March 8, 1938. H. C. RENTSCHLER ET AL 2,110,609

METAL VAPOR LAMP

Filed Aug. 30, 1933 2 Sheets-Sheet 1

Fig. 1.

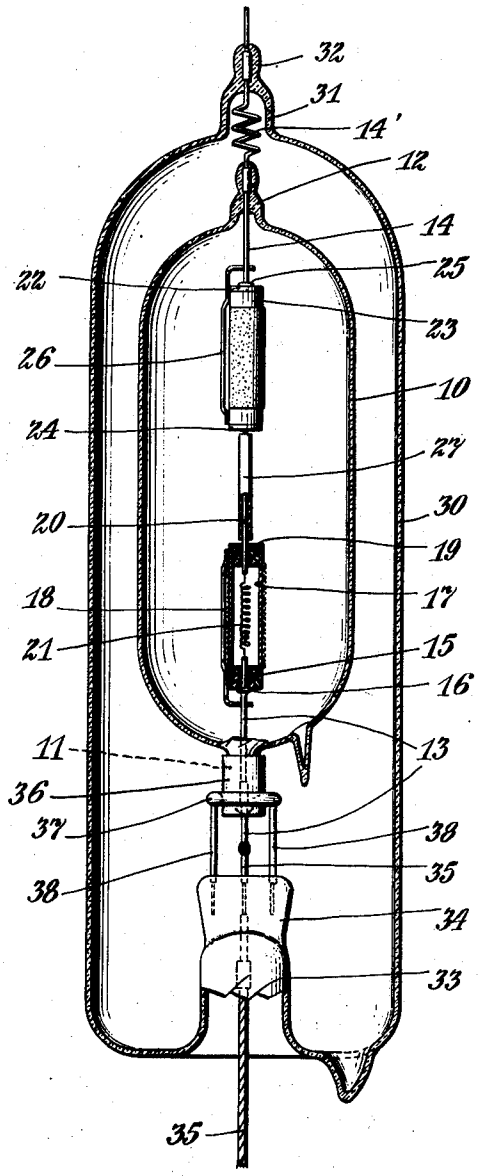
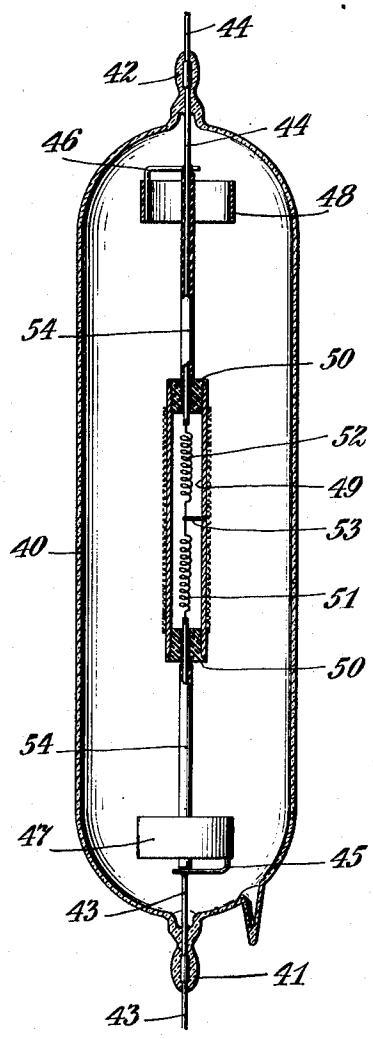


Fig. 2.



