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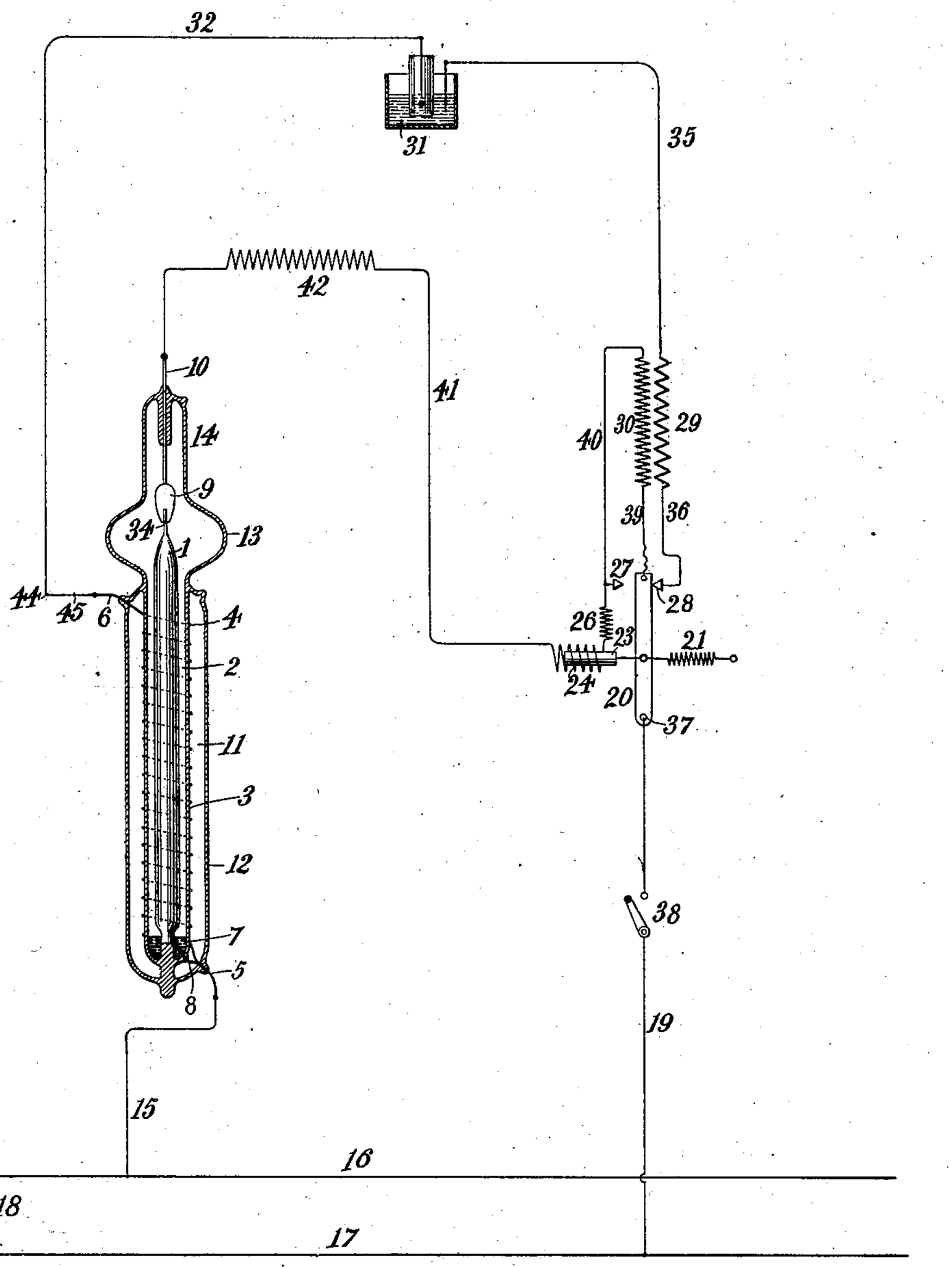
H. N. POTTER.

MERCURY VAPOR LAMP.

(Application filed July 24, 1900.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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MERCURY-VAPOR LAMP.

SPECIFICATION forming part of Letters Patent No. 707,975, dated August 26, 1902.

Application filed July 24, 1900. Serial No. 24,651. (No model.)

To all whom it may concern:

Be it known that I, HENRY NOEL POTTER, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Mercury-Vapor Lamps, of which the following is a specification.

