

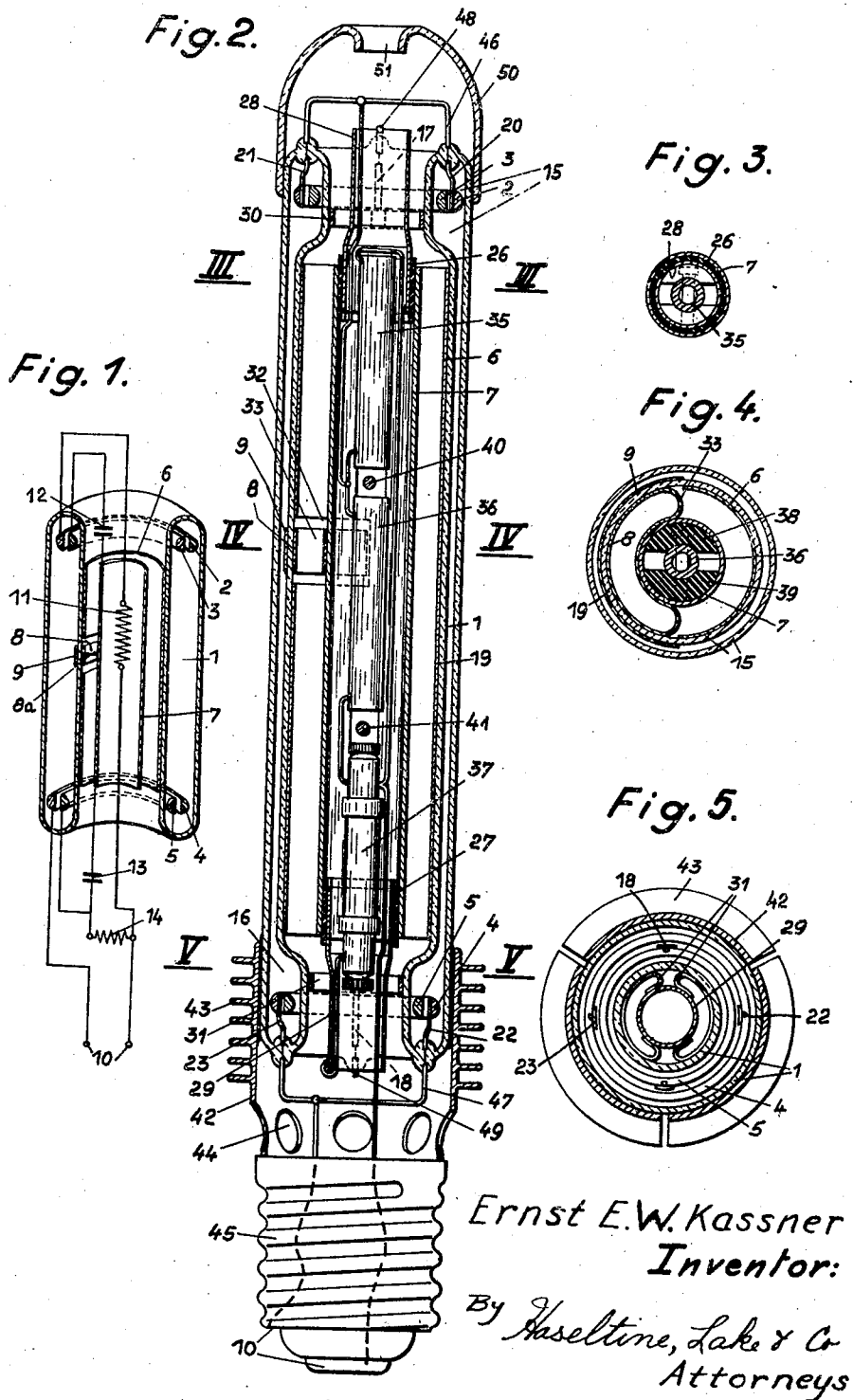
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ELECTRIC LAMP

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ELECTRIC LAMP

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My invention relates to electric lamps, more particularly of the kind in which an electric discharge is initiated between two electrodes arranged in a vessel containing a body of gas and/or metal vapor.

It is an object of my invention to provide a lamp of the kind referred to having high efficiency and a large output.

