Sept. 15, 1959 E. LEMMERS 2,904,715

MODULABLE DISCHARGE LAMP

Filed Oct. 29, 1954 3 Sheets-Sheet 1

Fig. 1

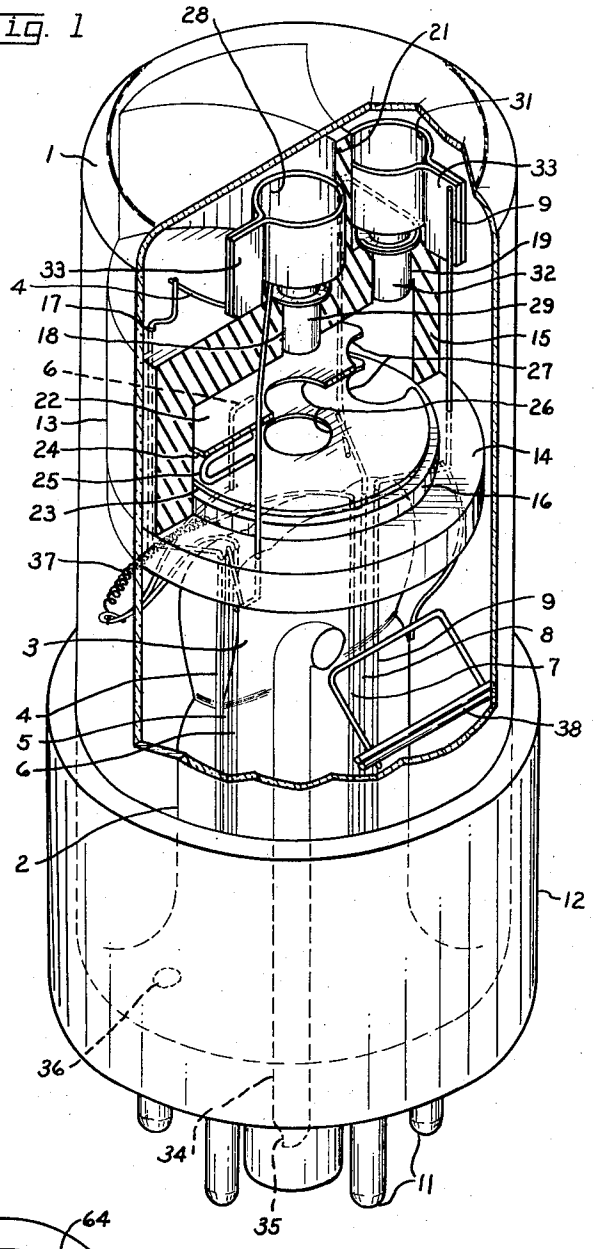
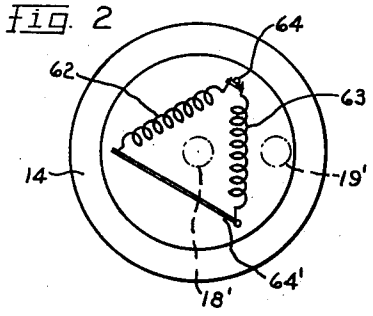


