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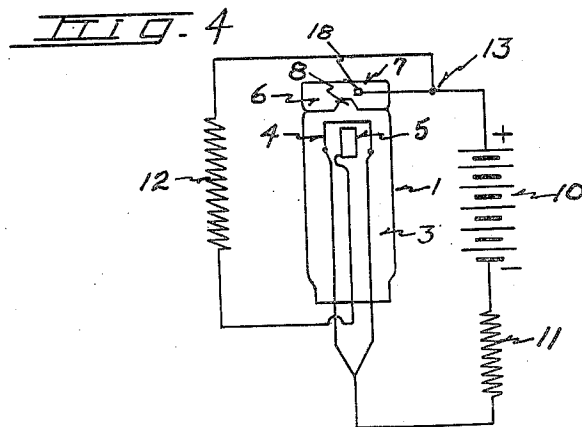
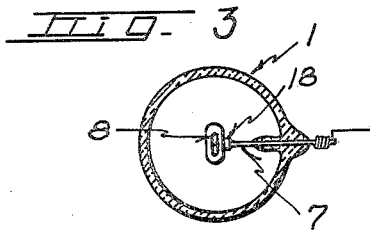
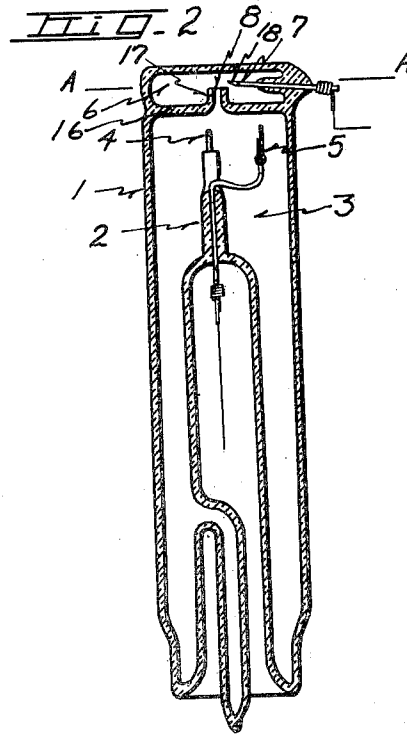
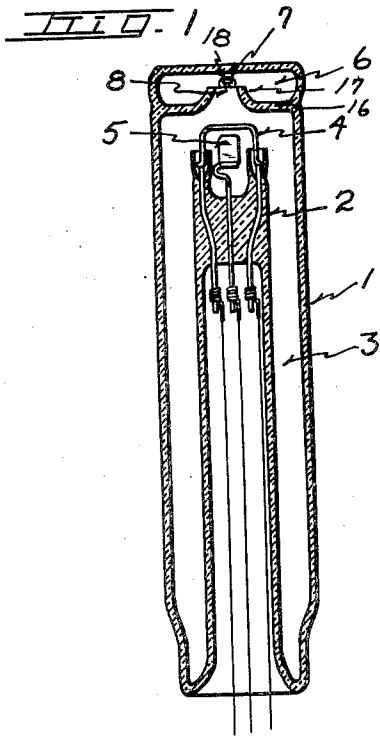
T. W. CASE

