of regulation. A rheostat used in the manner described, and properly adjusted in amount to the kind of filament undergoing treatment, so limits the current flow that the temperature of the filament is maintained at that degree of heat which is proper for the treatment, and it acts to prevent an abnormal change of temperature. This rheostat E is placed in the common circuit leading through the filament and the rheostat F in order that any change may correspondingly affect both circuits. The increase of current in the filament following the decrease in its resistance depends upon the relative adjustment of the rheostats E and F , these being relatively adjusted in accordance with the character of filament to be treated. Thus, in the case of high resistance filaments, the rheostat F will be high relative to that of E and in the case of coarse filaments, such as used in series incandescent lamps, or low voltage lamps, the rheostats E and F would both be lowered in value and their relative difference be less than in the former case.

It is of course understood that a device having self-induction may be used in place of a

rheostat, providing alternating currents are used. It is preferable, however, to in all cases use non-inductive resistance, which will make the apparatus adaptable for either direct, alternating or pulsating currents.

Our improved circuit controller is shown in Figs. 1, 2, 3 and 4. It has a slate base O , on which are mounted the coils H' , H^2 , H^3 , H^4 , the first two being in the rheostat circuit and the other two in the filament circuit. The coils are made up of copper wire, the size of which depends upon the general class of lamps for which they are designed. Wire .025 of an inch in diameter has been found about right for one hundred to one hundred and ten volt sixteen candle power lamps. Between the coils mounted as shown, is an armature composed of a supporting beam h pivoted, preferably on jeweled bearings in a double armed bracket h' . At each end of the beam is a pair of iron disks h^2 , each disk being directly opposite to one of the four coils. The disks are each composed of two plates of thin soft iron corrugated as shown, and placed with the corrugations at right angles. In each disk are four radial saw-cuts, extending preferably nearly to the center, and spaced about ninety degrees apart. The cuts are so arranged that when the two plates are put together, the cuts in one stand about midway of the cuts in the other. The plates are well shellacked on the sides which face each other, and after being screwed or otherwise fastened together, they are baked, which hardens this shellac and secures the plates strongly to each other. The cuts prevent eddy currents, and the whole structure is very rigid and light.

Pivoted concentrically with and preferably below the beam h is a bar P , at each end of which is an arm p extending upwardly into the path of movement of the disks h^2 , one arm one side and the other on the other side. These arms serve as stops to limit the movement of the beam h toward the coils in the rheostat circuit. A screw P' working in nuts p' on the base O engages with the bar P , and serves to adjust the position of the stops. A spring P^2 may be used to keep the bar pressed against the end of the screw.

Fastened to an upright on the bar is a piece of insulation Q to each side of which are attached the metallic terminals i , one of which is yielding so as to be brought in contact with the other terminal and close the battery circuit, when struck by the armature.

In order to adjust the system to a standard, we provide a rheostat R , which is set at the amount of resistance which the hot filament should have when fully treated. A small auxiliary rheostat R' is connected with the rheostat R , and is shunted by a switch S . The rheostat R' represents the greatest allowable variation in the resistance of the finished filament, say one half an ohm.

The rheostats E , F , are roughly adjusted with reference to each other for the given

filament. The rheostat R is now connected into the filament circuit, the switch S being closed to cut out the small rheostat R'. The stops *p* are now adjusted by means of the screw P' until the armature lever *h* is attracted by the filament circuit coils H³, H⁴, closing the battery circuit and breaking the filament circuit, as before described. As the armature approaches these coils its motion is accelerated, owing to the increasing strength of the field, the effect being to give the armature a quick decided movement. The switch S is now opened, thus interposing the auxiliary rheostat R' in series with rheostat R. The switch M is now closed again, and if the armature *h* now closes the switch I, the stops *p* must be further adjusted until the operation of the armature will not take place with the auxiliary rheostat in circuit.

It is obvious that instead of having the resistance of the rheostat R exactly that of the finished filament, it can be made less or greater and the windings of one or more of the coils changed so that their magnetic effect is varied accordingly.

Having thus described our invention, what we claim, and wish to protect by Letters Patent of the United States, is—

1. The combination with a suitable source of current, of two parallel circuits, one containing a known resistance and the other a lamp filament surrounded with a hydrocarbon fluid, a circuit controller having opposing coils included respectively in the two circuits, and a non-inductive resistance in series with both circuits, substantially as described.

2. The combination with a suitable source of current, of two parallel circuits one containing a known resistance, and the other a lamp filament and a switch, an electromagnet adapted to operate said switch, a battery in circuit with said magnet, and a device controlling the battery circuit and having opposing coils included respectively in the two parallel circuits, substantially as described.

3. A circuit controller responsive to the change in the ratio of current strength in two parallel circuits, consisting of opposing coils included respectively in said circuits, and an armature free to vibrate between them, comprising corrugated sheet iron disks, substantially as described.

4. The combination with the opposing coils of an armature comprising a beam carrying at each end two parallel disks of corrugated sheet iron, substantially as described.

5. The combination with the opposing coils, of an armature comprising a beam carrying at each end a disk of soft iron composed of two corrugated plates, placed with the corrugations at right angles, substantially as described.

6. The combination with the opposing coils, of an armature comprising a beam carrying at each end a disk of soft iron, composed of

two corrugated plates each containing radial saw cuts, substantially as described.

7. The combination with the opposing coils, of an armature comprising a beam carrying at each end a disk, composed of two corrugated iron plates, secured together by baked shellac, substantially as described.

8. In a circuit controller, the combination with the pivoted armature, of a bar pivoted concentrically therewith and provided with arms extending on both sides of the armature, and means for adjusting said bar, substantially as described.

9. In a circuit controller, the combination with the pivoted armature, of a bar pivoted concentrically therewith and provided with an arm at each end extending into the path of movement of the armature, and a screw for moving said bar, substantially as described.

10. In a circuit controller, the combination with a pivoted armature, of a bar pivoted concentrically therewith and having arms serving as stops to limit the movement of said armature, and an upright on said bar carrying contacts adapted to be closed by said armature, substantially as described.

11. The combination with a system of parallel circuits for treating the filament for an incandescent lamp, of means for standardizing the system, comprising a rheostat to be substituted for the filament, and an auxiliary rheostat adapted to be included in series with the other rheostat, said second rheostat having a resistance equal to the allowable variation in the resistance of the finished filament, substantially as described.

12. The combination in an apparatus for the automatic treatment of incandescent lamp filaments to bring them to a definite resistance, of a divided circuit one branch of which includes the filament to be treated and the other a selected resistance, a resistance, or its equivalent, in a circuit common to both branch circuits, and a cut-out apparatus for stopping the treatment controlled by the relative flow of current in the branches of said divided circuit.

13. The combination with a suitable source of current, of a divided circuit one branch of which includes a known resistance and the other the lamp filament and a switch, an electro-magnet adapted to operate said switch, a separate circuit including the coils of said magnet and a current source, and a device controlling said separate circuit responsive to the currents flowing in both branches of said divided circuit, substantially as described.

In witness whereof we have hereunto set our hands this 21st day of August, 1893.

HENRY D. BURNETT.
SAMUEL E. DOANE.

Witnesses:

JOHN W. GIBBONEY,
BENJAMIN B. HULL.