Sept. 29, 1953 M. G. CLARKE ET AL 2,654,042

INTEGRALLY CAPACITIVELY BALLASTED DISCHARGE LAMP

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Fig. 1.

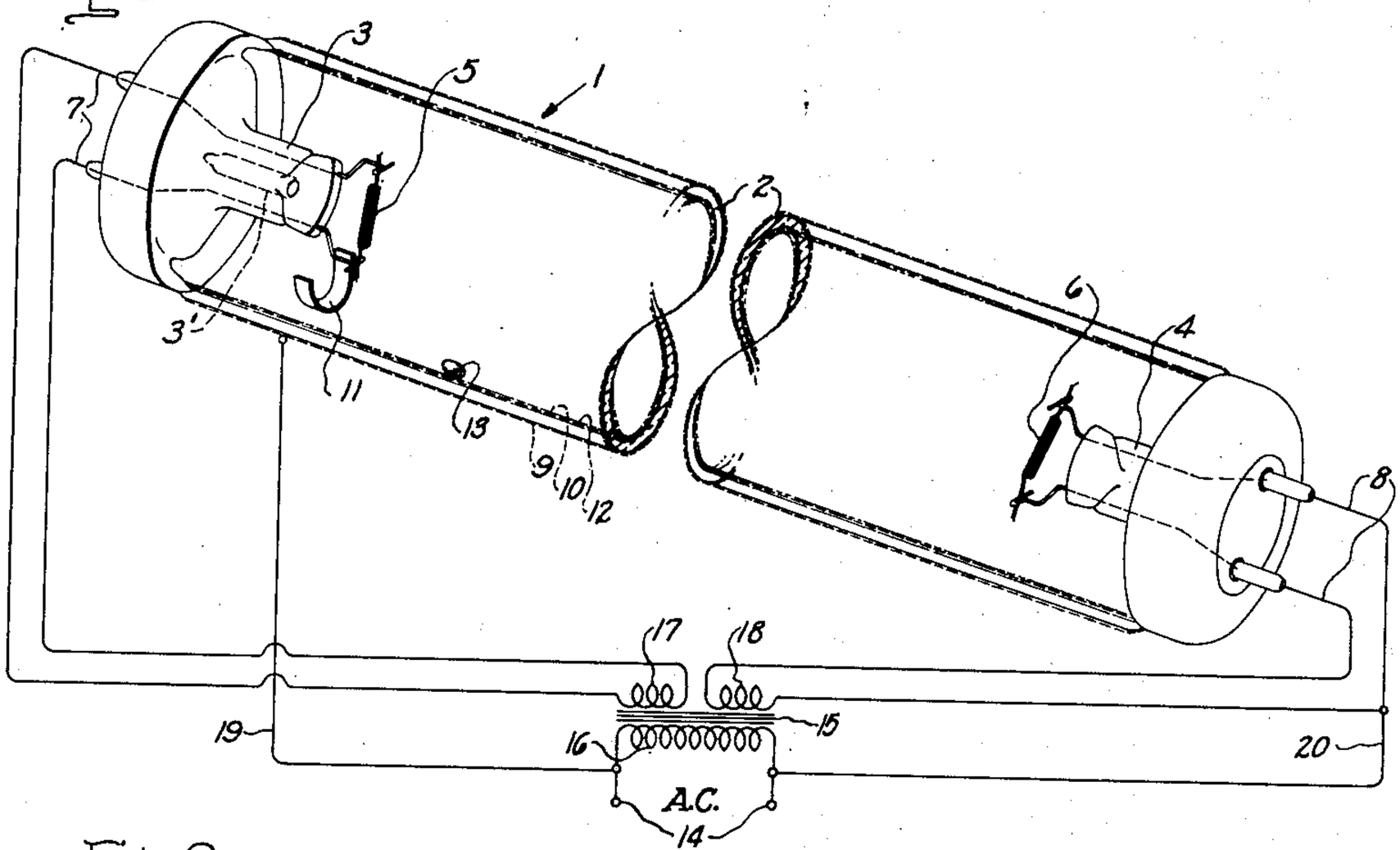


Fig. 2.