1,970,223

SOUND RECORDING GLOW LAMP

Original Filed June 28, 1929

3 Sheets-Sheet 1



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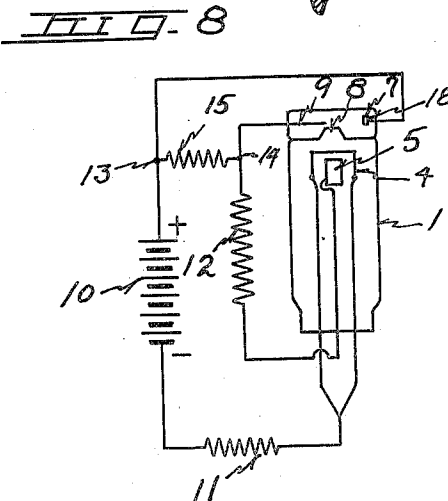
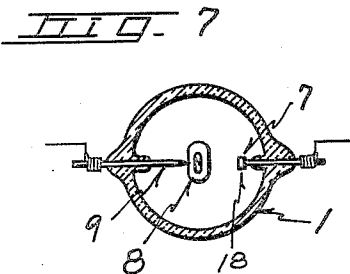
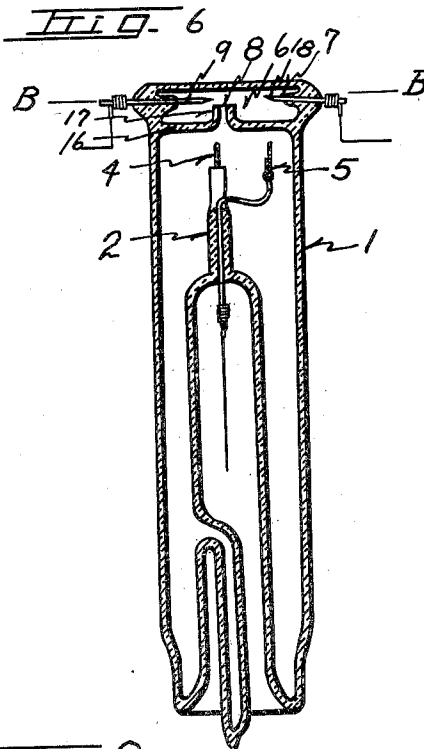
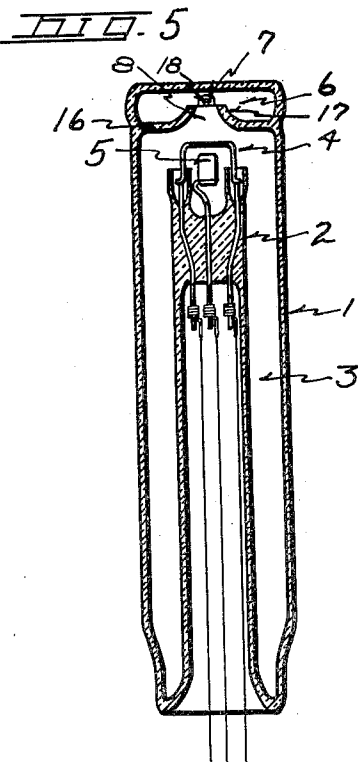
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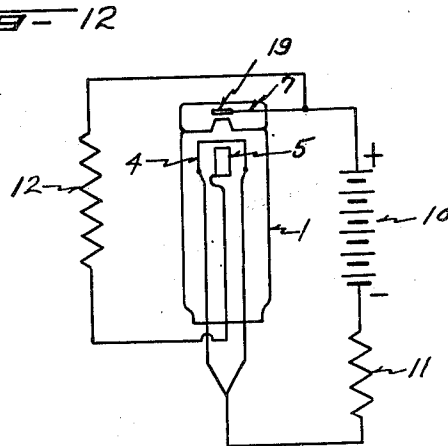
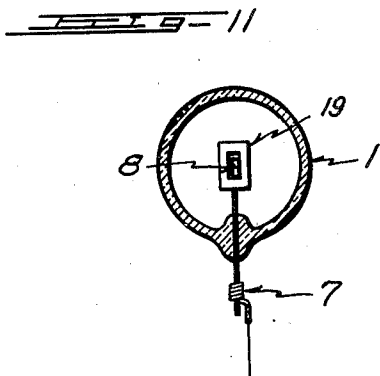
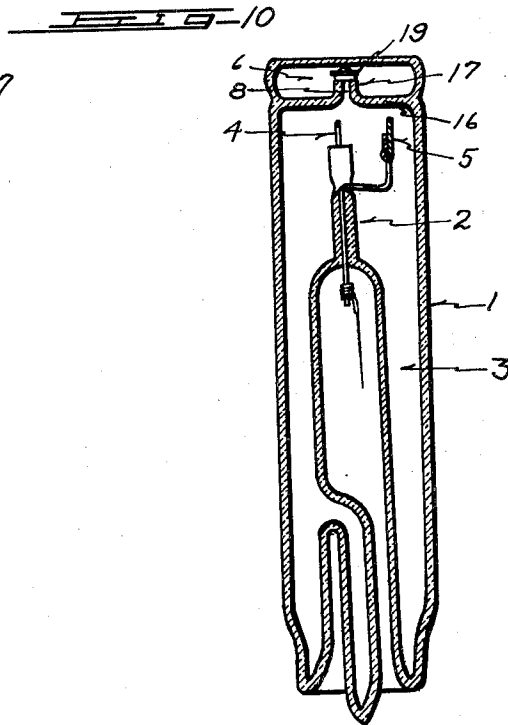
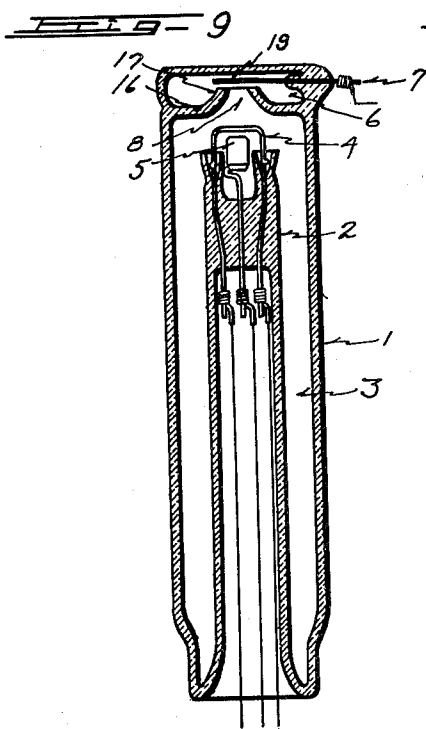
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

