July 3, 1934. L. K. MARSHALL 1,965,127

ELECTRICAL DISCHARGE LAMP

Original Filed April 22, 1931 2 Sheets-Sheet 1

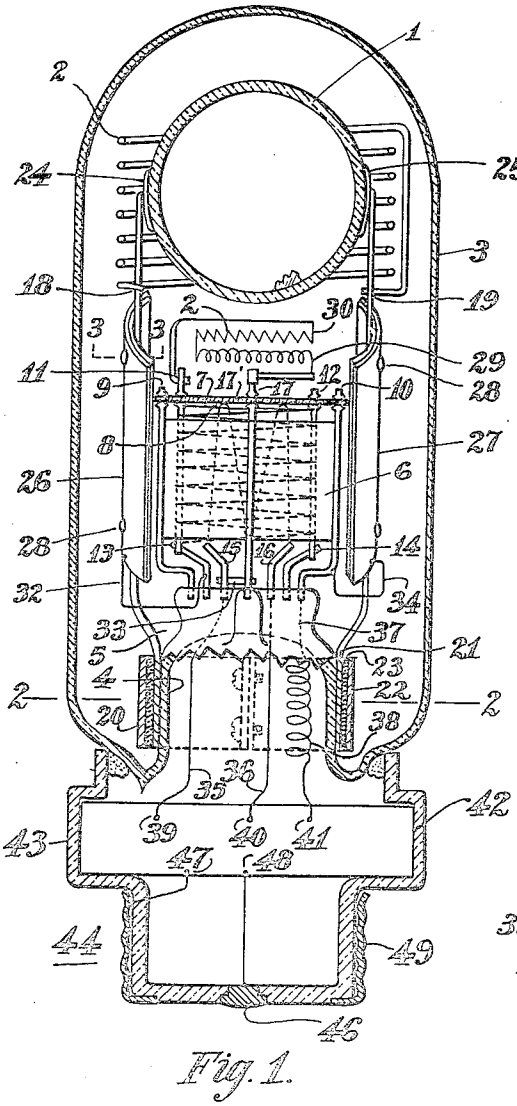


Fig. 1.

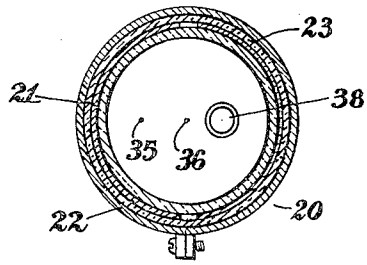


Fig. 2.

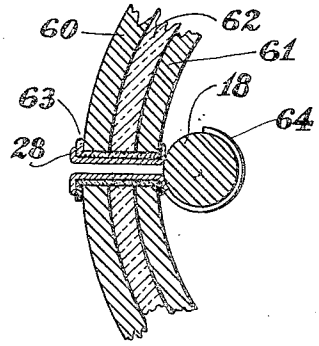


Fig. 3.

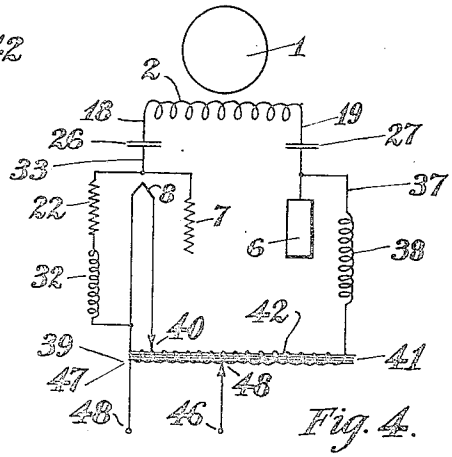


Fig. 4.