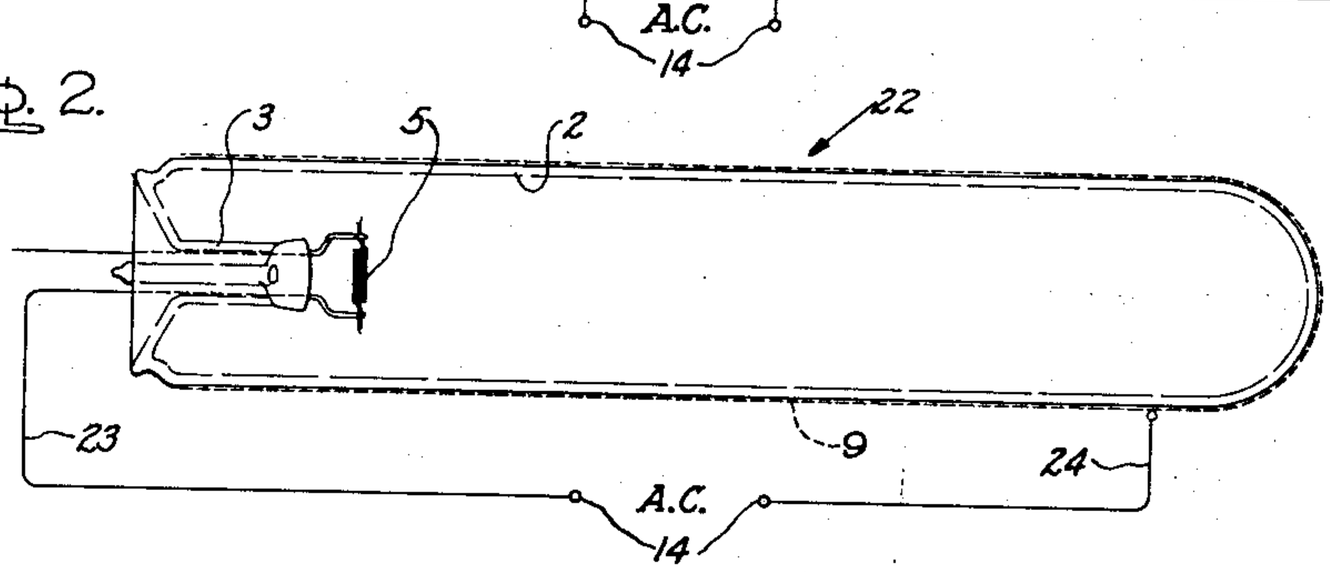
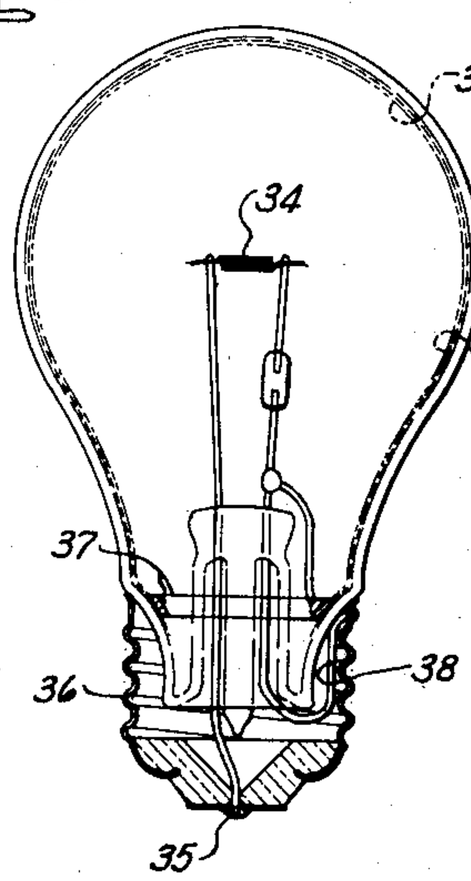


Fig. 3.



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INTEGRALLY CAPACITIVELY BALLASTED DISCHARGE LAMP

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8 Claims. (Cl. 313—109)

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The present invention relates to gaseous electric devices generally and more particularly to devices of the kind in which there is produced a discharge having a negative volt-ampere characteristic. The invention is concerned with an improved construction, integral with the device or lamp, which converts the inherent negative volt-ampere characteristic of the discharge to a resultant positive volt-ampere characteristic for the device as a whole. This permits operation of the lamp directly from an alternating voltage source without the use of external ballasting impedances.