Fig. 2



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fig. 3

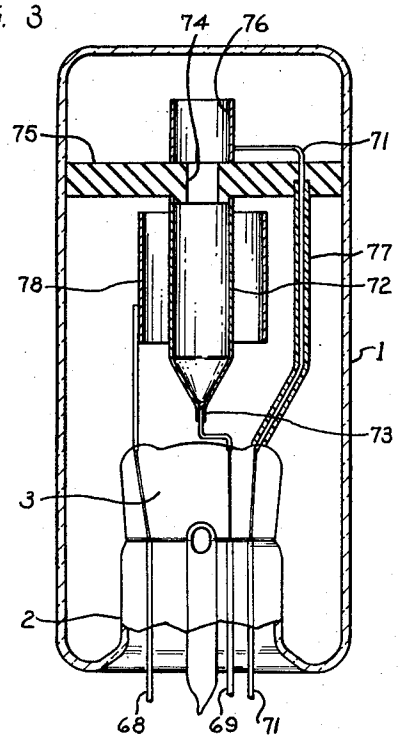
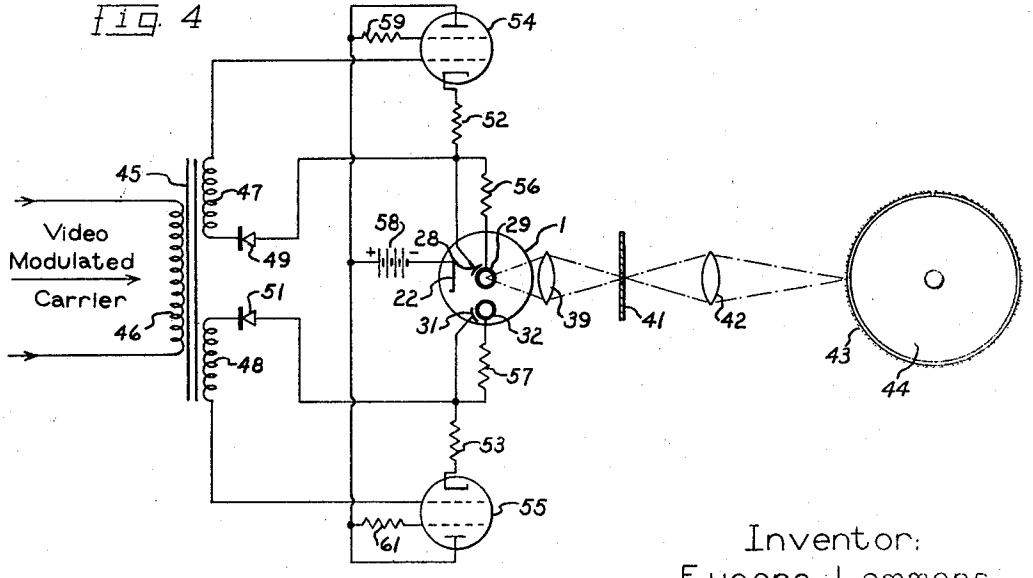


fig. 4



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MODULABLE DISCHARGE LAMP

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Fig. 5

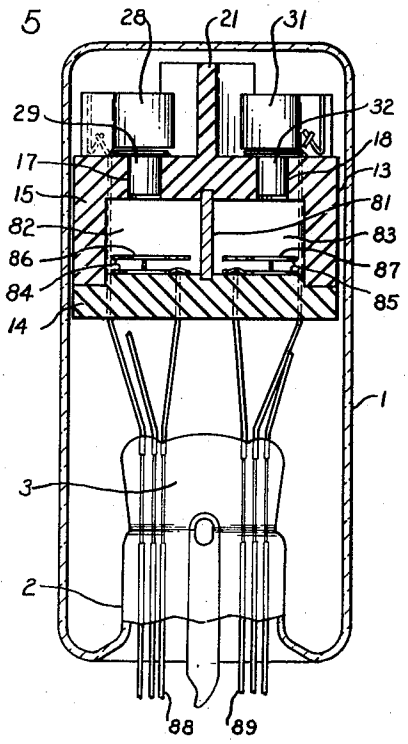
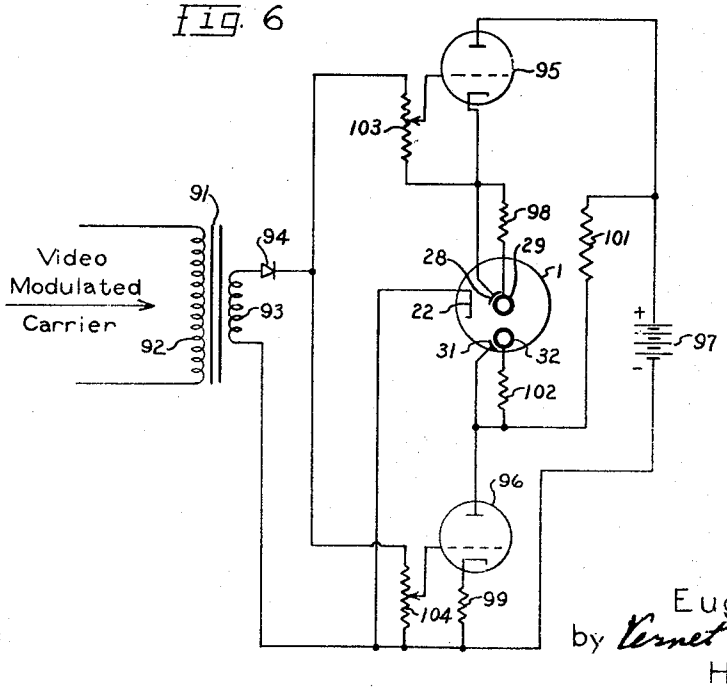


Fig. 6



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United States Patent Office 2,904,715 Patented Sept. 15, 1959

2,904,715

MODULABLE DISCHARGE LAMP

Eugene Lemmers, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of New York

Application October 29, 1954, Serial No. 465,465

4 Claims. (Cl. 313—185)

This invention relates in general to modulable electric discharge lamps or devices used for translating an electric signal into a variation in intensity of light or other radiation. It relates more particularly to modulable discharge lamps providing a light source of relatively small area and rich in actinic radiation. Such lamps approximate point sources and are particularly useful for achieving fine resolution in the transmission of printed material or pictures by electrical means.