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July 3, 1934. L. K. MARSHALL 1,965,127

ELECTRICAL DISCHARGE LAMP

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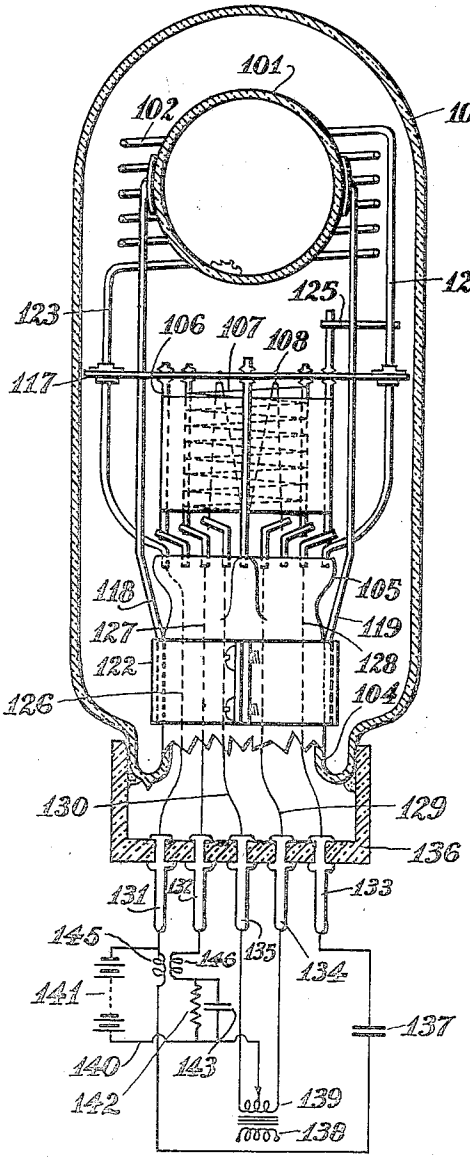


Fig. 5.

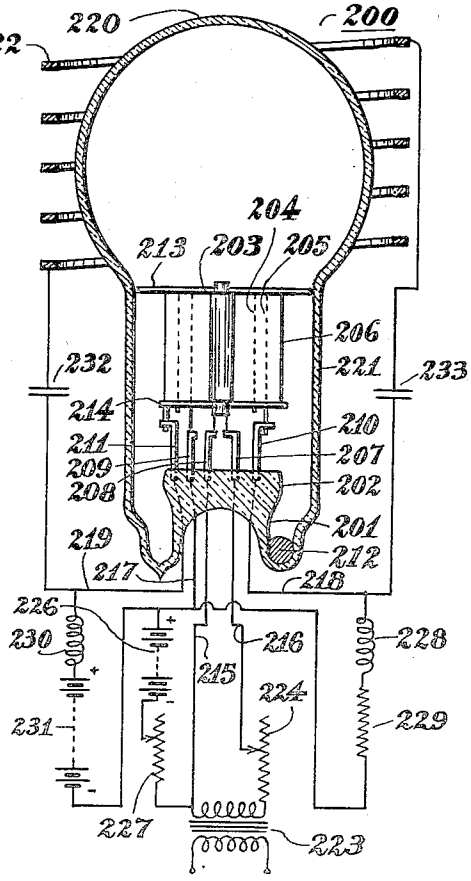


Fig. 7

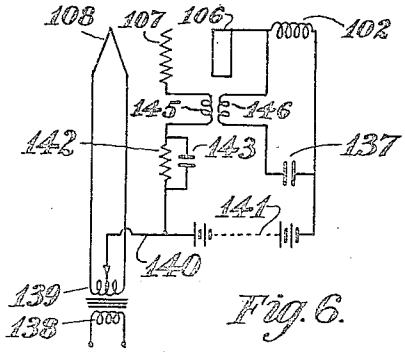


Fig. 6.

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UNITED STATES PATENT OFFICE

1,965,127

ELECTRICAL DISCHARGE LAMP

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Application April 22, 1931, Serial No. 531,895
Renewed November 1, 1933

17 Claims. (Cl. 176—124)

This invention relates to electrical discharge lamps, and it has especial relation to lamps which are adapted to be energized by high frequency currents.

Among the objects of my invention is the provision of such a lamp in which both the source of light and the source of electrical oscillations are combined in a single tube.

The foregoing and other objects of my invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawings, wherein:

Fig. 1 is a view partly in section of a device incorporating my invention;

Fig. 2 is a cross-section taken along line 2—2 of Fig. 1;

Fig. 3 is an enlarged cross-section taken along line 3—3 of Fig. 1;

Fig. 4 is a diagrammatic showing of the circuits involved in Fig. 1;

Fig. 5 is a view similar to Fig. 1 showing a slightly different form of lamp embodying my invention;

Fig. 6 is a diagrammatic showing of the circuits involved in Fig. 5; and

Fig. 7 is a view similar to Fig. 1 of another embodiment of my invention.

