

Jan 6, 1931.

E. A. LEDERER
GLOW DISCHARGE LAMP
Filed July 9, 1924

1,787,689

2 Sheets-Sheet 1

FIG. 1

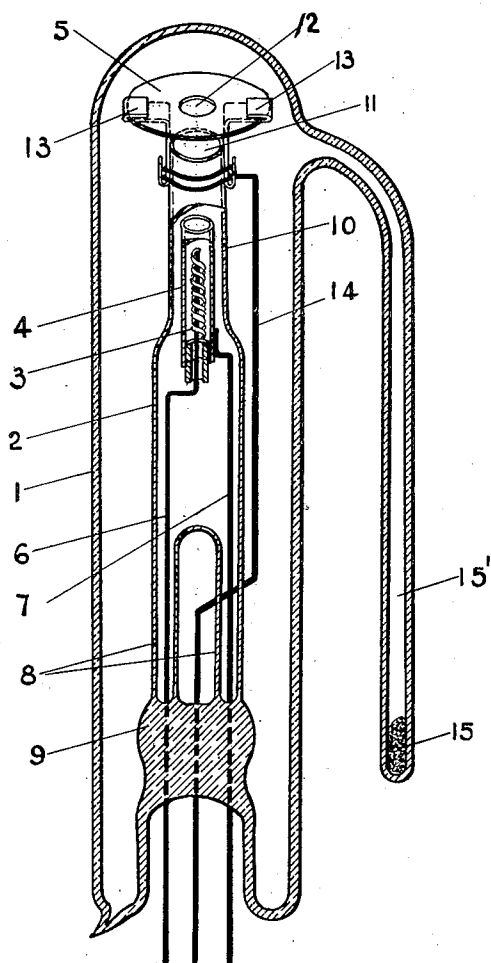


FIG. 2

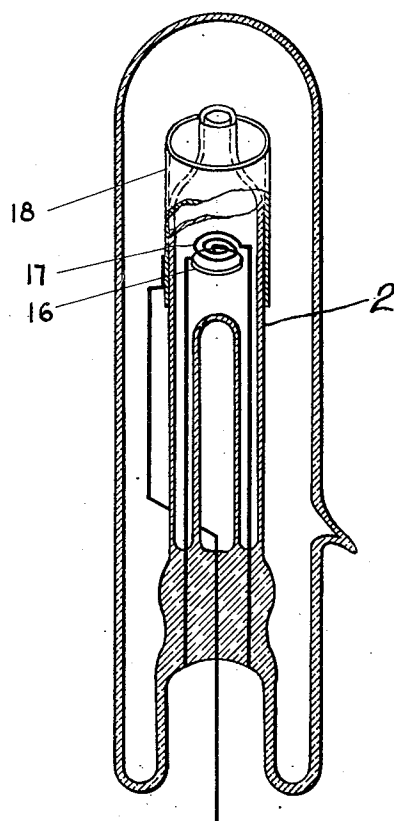
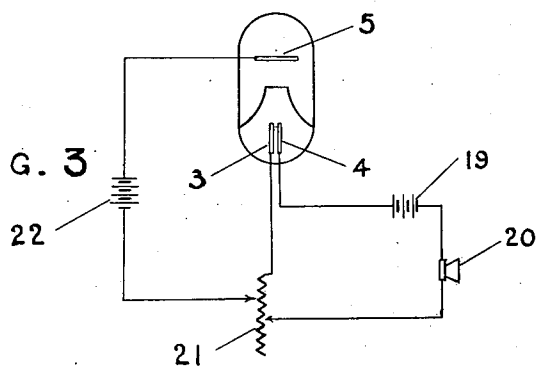