In my Patent 2,445,678, entitled "Electric Discharge Device," there is described a lamp providing a light source of small area and in which the intensity or brilliance of radiation from the discharge can be modulated by varying the discharge current. The preferred construction described therein comprises a cathode and a main anode spaced in front thereof and so arranged that the discharge between cathode and anode is visible end-on past the latter. An auxiliary anode or control electrode is provided, and, by maintaining a potential difference between the cathode and this auxiliary anode, a part of the discharge is diverted from the main discharge with the result that the end-on intensity of the radiation from the main discharge varies in greater proportion than the total discharge current.

A difficulty which has been encountered with that lamp and which also appears to be present with the modulable small area light sources commercially available, is that of variability in the intensity of radiation at any given time depending upon the average intensity of radiation or current flow through the lamp over the immediately preceding time interval. For instance, in the transmission of pictures, when the lamp is reproducing, by a suitable scanning sequence, a shaded area of low average brightness and then shifts to a sunny area of high average brightness, the instantaneous increase in radiation from the lamp may be less than it would be for the same change in brightness occurring in an area of constant average brightness. A reciprocal effect is observed when a decrease in the average brightness occurs. If, by relation to the scanning sequence, there are regions of pronounced time duration where the brightness is other than average, the radiation from the lamp experiences a slow shift which causes a variation of picture density for a given signal. Due to the range and the distribution of the light tones in any given picture, this condition is not always apparent. However, where all the dark tones are in one area and all the light tones in another area, the trouble becomes quite apparent and results in a distortion of the tonal values of the picture.

The object of the invention is to provide a new and improved modulable lamp of small light area having improved stability in the relation between generated radiation and discharge current.

A more specific object is to provide a modulable lamp of the instant kind which eliminates or substantially reduces the instability resulting from changes in average radiation.

Another object of the invention is to provide a modulable lamp of the instant type wherein an instantaneous change in tonal value is accurately reproduced irrespectively of the average tonal value.

Yet another object of the invention is to provide light intensity modulating systems of improved stability and accuracy for the reproduction of signals, such as transmitted images.

During the course of the studies and tests which led to the instant invention, it has been discovered that the observed instabilities are due to the fact that the light or radiation generated depends to some extent on the average heat loss or wattage dissipation in the lamp. This observation applies not only to the commercially available glow modulator tubes, but also to the modulable lamp of my earlier mentioned patent.

In glow modulator lamps or tubes, the light generated varies with the cathode fall or voltage drop. If such lamps are left for several minutes at some intermediate to large current, the cathode heats up, the cathode fall decreases and the light output changes accordingly. Whereas at first the cathode fall decreases, this brings about a decrease in the wattage loss in the lamp which eventually causes the cathode to cool and the cathode fall to increase again. Thus a cycling action may occur which produces a variation in picture density for a given signal.

In the lamp of my earlier-mentioned patent, the instability appears to occur through a different mechanism inasmuch as the light source is an end-on viewed positive column and what happens at the cathode has relatively little effect on the light produced. That lamp uses mercury as the ionizable medium because the available rare gases do not give sufficient actinic radiation output in the positive column. Here the instability appears to be due to changes in mercury pressure from low average signal to high average signal, and the change in mercury pressure in turn results in a change in average radiation.

In accordance with the invention, the above-described difficulties may be obviated by a lamp having twin discharge paths operable in opposite phase and an electrode structure which permits at least one of the paths to be viewed endwise, that is, in depth. In a positive column-type of modulable lamp, a lamp in accordance with the instant invention is provided with two anodes and operates with two positive columns. Such a lamp may be operated in a push-pull type of amplifier with the two columns in opposite phase. At zero signal, one positive column is very dim and the other is very bright; at maximum signal, the reverse occurs. Thus, for any signal there is a change in opposite directions in the light output of the two positive columns, but there is essentially no change in the total lamp current, so that the lamp operates at substantially constant wattage. Consequently the mercury pressure remains constant and the light or radiation output for a given signal or current value is stabilized. The positive columns are physically separated from each other sufficiently to achieve optical independence. Thus each positive column may be used independently of the other, one giving a positive and the other, a negative light signal.

The invention is also applicable to negative glow types of modulable lamps, for instance the kind where a negative glow region is viewed in depth. In such case, there is provided a single cathode and a pair of negative glow discharge spaces operating therefrom. The discharge paths are operated in opposite phase so as to maintain the wattage loss at the cathode constant, whereby to stabilize the cathode fall. The negative glow spaces are physically separated so that one may be used without optical interference from the other.