In lamps which are energized by high-frequency, electrical currents, it is necessary to provide an oscillator to serve as the source of these high-frequency currents. The use of a separate tube and associated circuit as the oscillator renders the utilization of the lamp cumbersome, due to the considerable amount of auxiliary apparatus. In accordance with my invention I avoid the disadvantages of a large amount of auxiliary apparatus and secure various other benefits by combining in a single tube or unit both the oscillator and the light-generating element itself.

In the exemplification shown in Fig. 1, the light-generating element is indicated as 1. This light-generating element preferably comprises a thin-walled, quartz globe or container which contains a filling of a gas or vapor which possesses the desired spectral properties when excited by an electrical discharge. As such gaseous filling I prefer to use a mixture of a vapor, such as that of zinc, mercury, or the like, and a rare gas, such as argon, at a pressure of about several millimeters. Of course it is clear that various other gases, vapors, or mixtures thereof may be used.

An electrical discharge is produced within the container 1 by means of a coil 2 surrounding said container. This coil is fed with high-frequency currents from an oscillator.

With various vapors, the desired vapor pressure for operation of the lamp occurs at a temperature considerably higher than room temperature. The temperature of the container 1 which encloses the vapor is raised by the heat liberated by the discharge in the vapor. Thus it is often desirable to prevent excessive loss of heat by conduction from the walls of the container 1 in order that the proper temperature and vapor pressure may be maintained in said container. By enclosing the container in an evacuated space, said container is thereby effectively insulated against excessive loss of heat by conduction from its walls. I accomplish this result in the exemplification shown in Fig. 1 by enclosing the container 1 in the evacuated envelope 3. This envelope also contains the plate 6, the grid 7 and the filament 8, which are arranged as in the ordinary three-elements vacuum tube. These electrodes form part of the oscillator which feeds the coil 2.

In addition to securing compactness and heat insulation, it is also desirable to prevent radiation of the oscillation energy used for inducing high radiation in lamps of the type involved. The more confined the space in which the oscillator is built and the shorter the leads connecting the various parts of that oscillator, the less will be the tendency for radiation of the oscillations to occur. I secure both protection against such radiation and additional compactness by mounting practically all of the elements of the oscillating circuit within the envelope 3.

The various elements within the envelope 3 are supported as follows:

The envelope is provided with a reentrant stem 4 carrying a press 5 at its upper end. The plate 6 is supported by two plate standards 9 and 10 sealed in the press 5. The grid 7 is carried by two grid standards 11 and 12 supported by wires 13 and 14 also sealed in the press 5. The filament 8 is connected to and supported by the two filament leads 15 and 16. The press 5 is formed with a plurality of wings extending in more than one plane, the standards 9, 10, 11 and 12, and the wires 13, 14, 15 and 16 being sealed in the wings in one plane. A plurality of standards are sealed in the wings in another plane. Of these additional standards, the standard 17 is shown in Fig. 1. The upper ends of the standards 9, 10, 11 and 12 and of the additional standards, including the standard 17, project through the insulating plate 17'. This insulating plate maintains the upper

end of these standards in fixed relation with one another.