FIG. 3



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FIG. 4

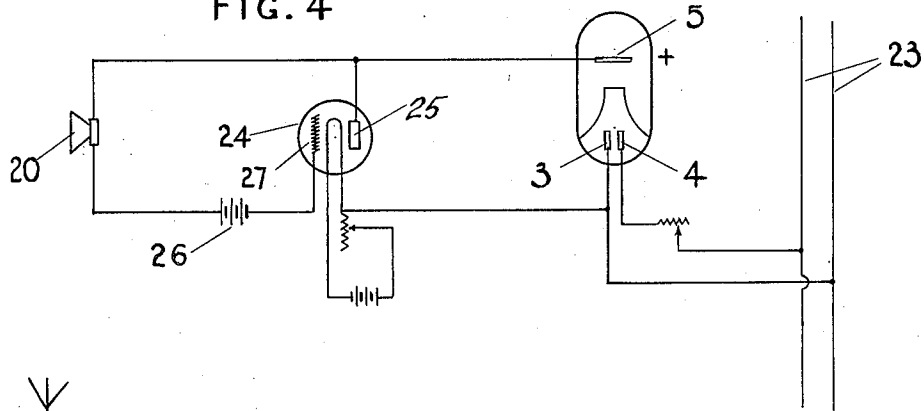
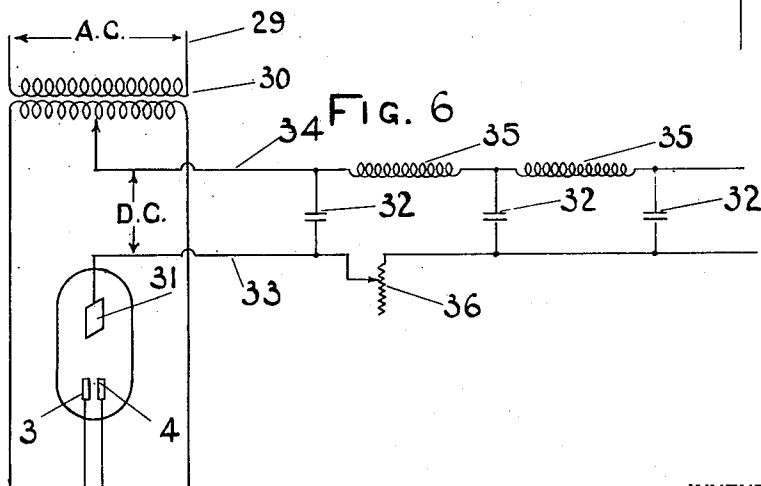
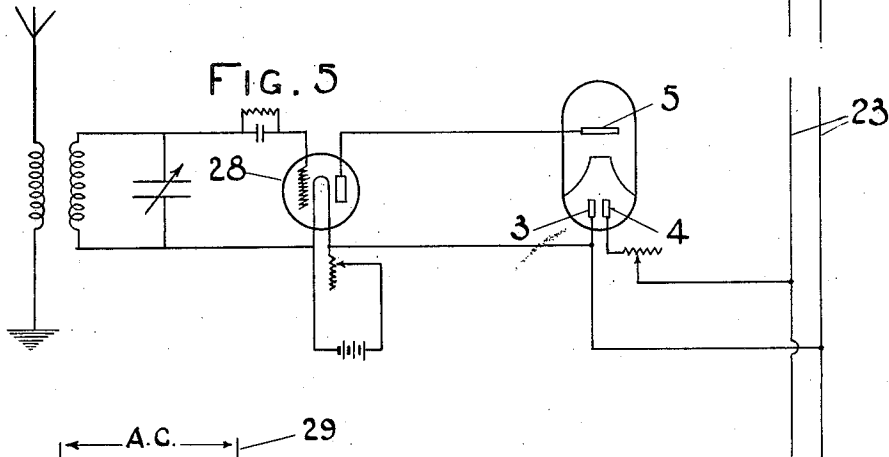


FIG. 5



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GLOW-DISCHARGE LAMP

Application filed July 9, 1924. Serial No. 724,991.

This invention relates to glow-discharge lamps and more particularly to lamps for converting electrical variations into variations in light.