1,970,223

SOUND RECORDING GLOW LAMP

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Application June 28, 1929, Serial No. 374,441
Renewed December 14, 1933

3 Claims. (Cl. 176—122)

This invention relates to a new and improved glow lamp for producing a photographic record of light variations corresponding to electrical variations as may be produced by sound variations or other means.

Coated cathode glow lamps as used in the present art of sound recording have a relative high intrinsic brilliancy as compared to the ordinary gas glow between electrodes and have proven to be freer from lag or inertia effects and will also operate at a lower voltage or generally have characteristics adapting the lamp for accurate reproduction of sound variations. The result is believed to result largely from the photo-electric character of the coating produced as for instance in the manner hereinafter described. The brilliancy of the lamp however has some limitations. At present, it is desirable to have the recording lamp in close proximity of the sensitized film to insure a well defined record. More flexibility in the arrangement of the recording apparatus is desirable and can be obtained by increasing the brilliancy of the total glow of the lamp thereby adapting the lamp for more efficient use with an optical slit structure.

It is an object of my invention to provide a positive column, coated cathode glow lamp of brilliancy far in excess of those in use at present. I have discovered that by the use of a specially formed envelope or tube and properly arranging the electrodes and adding another or others with suitable circuit connections, and also confining the glow to a definite inclosed space that the desired increase in brilliancy can be obtained.

The invention further relates to the details of the structure and the form and relation of the tube and the electrodes, and the particular pressure of the gas within the bulb, all as will more fully appear from the following description taken in connection with the accompanying drawings in which:—

Figure 1 is a sectional view of the glow lamp.

Figure 2 is a sectional view of the lamp at right angles to Figure 1.

Figure 3 is a sectional view of the lamp through the upper chamber of the bulb at A—A, Figure 2.

Figure 4 is a diagrammatic illustration of the potential connections to the various electrodes whereby the lamp is made operative.

Figure 5, a sectional view of the lamp shows an added electrode over the lamp illustrated in Figure 1.

Figure 6 is a sectional view of the lamp at right angles to Figure 5.

Figure 7 is a sectional view of the lamp through

the upper chamber of the bulb at B—B, Figure 6.