Discharge devices of the character mentioned above are used for many various purposes and appear in different forms, among which may be mentioned discharge lamps of the low pressure and high pressure types and the common tubular fluorescent lamps. In order to limit the current in such lamps and insure satisfactory operation, a positive impedance is inserted in series therewith across a source of voltage. Where the voltage supply is alternating, the impedance is generally in the form of a reactance, as otherwise an unnecessary wastage of electrical energy would occur. This reactance is usually of an inductive nature for normal supply frequencies, and it is generally not feasible to employ a reactance of a capacitive nature because of the deterioration of wave-form which occurs. However, where the frequency of the alternating supply is materially higher than the commercial frequencies of 50 to 60 cycles, for example a frequency of 200 cycles per second or more, the ballasting reactance may be capacitive in nature; and the wave-form of the current, and also the efficiency of the lamp, remain satisfactory.

Accordingly, it is an object of the invention to provide a new and improved electric discharge device in which series capacitance is used for stabilizing the operation and in which the capacitance is constructed integrally with the device.

Another object of the invention is to provide a discharge lamp construction wherein the inherent negative volt-ampere characteristic of the discharge is countered by the positive volt-ampere characteristic of a capacitance of which the dielectric is constituted by a part of the envelope wall of the device, the whole providing a resultant volt-ampere characteristic which is positive in nature.

A further object of the invention is to provide a discharge lamp construction wherein capacitive ballasting is achieved by utilizing a transparent conductive coating and an insulating glaze on the envelope wall as capacitive elements in combination with the ionizable medium within the lamp.

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In general, the invention provides a capacitance integral with the discharge device in the form of a conductive coating on the wall of the envelope of the device and surrounding substantially the whole of the discharge space. The coating is separated from the discharge space by dielectric material, either the envelope wall or a separate insulating glaze, and forms one terminal of the device while an electrode immersed in the ionizable medium forms the other terminal. As an example, the envelope may be coated externally with a conductive light-transmitting coating forming one side or plate of a series ballasting capacitance. The other plate of the capacitance may be either a second conductive light-transmitting film deposited internally on the envelope wall, or the ionized medium of the discharge itself enclosed within the envelope. In the case of a lamp provided with an internally deposited film or coating, a connection may be made from this coating to a discharge-supporting electrode within the envelope, which electrode cooperates with a second electrode at the opposite end of the path of the discharge within the device. In the case of the lamp where the ionized medium of the discharge itself forms the other side or plate of the capacitance, only one discharge-suporting electrode is necessary within the envelope.

For further objects and advantages and for a better understanding of the invention, attention is now directed to the following description and accompanying drawings. The features of the invention believed to be novel will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a pictorial view of a tubular elongated discharge lamp which is provided integrally with a series ballasting capacitance whereof the plates are formed by external and internal translucent or transparent coatings on the envelope wall.

Fig. 2 is a sectional view of an elongated discharge lamp provided with an integrally constructed ballasting capacitance whereof one plate is formed by a transparent coating on the exterior wall of the envelope and whereof the other plate is constituted by the ionized medium of the discharge itself.

Fig. 3 is a sectional view of a discharge lamp of standard pear-shaped bulb construction which is provided with a series ballasting capacitance whereof one conducting plate is constituted by a transparent conductive coating located between the interior surface of the envelope wall and a thin translucent dielectric glaze deposited on the inner surface.

Referring to Fig. 1, there is shown a discharge lamp 1 embodying my invention in which external and internal conductive coatings are provided on the envelope wall, the internal coating being connected to one of a pair of discharge-supporting electrodes. The lamp is represented as broken apart near its middle in order to facilitate the understanding of its construction. The lamp comprises an elongated tubular envelope 2 which is terminated at both ends in stem presses 3 and 4, stem 3 being further provided with an exhaust tube 3' for evacuating the envelope and introducing suitable gases therein. Mounted on lead-in wires passing through the stem presses are filamentary electrodes 5 and 6, which electrodes may consist of a coil of tungsten wire overlaid with a coating of activated electron-emitting material such as barium and strontium oxides. The electrode lead-in wires are connected to pairs of pins 7 and 8 fixed in suitable molded bases at both ends of the lamp.

The glass wall of the envelope 2 is coated both externally and internally with light-transmitting conductive coatings 9 and 10, respectively. As is well known in the art, a transparent conductive coating may be formed by the application of stannous chloride to the glass. Or again, a translucent coating may be formed by the sublimation onto the glass surface of certain metals. For instance, aluminum may be used to provide a conductive light-transmitting film. The internal conductive coating 10 is connected to one side of electrode 5 by means of a spring finger 11 mounted on one of the lead-in wires.