5 This lamp is particularly adapted for use in the electrical transmission of either still or moving pictures by wire or by wireless and for recording sound photographically but it is not so limited.

10 The electrical transmission of pictures is accomplished in substantially all of the known systems by converting the light intensity of small areas of said picture successively into electrical variations and transmitting said electrical variations by wire or
15 wireless to the receiving station where apparatus operating in synchronism with the transmitting apparatus reconverts the electrical variations into light modulations and projects such light modulations progres-
20 sively over a screen or a sensitized surface, as a film or plate, to reproduce the picture.

The variations in the current strength of the transmitted impulses may be produced in different ways. They may, for instance, be
25 obtained by the passage of a mechanical pointer over specially prepared metal picture having a cylindrical surface or they may be produced by introducing a pair of
30 rotatable ring prisms between an ordinary object or picture to progressively direct the light from small areas of the object or picture upon a light sensitive cell. The light sensitive cell translates the variations in light
35 intensity of the different parts of the picture into variations in current strength and these latter variations are transmitted to a receiving station by wires or by wireless.

In all of these systems it is desirable that
40 the apparatus for reconverting these electrical variations into light modulations should employ a concentrated light source of unvarying color, the intensity of which, may be instantly and accurately varied in
45 accordance with the variations in the received impulses.

It is desirable that the light source be concentrated in order that it may be projected
50 at any one instant on a relatively small area of the sensitized surface; it must be of con-

stant color since the photographic medium is differently affected by light of different wave lengths; it must be free from inertia to permit rapid transmission of the picture and to prevent distortion thereof; it must be capable of being varied accurately in accordance
55 with the variations in the transmitted impulses to produce the proper tone gradations in the reproduced picture and it must be intense or brilliant to reduce the necessary
60 time of exposure.

One of the objects of this invention is to provide a light source of this character.

Another object is to provide a lamp in which small current variations impressed
65 thereon will produce relatively large variations in the light intensity of the lamp.

Another object is to provide a glow-discharge lamp having a low starting potential and a high efficiency.
70

Another object is to provide a glow-discharge lamp operable on ordinary commercial lighting circuits.

Another object is to provide a discharge lamp in which the light emitting column
75 is confined to a relatively small cross sectional area.

Another object of the invention is to prevent undesirable and uncontrolled discharges in a lamp of this character.
80

Another object is to provide a discharge device capable of rectifying alternating currents.

Other objects and advantages will hereinafter appear.
85

In accordance with the preferred embodiment of this invention, the discharge lamp is provided with three electrodes, two of which are preferably arranged relatively
90 close together and serve to ionize a gaseous medium contained within the lamp so as to permit a low potential discharge between one or both of said electrodes and the third electrode. Preferably, the gaseous medium is a
95 rare gas as neon or helium at a low pressure by which the current consumption is decreased and the starting potential made relatively low: However, a mixture of rare gases with or without other gaseous chemical
100

compounds or vapors may be used, to modify the color for photographic purposes.

The cathode fall and consequently the potential drop between the electrodes may be further reduced by coating the electrodes with an alkali metal as potassium, sodium, rubidium, caesium, lithium, or alloys thereof, preferably vaporized on the electrodes after they are sealed into the lamp.

The ionizing electrodes may be enclosed in a chamber having a constricted discharge passage communicating with the third electrode and in which a positive glow is produced and concentrated into a column of small cross sectional area.

The ionizing electrodes may be connected in one circuit and the light-producing electrodes in another circuit, either of which may be varied to control the intensity of the light as will hereinafter more fully appear.

The transmitted impulses may be received by any of the usual radio receiving apparatus and impressed upon the electrodes of the lamp to produce light modulations corresponding to the transmitted impulses.

If it is desired to record sound photographically, the sound may be impressed by a microphone or similar device directly upon a circuit in which the electrodes of the lamp are connected or through suitable amplifying means, and the light variations thus produced projected on a continuously moving film.