The container 1 is supported within the envelope 3 by the two supporting arms 18 and 19. These two arms are rigidly connected to two plates 20 and 21, respectively. These plates are clamped tightly onto the stem 4 by means of a clamping ring 22. The plates 20 and 21 are maintained a slight distance apart at their ends (see Fig. 2), and are insulated from the clamping ring 22 by a layer of insulation 23. Thus the two arms 18 and 19 are electrically insulated from one another. These two arms carry supporting members 24 and 25 at their upper ends. These supporting members carry the container 1. The opposite ends of coil 2 are connected to the two arms 18 and 19, respectively. Thus these two arms afford a mechanical support for the container 1 and the coil 2, and also serve as electrical connections to said coil. The two condensers 26 and 27 are fastened to and supported by the two arms 18 and 19, respectively. These condensers are each formed by two curved conducting plates 60 and 61 (see Fig. 3), separated from each other by a layer of insulation 62. These plates are held together by a plurality of rivets 28. Each rivet is insulated from the plate 60 by an insulating bushing 63, but is in electrical contact with the plate 61. Each rivet is provided with a tongue 64 by which it is welded to its respective arm 18 or 19. Thus the arms 18 and 19 are in electrical connection with the inner plate 61 and insulated from the outer plate 60 of the condensers 26 and 27, respectively. A unit consisting of an inductively-wound coil 29 in series with a resistance 30 is supported at the upper ends of the standards 11 and 17. This unit is diagrammatically shown in Fig. 1. One end of said unit is electrically connected to the grid standard 11 and the other end is electrically connected to the plate standard 17. The standard 11 is also electrically connected by means of a conductor 32 to the outer plate 60 of the condenser 26, while the standard 17 is connected by a conductor 33 to the filament lead 15. The plate standard 10 is electrically connected to the outer plate 60 of the condenser 27 by means of a conductor 34. The filament leads 15 and 16 are provided with conductors 35 and 36 leading to the exterior of the envelope 3. The plate standard 10 is likewise provided with a conductor 37 leading to the exterior of said envelope. In series with the conductor 37 is an inductively-wound coil 38 which is diagrammatically shown in Fig. 1. The conductors 35, 36 and the outer end of the coil 38 are connected to three points 39, 40 and 41, respectively, of an auto-transformer 42. This transformer may be in the form of a toroidal coil wound upon a closed iron ring.

In order to make the unit complete in itself, the transformer is carried in the base 42 which is mounted on the lower end of the envelope 3, while the coil 38 is supported within the reentrant stem 4 of said container. The base 42 carries a socket 44 at its outer end. This socket comprises a shell contact 45 and a center contact 46 adapted to make electrical connections with the two terminals of an ordinary electric lamp socket. These contacts 45 and 46 are connected respectively to two points 47 and 48 on the transformer 42.

The circuits involved in Fig. 1 can be more clearly understood by reference to Fig. 4. The transformer 42 is fed with alternating current at the two points 47 and 48. The portion between the points 39 and 40 are used to furnish heating current to the filament 8. The entire transformer between the points 39 and 41 is used to impress a comparatively high voltage between the filament 8 and the plate 6. The grid 7 is connected to the filament 8 through the leak resistance 22. This resistance is of a high value, of the order of about 100,000 ohms. The circuit comprising the grid 7, the plate 6, the condenser 27, the coil 2, and the condenser 26 constitute an oscillatory circuit. The inductance 32 is used to prevent the oscillatory currents from flowing through it into the filament circuit. The inductance 38 is likewise used to prevent the passage of oscillatory currents.

When the filament 8 is energized and the source of potential is connected in the circuit in such a direction as to make the plate 6 positive with respect to the filament, oscillations will be set up in the oscillatory circuit. Since I have shown the circuit in Fig. 4 as being fed from an alternating current source, the above condition will not be true during one-half of each alternating voltage cycle. However, conditions under which the tube will oscillate will exist during the other half of each alternating voltage cycle, and oscillatory currents will be set up in the oscillatory circuit during each of said half cycles. Thus when a source of alternating potential is connected between the points 45 and 46, oscillatory currents will flow in the coil 2. These currents will induce an electrical discharge in the gas within the container 1. Upon such a discharge taking place, a light having the characteristic spectral properties of the gas will be emitted.

The light shown in Fig. 1 is entirely complete in itself. It can be operated merely by inserting it directly in an ordinary light socket fed with alternating current.

Instead of using an alternating potential to energize the tube, a direct potential could be used. In that case the oscillations produced by the tube would be continuous rather than intermittent as in the case of an alternating potential. Furthermore, the use of direct current would eliminate the necessity of such a transformer as is disclosed in Fig. 1.

Although I have described the interior of the envelope 3 as being evacuated, it may be desirable in certain instances to provide a gaseous filling within said envelope. For example, in some cases it is desirable to operate the lamp at extremely high intensities for purposes of increasing the efficiency thereof. In such cases the amount of heat liberated within the discharge becomes excessive and the temperature of the container 1 would tend to rise to an excessively high value. Under these conditions it is no longer desirable to insulate the container 1 against the loss of heat, but some means for conducting the heat away from the walls thereof is advisable. By surrounding the container 1 with gases of high heat conductivity, the heat liberated by the discharge is rapidly conducted to the walls of the envelope 3. Since these walls have a considerably greater area than the walls of the container 1, the total amount of heat conducted to them is rapidly dissipated into the surrounding atmosphere.