My invention is based on the fact that if in a lamp of the kind referred to at least a portion of the discharge path is sufficiently restricted so as to form, for instance, an annular chamber of very small width, by suitably choosing the pressure of the body of the gas and/or of the metal vapor ultra-short electric oscillations will be produced in the vessel. These oscillations are probably caused by periodical variations of the space charge which in their turn are caused by irregular charges on the inner surface of the walls of the restricted portions of the vessel, these charges being set up whenever the pressure of the gas and/or of the metal vapor is reduced to such an extent that the free path of the molecules and electrons of the gas and/or vapor is in the order of the width of the restricted discharge path. Thus it will be seen that the pressure must be chosen in dependency on the width of the discharge path and will, of course, vary in accordance with the nature of the gas and/or vapor.

The ultra-short oscillations produced in the manner set forth hereabove are extremely weak. According to my invention they are supplied to a resonant system tuned to the frequency thereof and are amplified by voltage amplification. Finally the amplified ultra-short oscillations are superimposed to the electric field causing the discharge which is a continuous or a low frequency field. By doing so the efficiency and the output of the lamp are considerably improved as will be understood from the following explanation.

The operating voltage of a lamp of the kind referred to at which a predetermined light intensity is obtained depends on the frequency. The voltage-frequency characteristic defining this dependency is approximately horizontal from low frequencies such as 50 cycles per sec. up to 10^7 cycles per sec. In other words, in this frequency range the operating voltage is approximately constant. At higher frequencies, however, i. e. those exceeding 10^7 cycles per sec. the characteristic referred to slopes down to a considerable extent. Thus, by superimposing on the operating voltage the amplified ultra-short oscillations set up in the lamp the operating volt-

age required for a predetermined output will be reduced or, vice versa, at a predetermined operating voltage an increased output or light intensity will be obtained.

In the drawing affixed to this specification and forming part thereof some embodiments of lamps according to my invention are diagrammatically shown by way of example.

In the drawing:

Fig. 1 is a perspective view, partly in section, of a lamp according to my invention, some accessory elements, such as resistances and condensers being indicated merely diagrammatically by appropriate symbols.

Fig. 2 is a sectional elevation of another embodiment of my invention showing a complete structure for practical use.

Figs. 3 to 5 are horizontal sections in the lines III—III, IV—IV, V—V, respectively, of the device shown in Fig. 2.

Referring now to the drawing and first to Fig. 1, 1 is a double-walled vessel made of suitable material, such as glass or the like. 2, 3 and 4, 5 are pairs of annular electrodes arranged in the vessel near the ends thereof, respectively. The width of the space between the walls is very small and may be restricted, if desired, as shown in Fig. 2. 6 and 7 are metal tubes concentrically arranged in the tubular passage formed by the interior wall of the vessel 1, the outer tube 6 forming a coating on said wall. 8 is a curved rectangular portion of the tube 6 separated from the body of the tube by air gaps so as to be electrically isolated therefrom. The portion 8 is electrically connected to the inner tube 7 by means of a connection 8a. 9 is a metallic member similar to the member 8 and arranged opposite thereto on the other side of the inner wall of the vessel 1, so as to be situated within the vessel. The members 8 and 9 and the portion of the glass wall arranged between them form a condenser. 10 are terminals adapted to be connected to a line supplying D. C. or an A. C. of a technical frequency, such as 50 cycles per sec.

One terminal 10 is connected to the electrode 4, the other one being connected to the electrode 2 through a resistance 11. The ends of the inner tube 7 are connected to the electrodes 3 and 5 through condensers 12 and 13, respectively, the condensers being designed in such manner that their impedance is negligible at high frequencies corresponding to ultra-short oscillations. 14 is a resistance through which the electrode 5 is connected to one of the terminals 10.

The vessel 1 is filled with a body of a suitable

gas and/or metal vapor such as neon, helium, argon in combination with mercury vapor and traces of potassium or sodium vapor. It should be understood that the mercury and the potassium or sodium are present as vapor only during the running of the lamp. At other times they are in liquid or solid condition. The pressure of said body is chosen so that the free path of the molecules is in the order of the width of the space between the walls of the vessel 1. Suitable pressures are for instance 2 to 10 mm. Hg. for the inert gases at widths amounting to .3-1 mm., when the lamp is not running. During running the pressure rises due to the vaporization of the metals and the rise of temperature.

The operation of this device is as follows:

When the terminals 10 are connected to a line the line voltage is imparted to the electrodes 4 and 5 and an auxiliary discharge is started between these electrodes. By the auxiliary discharge the body of gas present within the vessel 1 is ionized so that the main discharge between the electrodes 2 and 4 is initiated. The mercury and potassium or sodium is vaporized so that the body now comprises a mixture of gas and metal vapors.