Other objects and features of the invention and the several advantages thereof will become apparent from

the following specification taken in conjunction with the accompanying drawings. The features of the invention believed to be novel will be more particularly pointed out in the appended claims.

In the drawings, wherein like numerals denote corresponding parts throughout the several views:

Fig. 1 is a perspective view of a modulable lamp of the positive column-type embodying the invention in preferred form;

Fig. 2 illustrates an alternative cathode construction which may be used with the lamp of Fig. 1;

Fig. 3 is a sectional view of a modulable lamp of the negative glow-type, likewise embodying the invention;

Fig. 4 illustrates schematically a picture reproducing system using the positive column modulable lamp of the instant invention;

Fig. 5 is a sectional view of another positive column modulable lamp embodying the invention;

Fig. 6 illustrates schematically another operating circuit for a twin discharge path modulable lamp in accordance with the invention.

Referring to Fig. 1, the modulable lamp of the positive column type shown therein is similar in external configuration to a small glass radio receiving tube. The envelope **1** is a cylindrical glass bulb with the usual stem and flare construction **2** at one end, including a press **3** through which are sealed lead wires **4**—**9** whose inner projections within the bulb serve also as support wires for the various elements therein. The outer projections of the lead wires are soldered into the pins **11** of an octal-type base **12** cemented in the usual fashion to the sealed end of the envelope.

Positioned within the envelope immediately above press **3** is an insulator body **13** having a generally cylindrical hollow interior with its axis coinciding with the longitudinal axis of the envelope. The instant lamp, in regards to the construction of the insulator body, follows the teachings of copending application No. 465,466, filed October 29, 1954, now Patent No. 2,805,354, in my name jointly with Andrew Kovach, entitled "Modulable Lamp Construction," and assigned to the same assignee as the present invention. Insulator body **13** comprises a circular disk **14** and a hollow cylindrical shell **15**, both the disk and the shell making a relatively close fit within envelope **1**. Both parts of the insulator body are made of a suitable ceramic material, lava for instance, which is readily machined. For mass production, a ceramic which can be molded to shape and then baked hard, for instance that sold commercially under the name "Steatite," would be preferred. Disk **14** is provided with a raised circular step **16** whose edge forms a flange fitting against the lower edge of the side wall of shell **15** to assure accurate seating of the two parts. The shell and the disk are held together by the lead wires **4**, **5** and **8**, **9**, which are threaded through aligned holes in the disk and in the side wall of the shell. Some or all of the leads may be bent sharply at the points of entrance into and emergence from the holes through the insulator body whereby to lock the two parts axially together.

The circular end wall of the shell is provided with a pair of apertures, a central one at **18** and a side one at **19** for accommodating the two positive column discharges. It is also provided with a projecting portion **21** extending substantially to the end wall of the glass envelope, and generally of double concave form when viewed in section transverse to the longitudinal axis of the lamp. Portion **21** serves as a light partition to render the two columns optically independent of each other and at the same time assists in insulating the anodes of the two columns.

The single cathode **22** common to both discharge paths here shown is of the cold type, that is, the heat of the discharge is insufficient to render it thermionically emissive and it operates by what is generally known as "field emission." The cathode consists of a pair of spaced parallel disks **23**, **24** seated on raised step **16** of insulating disk **14**. The disks are conductive and have electron-emissive surfaces; they may consist of nickel coated with a mixture of barium and strontium oxides. The spacing between the two disks **23**, **24** is much less than the mean free path of the electrons in the ionizable medium with which the lamp is filled; for instance, it may be $\frac{1}{64}$ to $\frac{1}{8}$ inch. This produces a hollow cathode effect as a result of which electron-emission increases more linearly with applied voltage, because electrons rebound from the cathode walls and knock out more electrons in the process. The cathode disks are maintained in spaced alignment by welded wire strap **25** and the cathode is connected through lead wire **6** to one of the base pins **11**. Both cathode disks have a central opening at **26** and a side opening or lateral cutout at **27** in axial alignment with central aperture **18** and side aperture **19**, respectively, in the end wall of insulator shell **15**. The central hole and the lateral cutout prevent the cathode glow which bathes the surfaces of the cathode disks from being visible through the apertures in the insulator shell.