Figure 8 is a diagrammatic illustration of the potential connections to the various electrodes whereby the lamp is made operative.

Figure 9 is a sectional view of the glow lamp showing a modified anode structure.

Figure 10 is a sectional view of the lamp at right angles to Figure 1.

Figure 11 is a sectional view of the lamp through the upper chamber of Figure 10.

Figure 12 is a diagrammatic illustration of the potential connection to the various electrodes whereby the lamp is made operative.

The glow lamp constitutes an outer casing or bulb 1 of glass or quartz. This casing is constructed so as to form two compartments or chambers, a large one 3 and a smaller one 6 on the top of the bulb. The two compartments are separated by a cross wall or partition 16 having a passage 8 opening from chamber 3 into chamber 6.

As illustrated, this passageway is formed through the partition 16 and a tubular upstanding extension projecting into chamber 6. Although various arrangements of the tubular extension 17 may be made to provide a constricted passageway of some length and in certain cases the tubular extension may be omitted although it is found to have substantial advantages when present. The tubular extension may be formed in various ways as for instance, pressing up a portion of the glass wall or partition, by a properly shaped tool and then grinding off the closed end of the upwardly pressed portion until a passageway is formed. The passageway is preferably of rectangular form having an opening in the shape of the slit and the upwardly pressed portion of the partition forming the tube may taper inwardly and upwardly so that by more or less grinding down of the closed end of the upwardly pressed portion of partition 16 the length of the tubular extension is determined and also the length of the slit opening therefrom.

The tubular extension found best at this time is about $\frac{1}{8}$ inch in height, rectangular in form of an inch long and .050 of an inch wide. This constricted passageway gives rise to a positive column glow ideally suited for the purpose at hand.

Axially located in the bulb is a press 2 supporting the alkaline earth compound coated cathode 4 and an auxiliary or exciting electrode 5, which may be in the form of a plate. Above the opening in channel 8 and extending from the side of chamber 6 is located the anode 7.

The cathode 4 preferably in the form of a filament has a portion extending lengthwise of the opening from passageway 8 and as the film is adapted to move by the upper end of the bulb 1 across the slit opening from passageway 8 it is desired to offset the filament slightly out of line with the slit opening so that there will be no sputtering through the passageway or slit into the upper or top glass wall. This arrangement also allows the edge of the negative glow to come up through the slit and add somewhat to the positive glow.

It is preferable to accurately position the anode so that the glow is equally distributed through the length of passageway 8 at the slit opening. For that reason it is disposed substantially centrally of the length of the slit opening and is formed with a symmetrically enlarged terminal 18 positioned adjacent the side of the slit in Figures 1 to 4 or some distance therefrom as in Figures 5 to 8 inclusive due to the presence of additional structure hereinafter described. A preferred form of positive electrode is a rectangular plate with a hole cut in it as hereinafter described.

The operation of the lamp will be understood with reference to Figure 4.

Battery 10 makes connection from its positive terminal to anode 7. The negative terminal of 10 is connected to a stabilizing resistance 11 which connects with the two end leads on cathode 4. From connection 13 a higher resistance 12, say 50,000 ohms connects to an auxiliary or exciting electrode 5. Sufficient potential across cathode 4 and anode 7 will cause a discharge forming a glow about the cathode known as a cathode glow and an intense positive glow in the slit 8. Electrode 5 due to its nearness to the cathode 4 and also to a positive potential, will produce a slight ionization of the gas in between the main cathode and anode whereby an intense glow will be produced extending through the constricted passage 8 at lower voltages than if the exciting electrode were not used. Resistance 12 will limit the current between electrodes 5 and 4 so that the main discharge must occur between cathode 4 and anode 7 thru the slit 8.

Resistance 11 is used as a stabilizing resistance for maintaining the current between anode and cathode within safe limits of the lamp. An additional exciting electrode 9 is shown in Figures 6 to 8 inclusive.