The pressure being suitably chosen as pointed out hereinbefore, ultra-short oscillations are set up in the body of gas and metal vapor, the frequency of the oscillation being dependent, at a given shape of the vessel, from the number of ions per ccm. Thus the frequency may be varied by varying the pressure and/or the intensity of the main discharge.

The ultra-short oscillations are fed to the tube system 6, 7 by means of the condenser 8, 9 operating as a capacitive coupling between the tube system and the body of the gas and metal vapor. The tubes 6 and 7 operate as a resonant system the fundamental frequency of which is equal to the double length of the tubes. Thus it will be seen that by suitably choosing the pressure of the body of gas and metal vapor and/or the length of the tubes a tuning may be accomplished so that the frequency of the ultra-short oscillations set up in the body is equal to one of the natural frequencies of the tube system. The ultra-short oscillations withdrawn from the body by the tube system 6, 7 through the coupling condenser 8, 9 are amplified and fed to the electrodes 3 and 5 connected to the ends of the tube 7 through the condensers 12 and 13, respectively, the impedance of which is negligible at the frequency of the ultra-short oscillations. In consequence thereof an ultra-short alternating field is superimposed to the field set up between the main electrodes 2 and 4 so that the efficiency and the output of the lamp is increased as more fully set forth hereabove.

Referring now to Figs. 2 to 5 the vessel 1 is provided with a main portion of restricted width and enlarged end portions 15 and 16 in which the annular electrodes 2, 3 and 4, 5, respectively, are arranged, the cross section of the electrodes being semi-circular. 20, 21 and 22, 23 are supports for the electrodes 2 and 4, respectively. The electrodes 3 and 5 are provided with similar supports displaced by 90° with respect to the supports 20 to 23, two of these supports being shown in dotted lines and indicated by reference numerals 17 and 18. All the supports are sealed into the end portions of the vessel and made of conductive material so as to form leads by which the operating potentials are applied to the electrodes. The outer cylinder 6 of the tube system is designed as

in Fig. 1 as a coating on the surface of the inner wall 19 of the vessel, said coating being light reflecting so as to reflect the light produced in the restricted discharge path. The condensers 12, 13 of Fig. 1 are formed in Fig. 2 by metallic tubular extensions 28, 29 inserted into the end portions of the inner tube 7, insulating rings 26, 27 being interposed between the extensions 28, 29 and the ends of the tube 7, respectively. 30 and 31 are metal springs securing in position the extensions 28 and 29 and thus the inner tube 7, the shape of the springs being clearly shown in Fig. 5. At 32 a portion extending along half the circumference of the tube 6 is cut away so as to form a gap for the reception of the member 8 designed as a spring member 33 having electrical contact with the inner tube 7 so that the connection 8a shown in Fig. 1 may be dispensed with. The member 9 is formed as a metal coating on the outer surface of the inner wall 19 of the vessel 1. 35, 36, and 37 are resistance elements centrally arranged in the tube 7 and secured in position by insulating members such as 38, 39 shown in Fig. 4 which in turn are secured in position by means of holding screws 40, 41 indicated in Fig. 2. The insulating members are omitted in Fig. 2 for the sake of clearness. The elements 35 and 36 are connected in parallel and correspond to resistance 11 shown in Fig. 1 whereas element 37 is the equivalent of resistance 14 shown in Fig. 1. 42 is a holding member secured to the lower end of the vessel 1 and provided with cooling ribs 43 and openings 44 allowing a circulation of air through the central portion of the lamp. 45 is a socket secured to the holding member 42 and forming the terminals 10 for the connection of the lamp to a line. As will be seen from Fig. 2, one terminal is connected to a stirrup 47 sealed into the lower end of the vessel and connected to the leads 22 and 23, the other terminal being connected to one end of resistance 37, the other end of which is connected to the extension 29 which in turn is connected to the electrode 5 by means of the leads, such as 18, referred to above. In analogous manner stirrup 46 sealed into the upper end of the vessel 1 and connected to the leads 20, 21 is connected to one end of the elements 35, 36 connected in parallel, the other end thereof being connected to that one of terminals 10 which is connected to resistance 37. Extension 28 is connected to electrode 3 by means of leads such as 17. 50 is a cap provided with a central opening 51 for the passage of cooling air.

The operation of the device shown in Figs. 2 to 5 is quite the same as that of the device shown in Fig. 1 and thus needs no detailed description.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

In the claims affixed to this specification no selection of any particular modification of the invention is intended to the exclusion of other modifications thereof and the right to subsequently make claim to any modification not covered by these claims is expressly reserved.