Each discharge path is provided with a main hollow or apertured anode and an auxiliary apertured anode or control electrode **28**, **29** for the central path and **31**, **32** for the side path. The main anodes **28**, **31** as here shown consist of cylindrical metal sleeves, made for instance of nickel, of a diameter substantially larger than the diameter of the apertures in the insulator shell and axially aligned therewith. The anode shells may be formed by bending a strip of sheet metal into a loop and welding the ends along a medial seam to form a tab **33**; they are supported in place by the lead wires **4**, **9** which are welded to the seam tabs and provide connections to suitable ones of the pins **11** in the base. The auxiliary anodes or control electrodes **29**, **32** consist of flanged metal sleeves or eyelets, of nickel-plated iron for instance, which are fitted into apertures **18**, **19**, respectively, in the end wall of insulator shell **15**, with the flange at the upper or front side of the shell wall. The eyelet holes of control electrodes **29**, **32** determine substantially the area of the light source and for this reason they are made as small as possible consistent with the quantity of light required to be obtained.

The lamp is evacuated and filled with a suitable ionizable medium consisting of a starting gas at a low pressure and a small quantity of mercury, through exhaust tube **34** and is then sealed by tipping off the exhaust tube at **35**. A suitable starting gas consists of a mixture of neon with 0.8 percent argon at 45 millimeters pressure. The mercury is indicated by a supply droplet **36** inside the envelope which is preferably in excess of the amount required to saturate the filling at the operating temperature of the lamp. Between the ends of leads **6**, **7** is connected a resistance heater **37**, such as a coiled-coil of fine tungsten wire. The current through this heater may be thermostatically controlled to maintain a fairly constant temperature within envelope **1** despite wide variations in ambient temperature. A getter strip **38** consisting of a barium-containing metal may be provided to clean up any residual gases during the evacuation process.

The lamp of Fig. 1 may be used in the circuit illustrated schematically in Fig. 4, representing the receiving apparatus of a facsimile system for transmitting photographs by radio or wire. In this system, a print of the picture which is to be transmitted is placed on a cylinder at the transmitting station and revolves at a moderate rate of speed. As the cylinder revolves, a pin point of light is moved slowly across the cylinder and reflects from the print back to a photoelectric tube, thereby providing a helical scan of the print. The photoelectric tube generates a signal in accordance with the variations of light striking it, which signal is superimposed as an amplitude modulation on a suitable carrier and transmitted to the receiving station either by radio or telephone circuit. At the receiving station, the modulated carrier is translated into a suitable signal to operate the modulable discharge

lamp. The small area light source provided by the lamp is focused into a pin point by means of an optical system comprising an objective lens **39**, a pinhole mask **41**, and a projection lens **42**. The projection lens focuses the pin point of light on a blank sheet **43** of sensitized photographic paper which is attached to a revolving drum **44**. Drum **44** is caused to rotate synchronously with the drum at the transmitting station, and at the same time the modulable tube with its optical system is caused to translate across the drum in synchronism with the pin point of light at the transmitting station, thereby causing the helical scan to be reproduced identically at the receiving point.

The receiving apparatus for energizing the modulable tube comprises a transformer **45** having a primary winding **46** which receives the carrier wave amplitude modulated by the video signal, and a pair of secondary windings **47, 48**. Secondary windings **47, 48** are connected, in series with rectifier elements **49, 51** and cathode biasing resistors **52, 53**, in the cathode to signal grid circuits of power amplifier tubes **54, 55**, respectively. Cathode resistor **52** is connected to central main anode **28** of the modulable lamp, whereas cathode resistor **53** is connected to side main anode **31**. The central and side control electrodes **29, 32** of the modulable lamp are connected to their respective main anodes by voltage dropping resistors **56, 57**. The anodes of amplifier tubes **54, 55** are connected to the positive side of a unidirectional voltage supply represented by a battery **58** whose negative side is connected to cathode **22** of the modulable lamp. Amplifier tubes **54, 55** may consist of type **6V6** beam tetrode tubes in which case the screen grids are connected to the anodes through voltage dropping resistors **59, 61**. The instant arrangement wherein the lamp is inserted in the cathode to negative side of the amplifier tube's voltage supply allows push-pull operation of the lamp with but one cathode.

In operation, rectifier elements **49, 51** cause demodulation of the carrier with energization of amplifier tubes **54, 55** in opposite phase. The discharge current in one discharge path in the lamp, for instance that between cathode **22** and main anode **29**, increases with the signal whereas that in the other discharge path between cathode **22** and main anode **32** decreases. The intensity of the endwise radiation from the discharge depends on the discharge current. Thus the intensity of radiation from one discharge path increases as the other decreases and vice versa. Since the two discharge paths are operated in opposite phase from a balanced push-pull amplifier, there is essentially no change in the total cathode current. Thus the wattage dissipation of the lamp remains substantially constant and the mercury pressure, which is determined by the temperature of the lamp, likewise remains constant. As a result, the instability and cyclic variations in light occurring in prior art lamps with changes in the average brightness of the transmitted image or signal strengths are eliminated or substantially reduced.