Potential across cathode 4 and anode 7 will cause an intense positive glow to form within the glass passageway. Electrode 5 due to its proximity and due to the fact that there is no high resistance passageway between it and the negative electrode will strike a glow at a much lower voltage than could be obtained between cathode 4 and anode 7 which has a much higher resistance passageway. This electrode 5 is merely used as an exciting electrode so that as the voltage applied to the light drops the ever present ionization keeps the glow alive in the glass passageway.

The operation of the lamp shown in Figures 5, 6 and 7 is similar to the one previously described. However, the added exciting electrode 9 in chamber 6 may under certain conditions have advantages.

In Figure 8, the positive terminal of battery 10 is connected to the anode 7 while the cathode 4 is connected through stabilizing resistance 11 to the negative terminal. The exciting electrodes 5 and 9 must operate at a lower potential fall from cathode than does the anode 7. Excitation

for these electrodes is obtained from the same battery used in maintaining a potential across anode and cathode, the proper potential being obtained by means of series resistances 12 and 15.

From connection 13 potential finds its way through resistance 15 to exciting electrode 9 at 14. The resistance 12 connects exciting electrode 5 to its exciting potential. The magnitude of the resistance 12 and 15 will determine the fall of potential across the electrodes 5 and 9 to cathode 4. With the proper potential adjustment on the various electrodes, an intense and highly brilliant glow is produced extending well through the constricted passage 8. The efficiency of the lamp as a device for making a sound record is to an extent due to the activated alkaline earth coating on the cathode. The gain in high brilliancy is at present believed due to the presence of the activated coating on the cathode which is photoelectrically active and a process of self excitation due to the glow as it increases or diminishes produces the results obtained.

In Figures 9 to 12 inclusive, the anode 19 is shown in the form of a plate having a rectangular opening centrally located and slightly larger than the slit opening 8 in tube 17. Having anode 19 centrally located over opening 8 produces a more uniform glow than with the anode shown in Figures 1 to 8 and is therefore, the preferred structure.

The exciting electrode or electrodes ionize gas near the high resistance passageway or slit reducing the cathode fall to such an extent that with a reasonable low potential between anode and cathode, an intense glow is produced that is very sensitive to potential changes. This makes the lamp a very efficient device for sound recording when modulated by electrical impulses corresponding to sound waves. The lamp thus described may be manufactured in the following manner.

The electrode which is to act as the cathode may be formed of a platinum strip .011 inch wide and .0005 inch thick although various sizes may be used. The strip is bent into U-shaped form in conformity with the illustration of the electrode 4 shown in the drawings. The platinum strip is heated to a dull red heat with a direct current of 2 to 3 amperes. Calcium nitrate is then applied covering the entire strip. The heat of the strip oxidizes the nitrate forming a hard protective coating of calcium oxide. The calcium oxide protects the platinum strip from the corrosive action of an alkaline earth compound as barium nitrate which is later applied. A coating of barium nitrate is then applied until the filament has a combined thickness of .035 inch. The heating of the filament strip is continued and the nitrate is converted into oxide.

The electrodes are then assembled in the lamp as illustrated. A baking furnace is then placed over the tube and the structure is baked until the temperature rises to 100 degree centigrade during which time the coated platinum filament is disconnected from the direct current source and an oil pump vacuum is maintained.

The furnace is shut off and the structure allowed to cool for fifteen minutes. The furnace is then allowed to heat until a temperature of 200 degrees centigrade is obtained after which it is again allowed to cool for fifteen minutes. This periodical heating and cooling is continued until a temperature of 400 degrees centigrade is obtained.

The baking process has for its purpose the

volatilization of any moisture in the tube and the coated platinum strip. During the process of forming the coating on the platinum strip, considerable barium hydroxide was produced which is also decomposed by the baking process. To eliminate any final trace of moisture, the platinum filament is heated with direct current of approximately 3 amperes and the bulb is pumped to a high vacuum with a mercury pump operating in conjunction with an oil pump for from fifteen to twenty minutes.

The electrodes still contain a considerable amount of gas and in order to drive out all traces of gas a high voltage, as for instance 1200 volts A. C., is connected between the platinum filament and the plate electrode.

