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PROCESS FOR MANUFACTURE OF GLOW LAMPS

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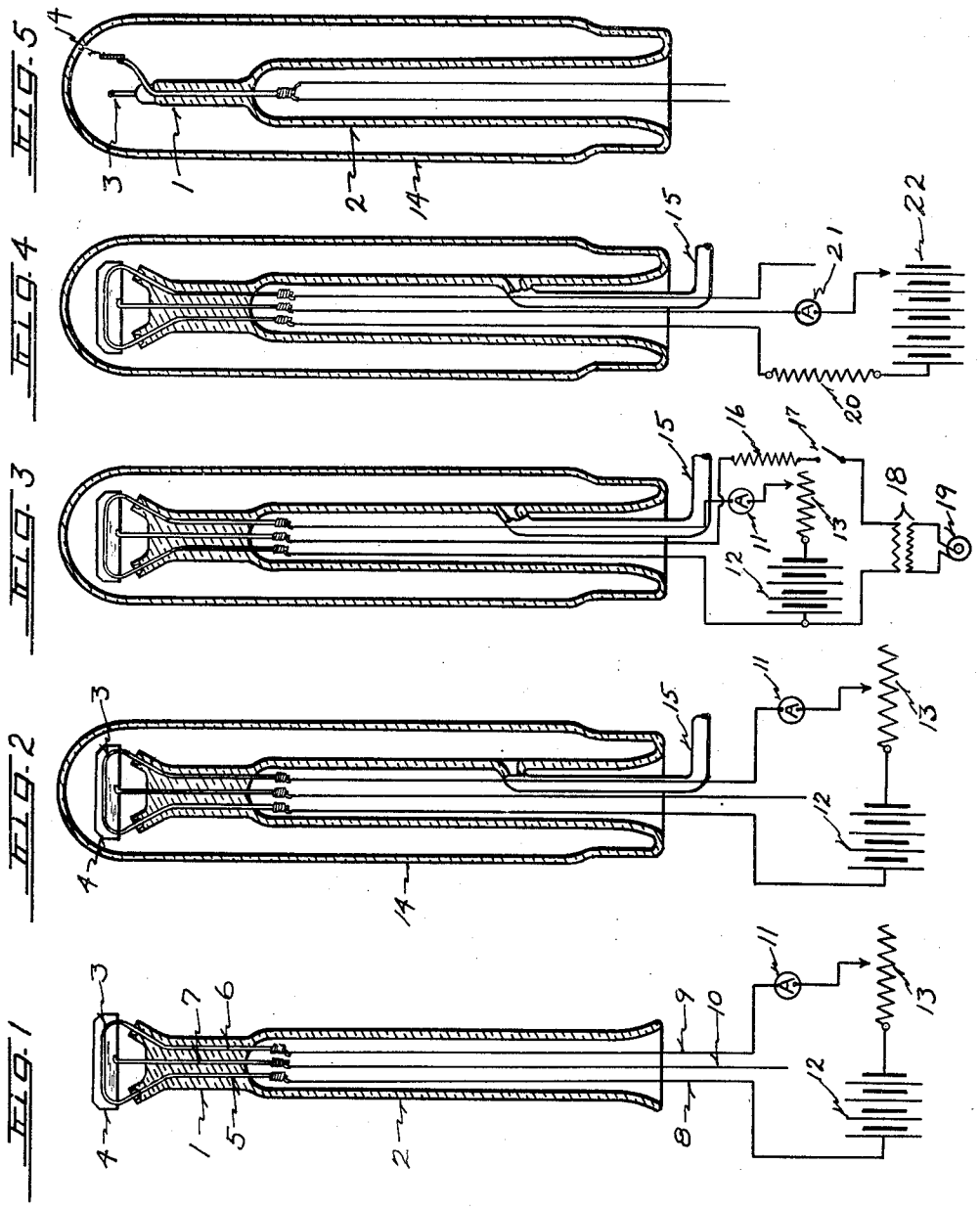

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PROCESS FOR MANUFACTURE OF GLOW LAMPS

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This invention relates to the process of manufacture of glow lamps for sound recording and other purposes.

It is an object of this invention to provide a simple means for commercially producing a glow lamp of high light intensity and capable of instantaneously varying its intensity in accordance with current modulations and having a comparatively long life under normal conditions of use. In order to more fully understand the process, reference will be made to the accompanying drawing in which:

Figure 1 is a view of the electrode assembly of a lamp before sealing in outer casing.

Figure 2 shows electrodes assembled in bulb in readiness for drying and evacuation process.

Figure 3 shows a view of the lamp and connections for activating and out gassing the electrodes.

Figure 4 is a view of the lamp and circuit connections for the final steps in the process of manufacture.

Figure 5 is a sectional view of the completed lamp shown at right angles to the other figures.