It will be appreciated that in the lamp illustrated in Fig. 1 each discharge path is optically accessible. One discharge path produces a modulated positive column discharge corresponding to a positive light signal, whereas the other gives a similar discharge corresponding to a negative light signal. By shifting the optical system from one discharge path to the other, the same lamp can be used to produce either a negative or a positive image of the transmitted picture signal without any changes in circuit connections.

Essential illustrative particulars of a modulable lamp such as shown in Fig. 1, which was actually built and tested, are here given:

The envelope **1** may be about 1 inch in internal diameter and 2⅜ inches long, with a substantially flat front end and with the stem and press extending forward into the interior of the bulb about 1¼ inches. The insulator body **13** may be about ⅝ inch in axial length and with the cathode cavity therein approximately ¾ inch in diameter and ¼ inch in axial length. The comparative dimensions of the electrode members may readily be seen in the drawing. Such a lamp, with a filling of a mixture of neon and 0.8 percent argon at 45 millimeters pressure and with an excess of mercury, operates with a voltage drop which remains substantially constant at about 90 volts. The current in each discharge path is variable between 2 and 32 milliamperes: at zero signal, one path draws 32 and the other draws 2 milliamperes; at middle signal value, each half draws 17 milliamperes.

Fig. 2 illustrates a variant of the modulable lamp of Fig. 1 wherein the cold type cathode **22** is replaced by a hot thermionic filamentary cathode. Referring to Fig. 2, the insulator body disk **14** has mounted thereon a pair of coiled filaments **62, 63** which are disposed in V fashion with one of the filaments located between the projections of the apertures **18** and **19** in the insulator shell, here represented by the dotted circules **18', 19'**. The filaments are connected together to a lead wire **64** at the apex of the V and their other ends are connected in parallel to a lead wire **64'**. Both sides of the filamentary cathode are brought out by the lead wires to a suitable pair of base pins **11**. The illustrated disposition of filaments prevents their thermal radiation from becoming visible through the apertures in the insulator body, and insures that substantially only the light from the modulable discharge reaches the external optical system. With a thermionic cathode, the voltage drop of the lamp is much lower than with a cold cathode and it is desirable to operate the lamp in a circuit of high series impedance in order to counteract the negative resistance characteristic of the lamp and resulting tendency to oscillate. With this embodiment, as with the embodiment of Fig. 2, the feature of twin discharge paths, operable out of phase one with the other whereby to equalize the total wattage dissipation, substantially eliminates any instability in light or radiation output consequent upon changes in average signal strength.

Fig. 3 illustrates another embodiment of the invention wherein the principle of equalization of total wattage dissipation by the provision of a pair of discharge paths operable out of phase is applied to a negative glow type of modulable lamp. The lamp comprises, as in the embodiment of Fig. 1, a generally cylindrical glass envelope **1** with the usual stem and flare closure **2** and press **3** through which are sealed lead wires **68, 69** and **71**.

The cathode **72** is in the form of a hollow thin-walled cylinder which is conically shaped at its lower end and crushed about the inward projection of lead wire **69** at **73**. The upper circular open end of the cathode cylinder abuts against a downwardly projecting circular flange around a central aperture **74** through an insulator disk **75** which partitions off the upper or forward end of the envelope. One anode **76** is located in front of the forward face of insulator disk **75** and is apertured, being in the form of a cylinder somewhat larger in diameter than aperture **74** and axially aligned therewith. It is connected to lead wire **71**, and the portion of the lead wire intermediate insulator disk **75** and press **3** is sheathed in an insulating sleeve **77**. The other anode **78** is in the form of a cylinder concentrically located with respect to cathode **72**. The tube is evacuated and filled with a suitable gas at a low pressure, preferably a mixture of an inert gas and a gas such as hydrogen or nitrogen rich in actinic radiation. As is well known in the art, low pressure negative glow lamps generally have gas fillings under 100 millimeters pressure, and commonly in the range from 10 to 50 millimeters.