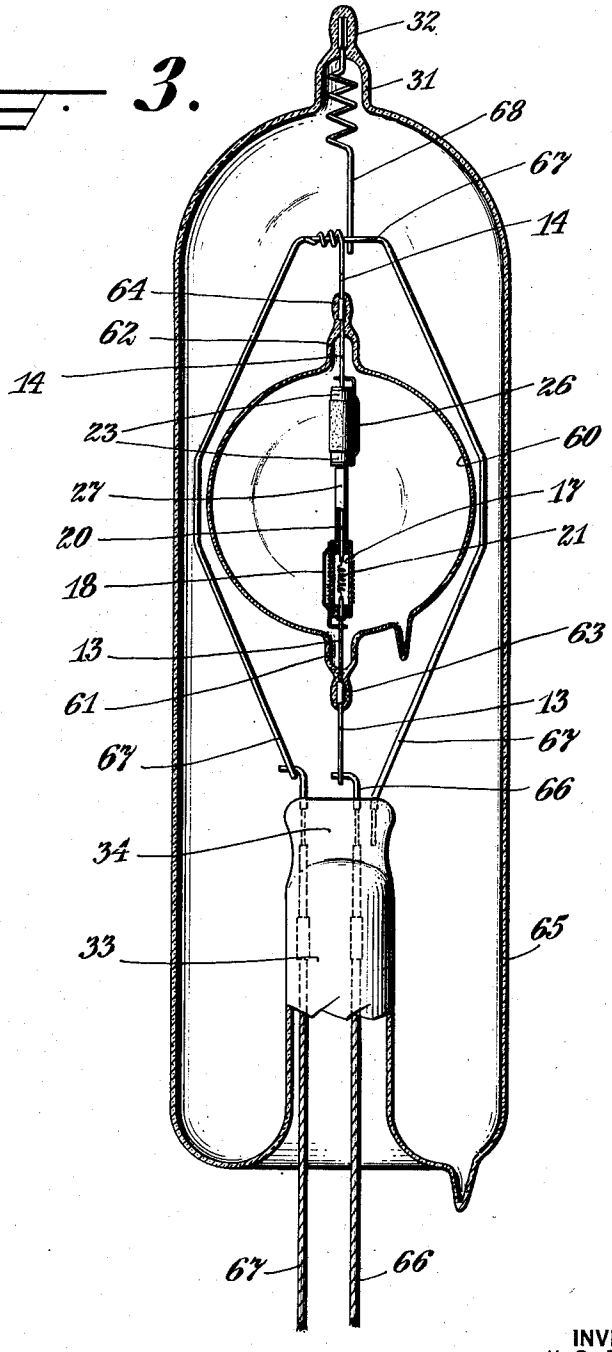
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Fig. 3.



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2,110,609

METAL VAPOR LAMP

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Application August 30, 1933, Serial No. 687,391

16 Claims. (Cl. 176—122)

This invention relates to electric discharge devices the gaseous atmosphere of which comprises metal vapor. More particularly the invention is concerned with a novel electric discharge device of the alkali metal type which finds practical application as an illuminating means.

An object of our invention is to provide a novel electric discharge device of relatively simple design and which may be readily manufactured.

A further object of our invention is the provision of an improved electric discharge device which may be readily and inexpensively constructed and which may be transported without great danger of breaking.

A still further object of our invention is to provide an improved electric discharge lamp of the metal vapor type, which has improved electrical and physical characteristics.

Another object of our invention is to provide an electric discharge device which may be operated at a lower temperature than devices of the same type heretofore proposed.

Other objects and advantages of our invention will be readily apparent from the following description and drawings wherein,

Figure 1 represents a view in elevation, with some of the parts broken away and others in section, of an electric discharge device embodying our invention.

Figure 2 represents a view in elevation, with some of the parts in section, of an electric discharge device embodying our invention and being a modification of the structure shown in Figure 1.

Figure 3 represents another modification of the construction illustrated in Figure 1.

One embodiment of our invention, as shown in Figure 1, comprises an elongated envelope 10 composed of glass such as a boro-silicate glass that is resistant to sodium vapor. The envelope has a plurality of outwardly extending oppositely disposed presses 11 and 12 located exteriorly of the space enclosed by the envelope. Forming a hermetic seal with the respective presses 11 and 12 are leading-in conductors 13 and 14 which extend interiorly and exteriorly of said envelope 10.

The conductor 13, sealed in said press 11, is rigid and has the interiorly disposed portion thereof extending through a central opening in an insulating plug 15 composed of isolantite or the like and having a shoulder. This plug 15 rests upon an enlarged section 16 of the rod 13 located intermediate its ends. A hollow tubular nickel element 17, serving as one of the electrodes, has one of its ends closely surrounding the recessed portion of the plug 15 and rests upon the shoulder thereof. The nickel cylinder is uncoated at its ends which represent about one quarter of the length thereof, but the section intermediate said lengths is coated with one or more of the oxides or carbonates of calcium, barium and strontium, which have good electron emitting properties. An L shaped rigid conductor 18 has the long arm thereof welded to the cylinder 17 at those portions thereof that are uncoated and the short arm is welded to the rigid conductor 13 below the enlarged portion 16.