The oscillator can be designed to operate very efficiently in such a gaseous atmosphere. This can be accomplished, for example, by decreasing the spacing between the electrodes to a point at which discharge paths between them are of the order of the mean free path of the molecules in the gas. The power output of an oscillator in a

gaseous atmosphere is ordinarily considerably greater than a similar oscillator operated in a vacuum.

In the case of a gaseous filling within an envelope 3, it is desirable to prevent a discharge being induced therein by the coil 2. This may be accomplished, for example, by maintaining the pressure of that gas sufficiently high so that a discharge is not initiated within that gas by the coil 2. It is further possible to prevent such a discharge from occurring by making the distance between the walls of the container 1 and the envelope 3 of small dimensions and the coil 2 being placed in this space. In such a case there is very little tendency for a discharge, due to the currents in coil 2, to occur outside of the container 1.

In order to cut down on the loss of light caused by radiations falling upon the coil 2, this coil is provided with a highly polished surface. Since the coil is either in a vacuum or else in an atmosphere which is inert with respect to the surface of said coil, this polished surface will keep indefinitely without tarnishing.

Instead of mounting all of the elements of the oscillatory circuit within the envelope 3, the structure of the tube can be considerably simplified by merely mounting the electrodes of the oscillating tube, the light-generating element and the inducing coil within the envelope. This is the structure which is shown in Fig. 5. Also instead of using the particular circuit, as shown in Fig. 1, any other suitable oscillatory circuit may be used. Such an alternative circuit is used in Fig. 5, which circuit is shown diagrammatically in Fig. 6.

In Fig. 5 is shown a light-generating element 101 which contains a gaseous filling similar to that in the container 1. This container is energized from a coil 102 fed from an oscillator. The oscillator includes the plate 106, grid 107, and the filament 108 arranged as in the ordinary three-element vacuum tube. The coil 102 and the three electrodes 106, 107 and 108 are mounted in the press 105 on the reentrant stem 104 of the envelope 103. The envelope 103 is evacuated and also encloses the container 101. This container is supported by the two arms 118 and 119 projecting from the clamping ring 122, which ring is clamped onto the stem 104. The coil 102 is supported by two standards 123 and 124 also sealed into the press 105. The electrodes 106, 107 and 108 are provided with standards in the same manner as shown for the electrodes in Fig. 1. The upper ends of the electrode standards project through an insulating plate 117 which retains these standards in fixed relation with one another. In addition, the arms 118 and 119, and the standards 123 and 124 also project through this plate which serves as an additional support for these members. The standard 124 is electrically connected with one of the plate standards by means of the wire 125. The standard 123 is provided with a conductor 126 extending to the outside of the envelope 103. The grid 107 and the plate 106 are provided with similar conductors 127 and 128, respectively. Two filament lead-in conductors 129 and 130 also leading outside of the envelope 103 are provided. The conductors 126 to 130, inclusive, are connected respectively to the five contact prongs 131 to 135, respectively. These five contact prongs are mounted in the base 136. The envelope 103 is also mounted on this base.

The oscillatory circuit for the tube is completed by connections external to the tube. A condenser 137 is connected between the contact prongs 131 and 133. The filament is energized by a heating transformer 138, the secondary 139 of which is connected to the two contact prongs 134 and 135. From a point intermediate the ends of the secondary 139, a conductor 140 leads to the negative end of a source of potential, such as a battery 141. The positive end of this battery is connected to the contact prong 131. The grid 107 is connected to the cathode by means of a connection extending from the contact prong 132 to the conductor 140. In this connection is placed a high-resistance leak 142 shunted by a condenser 143. The grid and plate circuits are coupled by means of two coils 145 and 146 which are placed in inductive relation with one another. The coil 145 is placed in the external grid circuit, as shown, while the coil 146 is placed in the external series circuit, including the condenser 137. The oscillatory circuit, as is most clearly seen from Fig. 6, comprises the coil 102 and the condenser 137.

When the filament 108 is energized and the battery 141 connected, oscillations will be produced in the oscillatory circuit, and the oscillatory currents flowing in the coil 102 will induce a luminous discharge within the light-generating element 101.