Tungsten wires 5 and 6 are sealed in lamp press 1 in any well known manner. To the upper ends of wires 5 and 6 is secured with silver solder filament 3 which is to act as the cathode and may preferably 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 3 in Figure 1. A nickel plate 4 supported by a tungsten wire 7 is sealed in press 2 as the anode in a position as shown in the drawing.

Silver lead wires 8, 9, and 10 are soldered to tungsten wires 5, 6, and 7 respectively which support the electrodes 3 and 4. In circuit with the cathode 3 and connected through leads 8 and 9 is a battery 12, ammeter 11 and a variable resistance 13. Resistance adjustment is made so that a current varying from 2 to 3 amperes will heat the electrode 3 to at first a dull red heat and later to a bright red.

During the heating process calcium nitrate is applied to the filament 3 which is quickly converted to calcium oxide. The calcium compound is applied until the entire exposed portion of filament 3 is covered. It will be necessary to decrease the resistance 13 from time to time as the coating is applied as it requires more current to heat the increase cross section of filament.

Barium nitrate is then applied to the heated filament and is uniformly spread over the entire surface. Care must be taken not to allow any compound to spatter on the nickel plate 4 as this surface is to act as the anode and must be clean.

The barium nitrate converted into barium oxide due to heating of the compound in air is applied until the filament has a total thickness of approximately .035 inch. The heating of the filament strip is continued until the nitrate is converted into oxide.

The calcium oxide is used merely for protection as barium nitrate has a corrosive effect upon platinum. The electrodes are then assembled in the lamp as illustrated in Figure 2. A baking furnace is then placed over the tube and the structure is baked until the temperature rises to 100 degrees centigrade during which time the coated platinum filament is disconnected from the direct current source or battery 12 and an oil pump vacuum is maintained through connecting tube 15. The furnace is shut off and the structure allowed to cool for 15 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 15 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 coated filament is heated by means of battery 12 connected thru resistance 13 and ammeter 11. The heating currents will be of the order of 3 amperes and at the same time 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 eliminate final traces of gas, the electrodes are connected in circuit as shown in Figure 3. Battery 12 is again used as a source for heating the filament 3. Alternating current from generator 19 is stepped up to 1200 volts by means of transformer 18. The secondary terminals of transformer 18 are connected to electrode 3 and electrode 4 respectively. A current limiting resistance 16 and a switch 17 is included in the transformer secondary circuit connection. Filament 3 is heated to a dull red heat by means of a current from battery 12 and the high potential from transformer 18 is intermittently applied across the electrodes.

Switch 17 is allowed to be closed only for a short period of time, say 5 to 10 seconds. At first a bright luminous discharge bluish in color is noted indicating that gas is being driven from the electrodes being treated with the high voltage alternating current. As this process is continued, the luminous discharge becomes less and less and finally a green flash appears between electrodes. At this point the electrodes are apparently de-gasified and the cathode electrode 3 is sufficiently activated for the next process.

The current is then disconnected and the activated coating on the filament is found to be photo-electric. The vacuum pump is shut off from tube 15 and gas is then admitted to the bulb while the electrodes 3 and 4 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.

A circuit diagram of this connection is shown in Figure 4. The gas preferred is a combination of helium and nitrogen in the ratio of about 95 parts helium to 5 parts nitrogen. The presence of nitrogen in the bulb causes the barium oxide coating to form a compound believed to be barium nitride.

When the gas within the bulb reaches a pressure where a discharge starts between the electrodes and the glow practically fills the space between electrodes 3 and 4, a current of about 2 to 3 milli-amperes is flowing and the gas admitted through tube 15 is shut off. 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 milli-amperes.

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 nitride 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 plate circuit. The negative glow under these conditions will be found closely surrounding the cathode 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 tube is then sealed off from the connecting tube 15 and is complete as far as the manufacturing process is concerned.

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 15 to 25 millimeters of mercury although a fairly wide range is possible between 10 and 40 millimeters of mercury, the important feature being that the pressure is such as to maintain the glow medium tightly on the surface of the cathode. The electrodes 3 and 4 are preferably arranged in close relation as for instance about one quarter of an inch apart although considerable variation is possible.

I claim:

1. In the process of producing a glow lamp comprising connecting a high direct current potential between the electrodes, one of which is coated, admitting a gas containing nitrogen until a glow covers the space between the electrodes, then allowing the glow to continue until the coated electrode has been activated, and finally admitting more gas so that a concentrated lavender glow is produced about the cathode.

2. In the process of producing a glow lamp comprising connecting a high direct current potential between the electrodes, one of which is coated, admitting a gas composed of approximately 95 per cent helium and 5 per cent nitrogen until a glow covers the space between the electrodes, then allowing the glow to continue until the coated electrode has been activated, and finally admitting more gas so that a concentrated glow is produced about the cathode.