In order that the invention may be more fully understood, reference is had to the accompanying drawings in which,

Fig. 1 is a sectional view of a discharge lamp;

Fig. 2 is a sectional view of another form of discharge lamp;

Figs. 3, 4 and 5 are diagram arrangements which may be employed for operating the discharge lamp; and,

Fig. 6 is a diagram arrangement utilizing the discharge device as a rectifier.

The discharge lamp shown in Fig. 1 comprises an envelope 1 containing a rare gas as neon or helium preferably at a relatively low pressure, a tubular chamber 2 in which concentric electrodes 3 and 4 are arranged and a third electrode 5 located outside of the chamber 2.

The electrode 3 is composed of a wire or ribbon of metal having a low cathode drop, as aluminum wound spirally about the leading-in conductor 6. The electrode 4 is in the form of a metallic tube preferably of aluminum, surrounding the electrode 3 and of such size as to have its surface arranged relatively close to the inner electrode whereby a compact structure is obtained and a glow-discharge produced therebetween at relatively low voltages. The electrode 4 is supported by the leading-in wire 7. The leading-in wires 6 and 7 are contained within tubular

legs 8 which latter form extensions of the chamber 2 and are fused to the reentrant stem 9 of the lamp. The leading-in wires are sealed in the stem 9.

The upper portion 10 of the chamber 2 has an open end 11 and is reduced in cross section to produce a constricted discharge passage between the outside electrode 5 and the electrodes 3 and 4. The electrode 5 comprises a disc of metal, as aluminum, having a central opening 12, supported by the reduced portion of the chamber 2 through a pair of clips 13 to which the leading-in wire 14 is suitably secured, as by welding.

In the operation of this lamp, a sufficient potential is applied between the electrodes 3 and 4 to cause a glow-discharge therebetween which ionizes the gas within the chamber and reduces the starting potential of the main discharge produced between the electrode 5 and one or both of the electrodes 3 and 4. By restricting the area of the discharge passage 10 and using a sufficiently low gas pressure preferably less than 12 mm. of mercury within the chamber, a brilliant positive column discharge is obtained. This intense light is emitted through the opening 12 in the electrode 5 and through the end of the envelope.

In order to reduce the cathode drop and thus still further reduce the starting and operating potential of the lamp, the electrodes are coated with an alkali metal, preferably potassium. The potassium 15 may be contained in a side chamber 15' and vaporized onto the electrodes after they are sealed in the envelope.

By having the electrodes 3 and 4 and their leading-in wires entirely enclosed within the chamber 2 and the tubular legs 8, the discharge between these electrodes and the electrode 5, is confined entirely to the restricted portion 10 of the chamber 2 and therefore, there is no stray discharge produced between these electrodes outside of the chamber 2.

In Fig. 2 a modified form of lamp is shown in which the electrodes 16 and 17, adapted to ionize the gas within the tube, are spaced apart longitudinally of the tube so that the discharge therebetween takes place in an axial direction and serves to more efficiently ionize the gas within the chamber 2. The electrode 16 may be in the form of a plate and the electrode 17 a grid or coil spaced thereabove.

The outside electrode 18 is shown in the form of a cylinder or tube surrounding the chamber 2, although it may take the form of a disk, as in Fig. 1 or any other suitable form. That portion of the discharge between the electrode 18 and the open end to the chamber 2, is of insufficient current density to produce light, and a dark spot consequently occurs in this portion of the discharge. Within the constricted portion of the chamber, the current density is sufficiently increased to produce a brilliant positive column. It has been

found, however, that the area of the electrode 5 should be greater than the cross sectional area of the constricted portion of the chamber 2 in order to produce such a positive column discharge at commercial voltages.