Another insulating plug 19, similar in all respects to the plug 15, has the recessed portion thereof extending into the upper end of the cylinder 17 and its shoulder rests upon the upper edge of said cylinder. A rigid conductor 20 extends through the central opening in the plug 19 and has its inner end welded to a helical heater filament 21 adapted upon incandescence to heat the electron emitting substance on the cylinder 17 to the proper temperature so that a sufficient electron emission may be provided. The lower end of the filament 21 composed of tungsten or the like is welded to that end of the conductor 13 located above the plug 15.

That portion of the conductor 14 extending within the envelope 10 is rigid and a section thereof extends through a central opening in a plug 22, similar to the plugs 15 and 19. A nickel cylinder 23 similar in all respects to the cylinder 17 has its upper edge resting against the shoulder of the plug 22. Like the other electrode 17, the electrode 23 has its ends uncoated, but the intermediate portion thereof coated with an electron emitting material as hereinbefore described. The lower end of the cylinder 23 has a plug 24, similar to the plug 22, for closing the same. That section of the leading-in and supporting conductor 14 has an enlarged section 25 just outside of the plug 22 to prevent the plug from sliding down to the end of the envelope. An inverted L shaped conductor 26 has its long arm welded to the uncoated sections of the electrode 23 and its short arm welded to the rod 14. The L shaped rods 18 and 26 keep the electrodes from sliding along the length of the envelope 10 and the stops or enlarged sections provide a means which, together with the arms 18 and 26, maintain the electrodes in position.

The conductor 20 has its upper end extending through the central opening in the plug 24. To the ends of the conductors 14 and 20 located in the cylinder 23 is welded a coiled filament heater element, similar to the heater 21 and not shown.

An insulating sleeve 27 composed of isolantite or the like surrounds that portion of the rod 20 located between the plugs 19 and 24 so that no appreciable discharge may take place along its length. Its ends abut the opposing faces of the plugs 19 and 24 to maintain them in position against the electrodes 17 and 23.

The envelope 10 contains a rare gas such as helium, argon or neon. When argon is employed we prefer that it shall be at a pressure of about 0.2 mm. of mercury. Also in said envelope is a sufficient quantity of metal, such as zinc, cadmium, sodium, caesium, rubidium or the like. In the course of our experimentations with lamps of this character we have found that when the interior of said envelope 10 is highly evacuated and contains only sodium or the like that the temperature of the bulb had to be above 235° C. in order that a glow discharge might be maintained. This was true for voltages between 15 and 115 volts. But when a rare gas, such as argon at 0.2 mm. of mercury pressure, was also present in the aforesaid free sodium containing envelope, the glow discharge did not disappear even at a temperature as low as 150° C. with impressed voltages of 20 to 60 or more volts. As far as we are aware, we are the first to have provided a rare gas such as argon, helium, or neon in a sodium vapor lamp, such as that disclosed by Arthur Compton in his Patent 1,830,312, issued to him on November 3, 1931 and in addition we are the first to have realized the effect of a rare gas in an alkali metal lamp.

In order that the lamp may efficiently operate, we provide an enclosing envelope 30 composed of an infra-red absorbing transparent glass. One end of the envelope is in the form of a short outwardly extending stem 31 having an outwardly extending press 32 at one end thereof in which the supporting and current carrying conductor 14 is hermetically sealed. That portion of the conductor 14 between the press 13 and the press 31 is in the form of a helical coil 14' whose diameter is just slightly less than that of the stem 31. The coil 14' serves to conduct electricity, to support the envelope 10, to allow for expansion and contraction of the structure within the envelope 30, and to take up shocks for the prevention of tube breakage.

The other end of the envelope has a reentrant stem 33 with a press 34 at its end. Sealed in said press 34 at about the center thereof is a rigid leading-in conductor 35 extending exteriorly and interiorly of said envelope. That portion of the conductor 35 within the envelope may act as a support like the conductor 14' and is welded to the conductor 13. Cemented to the outwardly extending press 11 is an insulator bushing 36. A ring shaped insulator 37 having a plurality of rigid rods 38 firmly embedded therein closely surrounds the insulator 36. The free ends of these rods are sealed in said press for mechanical support. The ring, rods and bushing cooperate to minimize vibration of the envelope 10.

As shown the inner tube is so mounted in said envelope 30 that it is appropriately and centrally spaced from the side walls thereof. The presses 11 and 12 of the envelope 10 and those of the envelope 30 are all in line. The conductors 13 and 14 serve as supporting and electrical conducting means.

By having single leads 13 and 14 at each end of the envelope, the electrodes may be placed near the ends of said envelope to avoid cold spots therein. In addition by having the electrodes symmetrically disposed as shown, the bulb 10 is at uniform temperature.