My invention relates to improvements in mercury-vapor lamps, the details of which improvements will be fully described in the specification which follows and more particularly pointed out in the claims. Experience has shown that the efficiency of lamps of this class depends largely on the ratio of the cross-sectional area of the path of the electric current or stream to the surface of the tube in which the mercury-vapor is hermetically inclosed. In general it appears to be a fact that a small tube having a proportionately large surface and small area of cross-section gives the highest efficiency. By reason of the peculiar property of gases which makes them absorb light of such wave lengths as they can themselves emit when luminous the portions of gas or vapor lying near the surface of the luminous stream in a mercury-vapor lamp are somewhat opaque to the light-rays given off by the more central portions of the gas. Moreover, the vapor or mercury has a temperature of maximum efficiency beyond which it is easily possible to heat it. Both these peculiarities conspire to render it advantageous to increase the radiating-surface and decrease the cross-section of the luminous stream. The means which I have provided for securing the results named consist in employing for the inclosing gas or vapor chamber tubes which have a portion of their bore (the central portion) occupied by a non-conducting material, and the first part of my invention is concerned with the utilization of such a tube for the purposes indicated.

To counteract the tendency of mercury-vapor to become heated by the electric current to a temperature too high for maximum efficiency, it has been suggested that the vapor be artificially cooled—say by inner chimneys or liquid-cooling tube within the lighting-chamber—but it is plainly advisable, if possible, to so design the tube or lighting-chamber that only enough heat is generated to bring the vapor to its temperature of maximum efficiency and to so dispose this vapor in space as to permit the greatest possible portion of the light to be freely emitted. To this end I propose to provide the luminous chamber of my lamp with a vacuum-jacket, whereby for a given expenditure of energy the temperature of the chamber, or rather of the tube forming the chamber, will be higher than it would be if the surface of the tube were permitted, as at present, to dissipate heat by radiation, conduction, and convection.

The other details of my lamp construction, together with the arrangement of the lamp in an electric circuit, will be fully set forth hereinafter and will be clearly understood by reference to the accompanying drawing, which is a vertical section of my lamp, combined with a diagram of the electric circuits.

In the drawing, 1 is an inner tube or rod of suitable material, arranged centrally within a second tube 3 of transparent material, as glass, so as to leave an annular space 2. Upon the tube 3 is mounted a coil or spiral of wire 4, this wire being of nickel, german silver, or other suitable material. The tube 3, together with its heating-coil 4, is sealed into a glass tube 12, leaving a second annular space 11. Leading-in wires 5 and 6 pass through the tube 12 and are connected to the opposite ends of the conductor 4. The tubes 1 and 3 are joined together or braced in position at their lower ends, and a small quantity of mercury 7 is introduced into the bottom of the tube 3. A branch 8 from the leading-in wire 5 runs to the mercury 7, thus connecting the latter with the outside circuit.

At the upper end of the tube 3 a bulb 13 is sealed on, having a narrow cylindrical portion 14 at its upper end. Within the bulb 13 and extending upward somewhat into the cylinder 14 is an electrode 9, constituting the anode of the lamp-circuit. The anode 9 is connected to a leading-in wire 10, which passes out through the upper end of the cylinder 14. The tube 1 may have a projecting lug or extension 34 to steady the anode, and it may itself be braced or supported by any suitable

means within the tube 3. It will generally be best to employ glass braces located within the bulb 13 rather than within the lighting-chamber formed by the annular space 2. The function of the bulb or enlarged chamber 13 is to constitute a cooling or condensing chamber, and the function of the projecting tube or cylinder 14 is to provide also for the collection of impurities and so make the upper portion of the lamp perform the double service of cooling or condensing the vapors and purifying them through the deposition of the impurities contained therein. The walls of the cylinder 14 will be cool relatively to the walls of the bulbous portion 13, the latter element being the one which discharges the greater portion of the condensing function. By reason of the position of the anode 9 at the mouth of the cylinder 14 the gases in the annular space at the mouth of the cylinder 14 are made hot, thereby facilitating the passage of impurities into the cylinder, while at the same time violent currents of gas surging into and out of the cylinder, which might disturb the lodgment of gaseous impurities therein, are prevented. The annular space 11 is exhausted to a high vacuum to prevent as far as possible the transfer of heat from the heated surface of the tube 3 by conduction and convection. The operating electric current passes through the annular space 2, proceeding from the anode 9 to the cathode 7.