Fig. 3 shows diagrammatically, one arrangement for operating the lamp in accordance with electrical variations impressed on a circuit in which the lamp is included. The electrodes 3 and 4 are connected in circuit with a battery 19, a current varying device 20 and variable resistance 21 and the electrodes 3 and 5 are connected in a local circuit including a battery 22 and the resistance 21. By varying the current in the circuit including electrodes 3 and 4, by means of the current varying device 20, the degree of ionization of the gas in the lamp will be varied and consequently the resistance between the electrodes 3 and 5 increased or decreased to modify the discharge therebetween and cause the light intensity of the positive column discharge to fluctuate in accordance with the variations produced by the current varying device, which, by way of example, is shown as a microphone.

It has been found that a small change in the ionizing circuit will cause a relatively large change in the light intensity of the lamp. If desired, the current varying means may be inserted in the circuit including the electrodes 3 and 5 and the glow-discharge between these electrodes controlled directly in accordance with variations in the current produced thereby.

In Fig. 4 an amplifying tube is introduced between the microphone and the discharge lamp. The ionizing electrodes 3 and 4 are supplied with suitable direct current through the line 23, and the current variations, in accordance with which it is desired to control the discharge, are impressed between the electrodes 3 and 5.

The electrode 5 is always at a positive potential. It is, however, less positive than the electrode 4 and therefore serves as a cathode for the electrode 4 whereby a discharge takes place therebetween, the circuit being completed through the plate and filament of the thermionic amplifier 24 to the line 23. The plate 25 of the amplifier is thus also maintained at a positive potential. The electrode 5 is also connected through the current varying device 20 and the battery 26 to the grid 27 of the amplifier whereby the grid is also given a positive charge. The battery 26, however, is connected in opposition to the line voltage so as to maintain the grid potential slightly lower than the potential of the plate. By thus maintaining the control circuit including the microphone 20 at a relatively high potential, a large amplification of the variations produced by the microphone is obtained and impressed on the lamp.

It is understood, of course, that the micro-

phone 20 has been used as the current varying device only for the sake of simplicity in illustrating and describing the invention, and that the lamp may be controlled in accordance with electrical variations produced in other ways, as in the electrical transmission of pictures, the so called television, radio movies and similar applications.

In Fig. 5 is shown diagrammatically, an arrangement for controlling the light of the discharge lamp in accordance with current variations transmitted by radio. The receiving apparatus shown in the left of Fig. 5 may be any suitable type, the form here shown being by way of example only. The electrical variations received by the antennae circuit and detected and amplified by the thermionic valve 28, are impressed between the electrodes 3 and 5 of the discharge lamp and the intensity of the light is thereby varied in accordance with the received impulses.

In Fig. 6 is shown one arrangement for using the discharge lamp as a rectifier for supplying direct current, for any desired purpose as, for instance, supplying the plate current for radio tubes. The alternating current source 29, for instance the ordinary commercial lighting circuit of 110 volts, is stepped up by a transformer 30, the opposite ends of which are connected to the electrodes 3 and 4. The third electrode in this instance, may take the form of a plate 31, which should be of relatively large area as compared to the electrodes 3 and 4. Direct current is obtained between the electrode 31 and the central portion of the secondary of the transformer 30 and the irregularities in such current are smoothed out in any desired manner as by shunting a number of condensers 32 across the conductors 33 and 34 and introducing inductance coils 35 in series in the line. The voltage may be controlled by a suitable rheostat 36.

The rectification of the alternating current is obtained by virtue of the difference in cathode drop of the electrode 31 and the electrodes 3 and 4. The electrode 31 because of its large surface, has a relatively small cathode drop as compared to the electrodes 3 and 4. It would therefore require a higher voltage to produce a discharge between either of the electrodes 3 or 4 and the electrode 31 when the former electrodes are used as a cathode than when the latter is used as a cathode. By suitably proportioning the size and shape of these electrodes and the gas pressure within the device, the discharge in one direction may be entirely suppressed and a discharge be produced alternately between the electrode 3 and 31 and the electrode 4 and 31.