Another embodiment of our invention is shown in Figure 2 and may be substituted for its broadly corresponding structure disclosed in Figure 1.

The discharge device comprises an elongated envelope 40 composed of a sodium vapor resistant glass. Presses 41 and 42 extending outwardly from the envelope have respective rigid leading-in and supporting conductors 43 and 44 sealed in said presses 41 and 42 and extending interiorly and exteriorly of said envelope. Secured to said conductors 43 and 44 within, and near the ends of, the envelope are respective angle rods or supports 45 and 46 welded to the respective conductors 43 and 44 and to respective short cylindrical molybdenum plates 47 and 48 that serve as anodes. These anodes 47 and 48 are concentric with the rods 43 and 44. An indirectly heated cathode is mounted in the center of said envelope. It comprises an elongated nickel cylinder 49 having its end portions uncoated and the portion between said end portions coated with an electron emitting material, such as oxides or carbonates of calcium, strontium and barium. At each end of said cylinder 49 is located an insulator plug 50 similar to the insulating plugs hereinbefore described.

Two filamentary heater elements 51 and 52 of the same resistance are located in said cylinder and in electrical series relation, with the outer ends of said elements welded to the portions of the conductors 43 and 44 located within said cylinder and extending through the central openings in said insulators. A conductor 53 is welded to the electrical connector between the two resistances 51 and 52 and to the cylinder 49 at the mid-length thereof.

In order that the discharge may not take place at the conductors 43 and 44 intermediate the anodes and the cathode and so that the cathode may be maintained in proper position, an insulator sleeve 54 of isolantite or the like surrounds each of the conductors 43 and 44, with the extremities thereof bearing against the end plugs 50 and the angle rods 45 and 46. The envelope contains an alkali metal, such as sodium and a quantity of a rare gas such as argon, neon or helium. This construction is simple and has the further advantage that there are no cold pockets present. The discharge current which with alternating current will be from the coated cylinder 49 first to one, and then to the other of the anodes, must pass through one of the heater coils, thus assisting in heating the electron emitting material and further in maintaining the proper temperature within the device.

Still another embodiment of our invention is illustrated in Figure 3 and comprises a substantially spherical envelope 60 composed of a sodium resistant glass and having located therein an electrode structure exactly the same as that illustrated in Figure 1 and hereinbefore described. By having the envelope spherical and by locating the electrodes substantially along a diameter thereof, with each electrode located near one end of the envelope, we are enabled to eliminate cold pockets and provide a device having a uniform temperature distribution along the surface of said envelope.

Also located in said envelope is a quantity of rare gas and a metal as hereinbefore set forth in the description of Figure 1. At diametrically opposed points in said envelope are short out-

wardly extending stems 61 and 62 having presses 63 and 64 at their outer ends. Sealed in said presses are the respective conductors 13 and 14. Surrounding said envelope 60 is an envelope 65 of exactly the same construction and composition as the envelope 30. A plurality of conductors 66 and 67 extending exteriorly and interiorly of said envelope are sealed in the press 34. The conductor 66 is welded to the conductor 13 and the conductor 67 extends upwardly along the envelope 60 and downwardly on the other side of said envelope 60 and has its other end sealed in said press 34.

The conductor 14 is coiled around the cross part of the conductor 67 and is welded at its end to said conductor. Although we have found that this structure is sufficiently strong in most cases, we prefer to weld the rod 68 to the cross part of the conductor 67 and to seal the same in the press 32.

The invention is to be limited not to the exact construction shown, but only by the prior art.

We claim:

1. An electric discharge device comprising a container, a gaseous atmosphere therein comprising a condensible gas, a stem in the wall of the container outside of the space enclosed by the container, an envelope for the container provided with a reentrant stem opposed to said container stem, electrodes in said container, and electrode leads sealed in said stems for supporting said container and conducting electric current thereto.

2. An electric discharge device comprising an envelope, a gaseous atmosphere therein comprising a condensible gas, said envelope having a press outside the space enclosed by said envelope, an envelope for said first mentioned envelope, said second mentioned envelope having a reentrant stem, said stem having a press, electrodes in said first mentioned envelope, and means sealed in said presses for supporting said first mentioned envelope.

3. An electric discharge device comprising an envelope, electron emitting means and a gaseous atmosphere comprising a condensible gas therein, an envelope surrounding and spaced from said first mentioned envelope, a plurality of supporting means sealed to said second mentioned envelope, said supporting means sealed to said first mentioned envelope outside of the space enclosed by said first mentioned envelope.