3. In the process of producing a glow lamp comprising connecting a high direct current potential between the electrodes, one of which is coated, admitting a gas containing nitrogen until a glow covers the space between the electrodes, then allowing the glow to continue until the coated electrode sends out an intense bluish glow in the form of streamers throughout its entire length, and finally admitting more gas so that a concentrated lavender glow is produced about the cathode.

4. In the process of producing a glow lamp comprising coating an electrode with a calcium compound and then with another alkaline earth material, converting said material into the oxide, activating said coating with a source of high voltage alternating current and treating said coating in a low pressure atmosphere including nitrogen.

5. In the process of producing a glow lamp comprising coating an electrode with a calcium compound and then with a barium compound, converting said barium compound into barium oxide, activating said coating with a high voltage current, and treating said coating in a low pressure atmosphere including nitrogen forming thereby a different barium compound.

6. In the process of producing a glow lamp comprising providing an electrode with a coating comprising an alkaline earth material, converting said material into the oxide, activating said coating with a source of high voltage alternating current and treating said coating with a high voltage direct current in a low pressure atmosphere including nitrogen.

7. In the process of producing a glow lamp comprising providing an electrode with a coating comprising an alkaline earth oxide, activating said coating with a source of high voltage alternating current and treating said coating with a high voltage direct current in a low pressure atmosphere including nitrogen.

8. The process of producing a glow lamp comprising a bulb and anode and cathode electrodes therein which consists in providing the cathode with a coating of a calcium compound and then with a coating of another alkaline earth oxide and activating said coating by the passage of an electric current while the electrodes are surrounded by an atmosphere of gas including nitrogen forming thereby a different coating material on the cathode.

9. The process of producing a glow lamp comprising a bulb and anode and cathode electrodes therein which consists in providing the cathode with a coating of a calcium compound and then with a coating of barium oxide and activating said coating by the passage of an electric current

while the electrodes are surrounded by an atmosphere of gas including nitrogen forming thereby a different barium compound on the cathode.

10. The process of producing a glow lamp comprising a bulb and anode and cathode electrodes therein which consists in providing the cathode with a coating of an alkaline earth oxide and activating said coating by the passage of an electric current while the electrodes are surrounded by an atmosphere comprising substantially 95% of helium and 5% nitrogen forming thereby a different coating material on the cathode.

11. The process of producing a glow lamp comprising a bulb and inclosed therein anode and cathode electrodes therein which consists in providing the cathode with a coating of barium oxide and activating said coating by the passage of an electric current while the electrodes are surrounded by an atmosphere comprising substantially 95% helium and 5% nitrogen forming thereby a different barium compound on the cathode.

12. The process of producing a glow lamp comprising a bulb and anode and cathode electrodes therein which consists in providing the cathode with a coating of an alkaline earth oxide, and activating said coating by the passage of an electric current while the electrodes are surrounded by an atmosphere of gas including a relatively small percentage of nitrogen, and a relatively large percentage of an inert gas having high heat radiating characteristics.

13. The process of producing a glow lamp comprising a bulb and anode and cathode electrodes therein which consists in providing the cathode with a coating of a barium oxide, and activating said coating by the passage of an electric current while the electrodes are surrounded by an atmosphere of gas including a relatively small percentage of nitrogen, and a relatively large percentage of an inert gas having high heat radiating characteristics.

14. In the process of producing a glow lamp comprising connecting a high direct current potential between the electrodes, one of which is coated with a barium compound, admitting a gas composed substantially of 95 percent helium and 5 percent nitrogen until a glow occurs across the space between the electrodes, then allowing the glow to continue until the coated electrode has turned in color from light gray to dark brown to black and finally admitting more gas so that at a predetermined direct current potential substantially not to exceed 400 volts a predetermined value of current will flow between the electrodes.

15. In the process of producing a glow lamp, the steps comprising coating a foundation member with a calcium compound which is readily converted to an oxide, converting said calcium compound to an oxide and depositing thereon, a barium compound, then surrounding the foundation member as an electrode by a glow discharge whereby a photo-electrically activated condition is produced.

16. In the process of producing a glow lamp, the steps comprising coating a foundation member with a calcium compound which is readily converted to an oxide, converting said calcium compound to an oxide and depositing thereon a barium compound, subjecting said barium compound to an electrical discharge to render it photo-electrically active, then introducing an inert gas into the lamp and surrounding the foundation member, as an electrode, by a glow discharge whereby the coating is further photo-electrically sensitized.

17. In the method of producing a device having photo-electrical characteristics, the steps comprising coating a foundation member with a calcium compound which is readily converted to an oxide, converting said calcium compound to an oxide, and then providing thereon a layer of light sensitive material, and finally introducing an inert gas into the lamp and immersing the foundation member, as an electrode, in a glow discharge whereby the light sensitive surface is further sensitized.

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