It will thus be noted that both the positive and negative portions of the alternating current are utilized and a continuous direct current produced.

In place of making the electrodes 3 and 4

of less area than the electrode 31, they might be made of the same area and be differently shaped or arranged so as to obtain a point-to-plate discharge effect to produce a discharge therebetween in one direction only.

It will be understood that this invention is not limited to the particular embodiments shown and described as many variations may be made in the construction of the lamp and the circuit connections and apparatus utilized without departing from this invention.

What is claimed is:

1. A discharge lamp comprising an envelope containing a rare gas, a pair of closely spaced electrodes within said lamp for reducing the starting potential thereof one of said electrodes to serve as a main anode and a third electrode to serve as a cathode for causing a glow discharge within said lamp and a constricted discharge passage for said discharge.

2. A discharge lamp comprising an envelope having a rare gas therein, a chamber within said envelope having walls spaced therefrom and having a constricted discharge passage connecting with said envelope, a pair of electrodes in said chamber adapted to have a constant potential impressed thereon to ionize the gas in said discharge passage, and a third electrode outside of said chamber for producing a positive column glow-discharge within said constricted passage.

3. A discharge lamp comprising an envelope having a rare gas therein, an open ended chamber within said envelope having imperforate side-walls spaced therefrom, electrodes spaced longitudinally within said chamber, adapted to ionize a column of gas therein, and a third electrode outside of said chamber for producing a positive column discharge through the open end of said member between said inner and outer electrodes.

4. A discharge device comprising an envelope containing a gas, a pair of electrodes of relatively small effective glow discharge area between which a discharge is adapted to take place to ionize the said gas, a third electrode of greater effective discharge area spaced from said other electrodes and serving as a cathode therefor whereby a positive column glow discharge may be produced between at least one of said other electrodes and said cathode, said third electrode being apertured and means for directing the positive column discharge through the aperture thereof.

5. A discharge lamp comprising an envelope, a reentrant stem, a pair of leading-in conductors sealed through said stem, a tubular insulator surrounding both of said leading-in conductors and sealed to said stem, an electrode of small area secured to each of said leading-in conductors and disposed within a tubular insulating member disposed axially of said envelope, said tubular member having

a restricted outlet, and a third electrode disposed externally of said tubular member for cooperating with at least one of said first mentioned electrodes to produce a luminous discharge in said tubular member.

6. A discharge lamp comprising an envelope, leading-in conductors sealed through a wall of said envelope, electrodes secured to said leading-in conductors, a hollow insulating member within said envelope and sealed thereto; said insulating member surrounding said electrodes and leading-in conductors and having an outlet passage, and an electrode disposed externally of said insulating member to cooperate with said other electrodes to produce a luminous discharge within said insulating member.

7. A discharge lamp comprising an envelope, a gaseous filling therein, a stem in said envelope, a hollow insulating member within said envelope and sealed at one end to said stem, an electrode within said hollow member, a leading-in conductor sealed through said stem and joined to said electrode, a tubular discharge passage of small cross section extending from the interior of said hollow member to the exterior thereof, and an electrode disposed externally of said hollow member adjacent said discharge passage to permit light developed in said passage to be viewed along the axis of the passage.

8. A discharge lamp comprising an envelope containing a gas at a low pressure, a hollow open-ended insulating member sealed to and forming a chamber within said envelope, a pair of electrodes, each having small effective discharge areas, disposed in said chamber for ionizing the gas within said envelope, said hollow member being reduced to form a constricted passage at its open end and a third electrode having a relatively large effective discharge area disposed outside, in alignment with, and adjacent said constricted passage to produce a positive column discharge in said chamber when a variable potential is impressed between the third electrode and at least one of the ionizing electrodes, said third electrode having an aperture in alignment with said constricted passage.

In testimony whereof, I have hereunto subscribed my name this 8th day of July, 1924.

ERNEST ANTON LEDERER.