4. An electric discharge device comprising an envelope, electron emitting means and a gaseous atmosphere comprising a condensible gas therein, an envelope surrounding and spaced from said first mentioned envelope, said second mentioned envelope having a reentrant stem including a press, a plurality of supports sealed in said press, means exteriorly of the space enclosed by said envelope cooperating with said first mentioned supports for maintaining said first mentioned envelope in position.

5. An electric discharge device comprising an envelope, a gaseous atmosphere and an electron emitting means therein, a second envelope surrounding said first mentioned envelope, electrical conducting means sealed to said second mentioned envelope, said conducting means sealed to said first mentioned envelope outside of the space enclosed by said first mentioned envelope, said conducting means being electrically connected to said electron emitting means.

6. An electric discharge device comprising an envelope, a gaseous atmosphere and an electron emitting means therein, an envelope surrounding said first mentioned envelope, said second mentioned envelope having a reentrant stem including a press, current conductors sealed in said press, said conductors sealed in said first mentioned envelope exteriorly of the space enclosed by said first mentioned envelope.

7. An electric discharge device comprising an envelope, electron emitting means and a gaseous medium comprising a condensible gas therein, said envelope having a plurality of presses extending outwardly from the space enclosed by said envelope, supporting means sealed to each of said presses, an envelope surrounding and spaced from said first mentioned envelope, said supporting means being sealed to said second mentioned envelope for maintaining said first mentioned envelope in position.

8. An electric discharge device comprising an envelope, the atmosphere therein comprising a condensible gas, and an electron emitting means therein, said envelope having a plurality of presses, supports sealed in said presses, an envelope surrounding said first mentioned envelope and also having presses, said supports being sealed also in said second mentioned presses.

9. An electric discharge device comprising an envelope, an alkali metal and an electron emitting means therein, said envelope having a plurality of presses extending outwardly from the space enclosed by said envelope, an envelope surrounding said first mentioned envelope and also having presses, said supports being sealed in said second mentioned presses and cooperating with said first mentioned press for maintaining said first mentioned envelope in position.

10. An electric discharge device comprising an elongated envelope, a support sealed in each end of said envelope, a plurality of indirectly heated electrodes in line and located near the ends of said envelope, an envelope spaced from and surrounding said first mentioned envelope, said supports being sealed in said second mentioned envelope at the ends thereof.

11. An electric discharge device comprising an envelope, an alkali metal and a plurality of electrodes therein, said electrodes being in line, a plurality of supports for said electrodes, said supports sealed in said envelope exteriorly of the space enclosed by said envelope, an envelope surrounding and spaced from said first mentioned envelope, said supports sealed in said second mentioned envelope and connected to said first mentioned envelope, one of said supports including mechanical expansion and contraction means.

12. An electric discharge device comprising an envelope, an anode located at each end of said envelope and a cathode located intermediate said anodes, said cathode comprising a plurailty of heater elements in electrical series, a thermionically active element surrounding the same, said elements being electrically connected to said thermionically active element.

13. An electric discharge device comprising an inner envelope, a support sealed in each end thereof, an alkali metal discharge environment and a plurailty of axially alined hollow cylindrical electrodes indirectly heated by means housed therein, a quantity of rare gas also within said envelope for rendering the device operative at comparatively low temperatures, and an outer envelope holding said inner envelope in spaced relation by means of said supports.

14. An electric discharge device comprising an envelope, a support sealed in each end thereof,

an alkali metal discharge environment and a plurality of hollow cylindrical electrodes therein and heated by filaments housed thereby, argon at a pressure of about 0.2 mm. of mercury also within said envelope for lowering the temperature at which the device may be operated, and an outer envelope holding said inner envelope in spaced relation by means of said supports.

15. An electric discharge device comprising an elongated envelope, a pair of hollow cylindrical indirectly heated electrodes axially alined and each located near an end of said envelope, transparent heat insulating means enclosing said envelope, and leading-in conductors extending through said insulating means and end portions of said envelope and serving to support the latter.

16. An electric discharge device comprising an elongated envelope, a rare gas at reduced pressure sealed therein, sufficient alkali metal disposed in said envelope to take part in the discharge, a pair or electrodes in said envelope, axially alined with one another, and each disposed adjacent an end of said envelope, a larger envelope enclosing said first mentioned envelope for heat insulating purposes, and leading-in conductors extending through said larger envelope and end portions of said elongated envelope and serving to support the latter.

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