In its final assembly, where the lamp is to be utilized to produce visible light, a thin layer 12 of a fluorescent substance is deposited on the internal surface of the envelope over the internal conductive translucent coating. The function of this fluorescent coating is to convert the ultraviolet radiation produced by the discharge to light radiation within the visible spectrum. After assembly, the lamp is evacuated, filled with a starting gas such as neon, argon, krypton, xenon, or mixtures thereof at a low pressure in the neighborhood of 3 mm. In addition, a droplet of mercury 13 is introduced into the bulb which, during normal operation, fills the envelope with its vapor pressure at the operating temperature, such vapor pressure being in the range of a few microns.

Lamp 1, constructed as described above, may be operated directly from an alternating voltage source at the usually accepted voltage of 200 to 250 volts and preferably at a frequency in excess of 50 cycles per second, for instance, a frequency of 200 cycles per second. Where it is desired to operate the lamp from a source of lower voltage, means may be provided for supplying heating current to the filamentary electrodes 5 and 6. Such means may be, for instance, a transformer 15 whereof the primary 16 is connected across the alternating voltage supply terminals 14, and whereof the secondary windings 17 and 18 are connected across the filamentary electrodes 5 and 6, respectively. The actual operating circuit for the lamp is provided, in the same manner as where the electrodes are not preheated, by means of a direct connection 19 from the external conductive coating 9 to one of the alternating voltage terminals, and by means of a direct connection 20 from one side of filamentary electrode 6 to the other alternating voltage terminal.

Referring to Fig. 2, there is shown a discharge lamp 22 embodying a modified form of my invention in which an external conductive coating alone is utilized and in which the ionizable medium itself within the envelope is utilized as the other plate of the ballasting capacitance. Mounted at one end of envelope 2 is a single stem press 3 supporting the filamentary electrode 5. The opposite end of the envelope is simply sealed off. Conductive coating 9 is deposited on the exterior wall of the envelope and serves as one plate of the ballasting capacitance. In operation, one lead-in wire to electrode 5 has a direct connection 23 to one terminal of the alternating voltage supply 14, and the conductive coating 9 has a direct connection 24 to the other terminal of the alternating voltage supply. With this construction, the discharge medium within the envelope serves as the other plate of the series capacitance, and current limiting is achieved directly through the ballasting effect of the capacitance so constituted.

Referring to Fig. 3, there is shown a pear-shaped discharge lamp construction embodying a further modification of my invention. Where the frequency of the alternating supply voltage is relatively low and it is, nevertheless, desired to obtain a relatively intense discharge, the value of the integral ballasting capacitance may be increased by reducing the thickness of the dielectric. Of course, it is not possible to decrease indefinitely the thickness of the glass envelope since extreme fragility is undesirable, but this difficulty may be obviated by the use of a dielectric skin or layer on one surface of the main glass envelope. Thus, in the pear-shaped lamp 30, the interior surface of the glass envelope 31 is coated with a thin layer 32 of a transparent conductive substance. Deposited internally and over the conductive layer 32 is a glazed film 33 of a suitable glass or ceramic substance. The glazed film need not be transparent but should be at least translucent. Where it is desired to use lamp 30 as a source of visible light, a coating of a fluorescent substance or powder is deposited on the interior surface of the glazed coating 33. In such case, the interior of the envelope 31 would be evacuated and filled with a starting gas and, preferably, a metal vapor such as mercury. On the other hand, when a gas such as neon, which produces visible radiation directly, is utilized, the fluorescent powder may be omitted. The lamp is provided with a single electrode 34 which may be constituted by a coil of tungsten wire activated with electron-emitting materials such as strontium or barium oxides. The electrode 34 is supported on a lead-in wire which is connected to the central pin 35 of a screw base 36. The conductive coating which is located between the exterior glass envelope and the internal glaze is connected by means of a metal ring 37 and a lead-in wire 38 to the body of the screw base 36.

The lamp 30 may be screwed in directly to the usual type of standard screw socket on a commerical supply of approximately 230 volts at 50 cycles. With this construction, the thickness of the dielectric constituted by the glaze between the conductive coating and the ionizable medium is so small that the series capacitance has a high enough value to conduct sufficient current to permit the generation of commercially utilizable light. The ballasting is achieved, in the same manner as described heretofore, by means of the positive resistance characteristic of the integral capacitance in series with the discharge.