The high voltage is applied intermittently until the electrodes become thoroughly heated as indicated by a green flash between electrodes and substantially all gas has disappeared from the electrodes and the tube.

The current is then disconnected and the activated coating on the filament is photo-electric. Gas is then admitted to the bulb while the electrodes 4 and 5 are connected in a circuit including a source of potential of about 650 manually variable volts in series with a resistance of about 8000 ohms. The gas preferred is a combination of helium and nitrogen in the ratio of about 97 parts helium to 3 parts nitrogen and the nitrogen is apparently gradually combined with the oxide coating to effect nitrating of the oxide coating.

When the gas within the bulb reaches a pressure where a discharge starts between the electrodes and the glow practically fills the space between the electrodes 4 and 5 there is about 2 to 3 milliamperes flowing in the circuit between the electrodes. The apparatus is permitted to run in this condition until the glow is evenly distributed over the entire cathode and the current will have risen to approximately 30 to 40 milliamperes. Usually the glow starts in a non-uniform manner and later spreads out more or less uniformly over the entire U-shaped electrode. Wherever the filament becomes activated and glows it will be found that the coating has turned dark brown to black.

This active product that has been formed is at present believed to be a barium nitrate compound and is photo-electrically active.

The voltage in the circuit is then reduced to about 370 volts through the same resistance of about 8000 ohms and more gas is admitted to the bulb until a current of approximately 18 milliamperes is flowing in the circuit. The negative glow under these conditions will be found quite tightly surrounding the electrode and the glow is substantially lavender in color and separate from the anode glow, which is quite pink in color on the surface of the anode.

The activated coating on the cathode has a substantial photo-electric character and the entire combination produces a light of high actinic value.

The pressure which I have found in practice to be preferable is approximately 20 to 25 mil-

limeters of mercury altho a fairly wide range is possible between 10 and 50 millimeters of mercury, the important feature being that the pressure is such as to maintain the glow medium tightly on the surface of the electrode. The electrodes 4 and 5 are preferably arranged in close relation, as for instance about one-quarter of an inch apart, altho considerable variation is possible.

The lamp so produced is peculiarly efficient for the purpose of causing light variations to follow electrical variations faithfully, such as produced by sound variations as the inertia in ionization is reduced by the coating on the cathode, and it will be understood that the production of the glow typical of this lamp and constituting the light to be varied and photographed is dependent upon a number of related conditions, such as the pressure of the gas; the form and spaced distance of the electrodes; the coating of the electrode or electrodes; the voltage used; and that the specific disclosure here is of one particular related condition of the elements of the structure by which a glow highly efficient for the purpose is produced and variations in one related condition will necessitate variations in other related conditions.

Altho I have shown and described a specific structure as illustrative of an embodiment of my invention, I do not desire to restrict myself to the details of the same except where they are specifically set forth in the claims, as various changes and modifications may be made without departing from the invention.

I claim:

1. A lamp for use in producing a photographic record of light variations corresponding to electrical variations comprising a bulb having a partition separating the bulb into two compartments, said partition having an opening there-through and a tubular extension bordering the opening and terminating in a slit, an anode in one compartment, an elongated filamentary cathode in the other compartment extending substantially parallel with the slit and arranged out of line with the slit.

2. A source of light comprising a bulb, an upper and lower compartment in said bulb, a constricted tubular passage connecting said compartments, an anode and exciting electrode in the upper compartment, a cathode and an exciting electrode in the lower compartment, an atmosphere of helium in said bulb at such a pressure that a glow is concentrated between anode and cathode.

3. A source of light comprising a bulb, an upper and lower compartment in said bulb, a constricted tubular passage connecting said compartments, an anode and an exciting electrode in the upper compartment, a cathode and an exciting electrode in the lower compartment, an ionizable gas within the bulb at such a pressure that a direct current in circuit with the electrodes will produce a glow between anode and cathode and concentrated in said constricted tubular passage.

THEODORE WILLARD CASE.