In the operation of the lamp of Fig. 3, the two anodes **76, 78** are driven in opposite phase, that is, they are energized in such fashion that when the current supplied to one anode increases that supplied to the other decreases in substantially the same proportion. As a result, the

total current drawn from the cathode remains constant irrespectively of the signal. Thus the wattage dissipation at the cathode is constant, its temperature remains constant, and accordingly the cathode voltage drop or fall does not vary. It will be appreciated that by reason of the thinness of the cathode wall both the interior and the exterior emitting surfaces are in close thermal union with each other, so that it becomes immaterial, as far as the temperature of either surface is concerned, whether current is drawn from the inside to anode 76 or from the outside to anode 78. Thus instability and variations in light output resulting from variations in the average signal strength or brightness of the transmitted image are substantially eliminated. It will be appreciated that with the lamp of Fig. 3, the useful light or radiation is obtained by viewing the cathode end-on through the aperture 74 and the high ionization density in the cathode, together with the fact that the discharge region is viewed in depth, assures a substantial luminous intensity.

Fig. 5 illustrates yet another embodiment of the invention wherein the principle of equalization of total wattage dissipation by the provision of twin discharge paths operable in opposite phase is applied to a positive column type of modulable lamp having two electrically insulated cathodes. In the positive column modulable lamp, the major requirement for stabilizing the radiation output is constancy of mercury pressure, contrary to the negative glow type wherein the major requirement is constancy of cathode drop. Accordingly, it is possible to provide two separate cathodes, one for each discharge path, and a good degree of equalization is realized providing the ionizable medium can circulate freely from one discharge region to the other. In this manner, a variation in average signal strength in one discharge path will be compensated by variation in the opposite direction in the other discharge path, and the mercury vapor will flow from one path to the other so as to maintain the pressure in each path substantially constant.

Referring to Fig. 5, the lamp comprises, as in the embodiment of Fig. 1, a generally cylindrical glass envelope 1 with the usual stem and flare closure 2 and a press 3 through which are sealed the lead wires. The insulator body 13, positioned within the envelope, comprises disk 14 closing the lower end of hollow cylindrical shell 15 and a septum or partition 81 dividing the interior of the shell into two hemicylindrical cavities 82, 83. All parts of the insulator 13 are made of a suitable insulating material, such as lava, or a ceramic which can be molded to shape and then baked hard. The cavities are provided with cathodes 84, 85 consisting of spaced plates with openings 86, 87 therethrough in line with the axis of apertures 17, 18 in the upper or front circular end wall of the shell on either side of portion 21. The cathode disks may be semicircular in shape and coated with electron-emissive materials, such as barium and strontium oxides. The discharge paths are provided with main anodes 28, 31 and auxiliary anodes or control electrodes 29, 32, arranged in the same fashion as the corresponding electrodes in the embodiment of Fig. 1. The cathodes 84, 85 are provided with individual lead wires 88, 89 allowing separate connections to each.

In the operation of the lamp of Fig. 5, the discharge paths are energized in opposite phase relation, so that when an increase in current occurs in one path a proportionate decrease occurs in the other. When one path carries a larger current for an appreciable length of time, the mercury pressure will tend to rise in the discharge path which is more heavily loaded, and to fall in the other. However, mercury vapor can readily flow from one discharge region to the other through the apertures 17, 18. The mercury pressure is thus equalized and remains substantially constant in both discharge regions and the desired stabilization is thereby effected. The lamp of Fig. 5 thus achieves stabilization of the radiation output similarly to that of Fig. 1, but in addition has the feature that the two discharge paths may be operated in totally independent electrical circuits. For certain applications, this is a decided advantage, particularly where it is desirable to operate one cathode at a constant unidirectional bias relative to the other.

Fig. 6 illustrates another circuit suitable for operating modulable lamps in accordance with the invention with the two discharge paths modulated in opposite phase. In this arrangement, one discharge path is connected in series with an amplifier tube and the other discharge path in parallel with another amplifier tube. By applying a signal in the same phase to each amplifier tube, the resulting signals effective across the discharge paths will be in opposite phase.

Referring to Fig. 6, the apparatus comprises a transformer 91 having a primary winding 92 which receives the carrier wave amplitude modulated by the picture signal, and a secondary winding 93. The secondary winding is connected, in series with rectifier element 94, in the cathode to grid circuits of amplifier tubes 95, 96. Tube 95 is connected in series with the discharge path in the modulable lamp served by main anode 28, whereas tube 96 is connected in parallel with the discharge path served by main anode 31. To this end, cathode 22 of the lamp is connected to the negative side of an unidirectional voltage supply herein indicated by a battery 97, and the anode of tube 95 is connected to the positive side of the battery. The cathode of tube 95 is connected to main anode 28 of the lamp, the associated auxiliary anode 29 being connected to main anode 28 through a voltage dropping resistor 98. The cathode of tube 96 is connected, in series with biasing resistor 99, to the negative side of battery 97. The anode of tube 96 is connected directly to main anode 31 of the lamp and the two are connected, in series with common coupling resistor 101, to the positive side of battery 97. The auxiliary anode 32 is connected to main anode 31 through a voltage dropping resistor 102. Potentiometers 103 and 104 provide loading for rectifier element 94 and permit separate adjustment of the grid signal to tubes 95, 96 whereby to compensate for individual tube characteristics.