While certain specific embodiments have been shown and described, it will of course be understood that various modifications may be made without departing from the invention. Thus, the

shape and sizes of lamps which have been described and also the types of cathodes may be changed and, likewise, the dimensions and the particular operating circuits. It will be understood that those which have been described are shown merely by way of illustrative examples. The appended claims are therefore intended to cover any such modifications coming within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A self-ballasting construction for an electric discharge device wherein the discharge proper has a negative volt-ampere characteristic, comprising an envelope filled with an ionizable medium and defining a discharge space, at least one lead wire sealed through said envelope and supporting therein a thermionic activated electrode, and a series ballasting capacitance constructed integrally with said device and comprising a conductive coating on the wall of said envelope and surrounding substantially the whole of said discharge space, a dielectric material separating said coating from said medium, said lead and said conductive coating serving respectively as terminals for said device whereat a resultant positive volt-ampere characteristic is presented.

2. A self-ballasting construction for an electric discharge lamp wherein the discharge proper has a negative volt-ampere characteristic, comprising a dielectric envelope filled with an ionizable medium, at least one lead wire sealed through said envelope and supporting therein a thermionic activated electrode, and a ballasting capacitance constructed integrally with said lamp and comprising an external electrically conductive and light-transmitting coating covering substantially the whole outside surface of said envelope, said coating being adapted to react capacitively through the walls of said envelope operating as a dielectric, said lead and said external coating serving respectively as terminals for said lamp whereat a resultant positive volt-ampere characteristic is presented.

3. A self-ballasting construction for an electric discharge device wherein the discharge proper has a negative volt-ampere characteristic, comprising a dielectric envelope filled with an ionizable medium, a pair of cooperating thermionic activated electrodes positioned at opposite ends of said envelope and supported on lead wires sealed therethrough, and a ballasting capacitance constructed integrally with said device and comprising external and internal conductive coatings covering substantially the whole outside and inside surfaces of said envelope, said coatings, in conjunction with said dielectric envelope, constituting a capacitance, and a connection from one of said electrodes to said internal coating, the lead to the other of said electrodes and said external coating serving respectively as terminals for said lamp whereat a resultant positive volt-ampere characteristic is presented.

4. A self-ballasting construction for an electric discharge lamp wherein the discharge proper has a negative volt-ampere characteristic, comprising a transparent dielectric envelope filled with an ionizable medium, a pair of cooperating thermionic activated electrodes positioned at opposite ends of said envelope and supported on lead wires sealed therethrough, and a series ballasting capacitance constructed integrally with said lamp and comprising external and internal electrically conductive light-transmitting coatings covering substantially the whole outside and

inside surfaces of said envelope, said coatings, in conjunction with the wall of said envelope serving as a dielectric, constituting a capacitance, and a connection from one of said electrodes to said internal coating, the lead to said other electrode and said external coating serving respectively as terminals for said lamp whereat a resultant positive volt-ampere characteristic is presented to an applied alternating voltage.

5. A self-ballasting construction for an electric discharge lamp wherein the discharge proper has a negative volt-ampere characteristic, comprising a transparent dielectric envelope having a pair of activated thermionic electrodes positioned at opposite ends thereof and supported on lead wires sealed therethrough, a starting gas at a low pressure of a few millimeters of mercury and a small quantity of mercury sealed within said envelope, and a series ballasting capacitance constructed integrally with said lamp, and comprising external and internal electrically conductive light-transmitting coatings covering substantially the whole outside and inside surfaces, respectively, of said envelope, said coatings constituting, in conjunction with the dielectric of said envelope, a capacitance, and a connection from said internal coating to one of said electrodes, the lead to said other electrode and said external coating serving respectively as terminals for said lamp whereat a resultant positive volt-ampere characteristic is presented to an applied alternating voltage capable of producing a discharge within said lamp.

6. A discharge device construction as in claim 1 wherein the envelope is a dielectric and the conductive coating is light transmitting and is placed on the outside surface of the envelope so as to react capacitively upon the ionizable medium through the envelope wall.

7. A discharge device construction as in claim 1 wherein the conductive coating is light transmitting and is placed on the inside surface of the envelope, and comprising in addition a dielectric glaze within said envelope covering said coating, said glaze serving as a dielectric between said coating and the ionizable medium.

8. A discharge device construction as in claim 1 wherein the conductive coating is light transmitting and is placed on the inside surface of the envelope, and comprising in addition a translucent dielectric glaze inside said envelope covering said conductive coating, said glaze serving as a dielectric between said coating and the ionizable medium, and a phosphor within said envelope deposited over said glaze.

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