I claim:—

1. An electric lamp comprising a double-walled vessel, two electrodes arranged in said vessel, said vessel being shaped so as to form a restricted discharge path between said electrodes, a gaseous body in said vessel, the pressure of said body being chosen so as to set up electrical ultra-short oscillations in said body whenever a discharge between said electrodes is started, a

resonant system arranged in the central portion of said double-walled vessel and tuned to the frequency of the ultra-short oscillations set up in said body, means for coupling said system to said body and means for superimposing the oscillations excited in said system on the discharge started between said electrodes.

2. An electric lamp comprising a double-walled vessel, two electrodes arranged in said vessel, said vessel being shaped so as to form a restricted discharge path between said electrodes, a gaseous body in said vessel, the pressure of said body being chosen so as to set up electrical ultra-short oscillations in said body whenever a discharge between said electrodes is started, a resonant system comprising two metal tubes concentrically arranged in the central portion of said double-walled vessel and tuned to the frequency of the ultra-short oscillations set up in said body, means for coupling said system to said body and means for superimposing the oscillations excited in said system on the discharge started between said electrodes.

3. An electric lamp comprising a double-walled vessel, two electrodes arranged in said vessel, said vessel being shaped so as to form a restricted discharge path between said electrodes, a gaseous body in said vessel, the pressure of said body being chosen so as to set up electrical ultra-short oscillations in said body whenever a discharge between said electrodes is started, a resonant system comprising two metal tubes concentrically arranged in the central portion of said double-walled vessel and tuned to the frequency of the ultra-short oscillations set up in said body, capacitive means for coupling said system to said body and means for superimposing the oscillations excited in said system on the discharge started between said electrodes.

4. An electric lamp comprising a double-walled vessel, two electrodes arranged in said vessel, said vessel being shaped so as to form a restricted discharge path between said electrodes, a gaseous body in said vessel, the pressure of said body being chosen so as to set up electrical ultra-short oscillations in said body whenever a discharge between said electrodes is started, a resonant system comprising two metal tubes concentrically arranged in the central portion of said double-walled vessel and tuned to the frequency of the ultra-short oscillations set up in said body, means for coupling said system to said body, auxiliary electrodes arranged in said vessel and means for electrically connecting said resonant system to said auxiliary electrodes.

5. An electric lamp comprising a double-walled vessel, two electrodes arranged in said vessel,

said vessel being shaped so as to form a restricted discharge path between said electrodes, a gaseous body in said vessel, the pressure of said body being chosen so as to set up electrical ultra-short oscillations in said body whenever a discharge between said electrodes is started, a resonant system comprising two metal tubes concentrically arranged in the central portion of said double-walled vessel and tuned to the frequency of the ultra-short oscillations set up in said body, auxiliary electrodes arranged in said vessel, means for electrically connecting said resonant system to said auxiliary electrodes and means for imparting an ignition potential to said auxiliary electrodes.

6. An electric lamp comprising a double-walled vessel, two concentrically arranged walls forming part of said vessel, two electrodes arranged in said vessel, said vessel being shaped so as to form a restricted discharge path between said electrodes, a gaseous body in said vessel, the pressure of said body being chosen so as to set up electrical ultra-short oscillations in said body whenever a discharge between said electrodes is started, a resonant system comprising two metal tubes concentrically arranged in the space limited by the inner one of said walls, the outer one of said tubes including a coating on said inner wall, said system being arranged in the central portion of said double-walled vessel and tuned to the frequency of the ultra-short oscillations set up in said body, means for coupling said system to said body and means for superimposing the oscillations excited in said system to the discharge started between said electrodes.

7. An electric lamp comprising a double-walled vessel, two concentrically arranged walls forming part of said vessel, two electrodes arranged in said vessel, said vessel being shaped so as to form a restricted discharge path between said electrodes, a gaseous body in said vessel, the pressure of said body being chosen so as to set up electrical ultra-short oscillations in said body whenever a discharge between said electrodes is started, a resonant system comprising two metal tubes concentrically arranged in the space limited by the inner one of said walls, the outer one of said tubes including a light-reflecting coating on said inner wall, said system being arranged in the central portion of said double-walled vessel and tuned to the frequency of the ultra-short oscillations set up in said body, means for coupling said system to said body and means for superimposing the oscillations excited in said system to the discharge started between said electrodes.

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