In operation, rectifier element 94 causes demodulation of the carrier with energization of amplifier tubes 95, 96 in the same phase. Thus an increase in signal strength will cause the currents to increase in both tubes. Since tube 95 is connected in series with its associated discharge path, an increase in current in that tube will bring about an increase in current in the associated discharge path in the lamp. However, since tube 96 is connected in parallel or shunt with its associated discharge path, and since the total current is limited through coupling resistor 101, an increase in current through that tube will cause a proportionate decrease in current through the associated discharge path. Thus, the required conditions are met, namely, that the signals effective across each discharge path in the lamp are in opposite phase, whereby the current in one path will decrease while that in the other increases. The instant circuit has the feature that it is operable from a single-ended transformer or input circuit, which is an advantage in certain applications.

While certain specific embodiments of the invention have been illustrated and described in detail, it is to be understood that these have been provided by way of illustration and not in order to limit the invention thereto. Obviously, the invention admits of many modifications in the lamp structures, shapes or material which have been mentioned. Other suitable circuits will readily occur to those skilled in the art for achieving the desired out-of-phase operation of the two discharge paths. The applications of such modulable light sources are, of course, not restricted to facsimile recording; other well-known applications include use in oscillograph timing markers, stroboscopic devices, and in general wherever a high in-

tensity modulated radiation source of small surface area is required.

The invention proper is to be determined by the following claims which are intended to cover any modifications coming within its true spirit and scope.

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

1. A modulable gaseous electric discharge lamp of the positive column type comprising a sealed vitreous envelope containing an ionizable medium including an inert starting gas and mercury, a cathode sealed within said envelope, an insulating body partitioning off a portion of said envelope from the region about said cathode, a pair of apertures through said insulating body, and a pair of anodes located in said partitioned-off portion, one adjacent each of said apertures, and cooperable with said cathode to define a pair of optically independent discharge paths extending through said apertures and viewable end-on therethrough, the portions of said cathode supplying each of said discharge paths being in close thermal union with each other whereby the wattage loss at said cathode may be maintained constant, irrespectively of the signal supplied to one anode, by supplying a signal of opposite phase to the other anode.

2. A modulable gaseous electric discharge lamp of the positive column type comprising a sealed vitreous envelope containing an ionizable medium including an inert starting gas and mercury, a cathode sealed within said envelope, an insulating body partitioning off a portion of said envelope from the region about said cathode, a pair of apertures through said insulating body, and a pair of hollow generally cylindrical anodes located in said partitioned-off portion, one about each of said apertures, and cooperable with said cathode to define a pair of optically independent discharge paths extending through said apertures and viewable end-on through said anodes, the portions of said cathode supplying each of said discharge paths being in close thermal union with each other whereby the wattage loss at said cathode may be maintained constant, irrespectively of the signal supplied to one anode, by supplying a signal of opposite phase to the other anode.

3. A modulable gaseous electric discharge lamp of the positive column type comprising a sealed vitreous envelope containing an ionizable medium including an inert starting gas and mercury, a cathode sealed within said envelope, an insulating body partitioning off a portion of said envelope from the region about said cathode, a pair of apertures through said insulating body, a pair of main hollow generally cylindrical anodes located in said partitioned-off portion, one about each of said apertures, and cooperable with said cathode to define a pair of optically independent discharge paths extending through said apertures and viewable end-on through said anodes, and a pair of auxiliary hollow control electrodes lining the walls of said apertures, the portions of said cathode supplying each of said discharge paths being in close thermal union with each other whereby the wattage loss at said cathode may be maintained constant, irrespectively of the signal supplied to one anode, by supplying a signal of opposite phase to the other anode.

4. A modulable gaseous electric discharge lamp of the positive column type comprising a sealed vitreous envelope containing an ionizable medium including an inert starting gas and mercury, an insulating body located within said envelope having a pair of laterally adjacent cavities formed therein, an axial aperture through the insulating body into each cavity, a cathode located in each cavity, a pair of main hollow generally cylindrical anodes located proximately to said insulating body, one about each of said apertures, and cooperable with said cathodes to define a pair of optically independent discharge paths extending through said apertures to respective ones of said cathodes, said apertures being of sufficient size to allow unimpeded circulation of mercury vapor from one cavity to the other whereby to equalize the mercury pressure in said cavities despite unequal discharge intensities therein.

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