If desired, the tube 1 may be exhausted of air to reduce the pressure on its walls due to the heated atmosphere inside the said tube when the lamp is operated. It is not necessary, however, that this should be done.

The electrical connections of the lamp are illustrated diagrammatically in the drawing. At 18 is shown a source of electrical energy having mains 16 and 17 proceeding therefrom. A wire 15 connects the main 16 with the common lamp and heater terminals 5 and 7. The opposite end of the heater is connected by the leading-in wire 6 with a wire 32, running to a suitable interrupter 31, which may be of the well-known Wehnelt or Simon type. Beyond the interrupter 31 the circuit proceeds, by way of a wire 35, to the primary 29 of an induction-coil and through the said primary, by means of a wire 36, to a switch-point 28. By means of the switch-point 28 connection is established with a movable lever 20, which is pivoted at 37 and held by a spring 21 against the switch-point 28. The lever 20 is connected with a main 17 by means of a wire 19, including a switch 38. The free end of the lever 20 is joined by a wire 39 to the secondary 30 of the induction-coil above mentioned. The opposite end of the secondary 30 is joined by a wire 40 to a switch-point 27, located opposite the switch-point 28 and so placed that the lever 20 may make contact with it when moved away from the switch-point 28. The contact 27 is further connected with a ballast-resistance 26, part or all of which is in the form of a solenoid 24 in inductive relation to a core 23. The last-named element is connected to the lever 20 and is adapted when sufficiently attracted by the solenoid 24 to move the lever away from lodgment against the switch point or contact 28 to lodgment against the switch point or contact 27. When the lever has been so moved, the secondary 30 of the induction-coil is short-circuited. The solenoid 24 is connected by a wire 41 through a resistance 42 to the leading-in wire 10, which extends to the anode 9 of the lamp. The resistance 26, the solenoid 24, and the resistance 42 may all be regarded as a common ballast-resistance for the lamp, and they may, in fact, be united in a single coil constituting a magnet or solenoid for operating the lever 20.

The operation of the apparatus as a whole is as follows: On closing the switch 38 current passes from the main 17 through the wire 19, switch-lever 20, contact-point 28, wire 36, primary 29, wire 35, interrupter 31, wire 32, leading-in wire 6, heater-coil 4, leading-in wire 5, and wire 15 to the main 16. The current thus turned on causes the heater-coil 4 to become warm, thus heating the tube 3 and the space and matter within it, including the mercury. At the same time the interrupter 31 is at work, causing pulsations in the primary of the induction-coil and an alternating electromotive force in the secondary thereof. As soon, now, as the mercury in the tube 3 has been warmed to a favorable starting temperature the secondary electromotive force causes a starting-current to flow in the lamp, after which the lamp-circuit is maintained in operation by the current from the mains. The current traversing the secondary of the induction-coil also traverses the coil 24 and is of sufficient quantity to cause the latter to attract its core 23, thereby moving the lever 20, breaking contact between the lever and the switch-point 28 and making contact between the lever and the switch-point 27. By the first action the heater, the primary of the induction-coil, and the interrupter are cut out, and by the second action the secondary of the induction-coil is short-circuited, thus protecting it from unnecessary and injurious heating due to the lamp-current. If for any reason the lamp should go out, the lever 20 returns to contact with the switch-point 28, thereby bringing the circuits into the proper condition for restarting the lamp.

Instead of connecting up the heater in series with the primary of the induction-coil and the interrupter the heater may be connected in parallel circuit with the other elements named.

The improvements described herein are applicable not only to lamps in which mercury vapor is the conducting and illuminating medium, but also to lamps containing other vapors or gases.

The apparatus described and shown in the present application is not claimed herein,

but forms the subject of a divisional application filed December 31, 1900, Serial No. 41,595.

The invention claimed is—

1. The method of utilizing substantially all the luminous effect of a gas or vapor rendered and maintained incandescent by the electric current, which consists in shutting off the current from the central portion of the gas or vapor and confining its action to a path outside such central portion.

2. The method of utilizing substantially all the luminous effects of a gas or vapor rendered and maintained incandescent by the electric current, which consists in arranging the gas or vapor path in the form of an annulus and causing the current to traverse this path.

Signed at New York, in the county of New York and State of New York, this 11th day of July, A. D. 1900.

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Witnesses:

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