Since the amount of apparatus outside of the tube, as shown in Fig. 5, is very small, the entire device can be made quite compact. The outside elements may be mounted, for example, on the same member which is adapted to receive the base 136.

When the electrodes of the oscillator are operated in a gaseous atmosphere, instead of using a separate container surrounding a separate gas in which the light-generating discharge is maintained, the same atmosphere which surrounds the oscillator electrodes may be used as the source of light. Also various arrangements of these electrodes may be used in order to more efficiently take advantage of the greater output available from a gaseous oscillator. In the exemplification shown in Fig. 7, I have illustrated a lamp of this kind.

A transparent envelope 200 is formed with a reentrant stem 201 carrying a press 202 at its upper end. This press supports a number of electrodes comprising an indirectly heated cathode 203, a screen electrode 204, a grid 205, and an anode 206, all concentrically arranged. The cathode 203 is provided with an internal heating filament, not shown, one end of which is connected to a supporting standard 207 sealed in the press 202. The electron-emitting element of the cathode comprises the usual coated metallic sleeve. The other end of the heating filament is connected to this sleeve, and said sleeve is provided with a conductor which is connected to a supporting standard 208 also sealed in the press 202. The screen electrode 204, the grid 205, and the anode 206 are electrically connected respectively to the three standards 209, 210 and 211, all of which are sealed in the press 202. The envelope 200 is filled with a suitable gas or vapor which may be, for example, mercury. At 212 I have indicated a drop of mercury which furnishes the requisite vapor. The electrodes 204, 205 and 206 are closely spaced from each other at a distance of the order of the mean free path of the molecules in the vapor surrounding them. Such an arrangement of the electrodes is based on and operates in accordance with the

description of the gaseous discharge tube contained in the application of James D. Le Van, Serial No. 447,495, filed August 25, 1930. Insulating plates 213 and 214 are used to support and maintain the relative position of the various electrodes. The plate 213 extends substantially entirely across the envelope 200, thereby separating the upper portion of said envelope from the lower portion thereof. This prevents the ionized discharge occurring in the light-generating portion 220 from passing into the portion containing the electrodes. The standards 207 and 208 are provided with conductors 215 and 216 leading to the exterior of the tube. The standards 209, 210 and 211 are likewise provided with external lead-in wires 217, 218 and 219. The envelope 200 is provided with a light-generating portion 220 and an electrode-containing portion 221 at one side thereof. A coil 222 surrounds the light-generating portion 220, and is adapted to produce a luminous discharge therein when fed by oscillator currents.

One of the circuits with which the tube, as shown in Fig. 7, can be used is illustrated in that figure. A source of heating current, such as a transformer 223, is connected between the two cathode leads 215 and 216. A regulating resistance 224 is provided in series with one of said leads 216. A source of potential, such as a battery 225, is connected in series with a regulating resistance 227 between the lead-in wires 217 and the conductor 215. The grid 205 is connected through its lead-in wire 218 to a radio-frequency choke 228 and a high-leak resistance 229 to the lead-in wire 217 of the screen electrode 204. The anode 206 is likewise connected through its lead-in wire 219, radio-frequency choke 230, and a source of potential, such as a battery 231, to the lead-in wire 217 of the screen electrode 204. The opposite ends of the coil 222 are connected through the two condensers 232 and 233 to the lead-in wires 219 and 218 respectively of the anode 206 and the grid 205.

The operation of the circuit and tube, as shown in Fig. 7, is briefly as follows:

The current from the heating transformer 223 raises the temperature of the cathode 203 to a point at which it emits electrons. The battery 226 establishes a potential between the cathode 203 and the screen electrode 204 which is sufficient to produce an ionizing discharge in the gas between said electrodes. This discharge produces large numbers of electrons and positive ions in said discharge space. The electrons pass rapidly through the meshes of the screen electrode 204, and enter the space between the electrode 204 and the anode 206. Since the anode 206 is at a positive potential with respect to the screen electrode 204, due to the battery 231, the electrons which pass through said screen electrode are attracted toward said anode. Some of the electrons pass through the meshes of the screen 204 with sufficient initial velocity so that the additional velocity gained by falling through the potential established by the battery 231 is sufficient to ionize some of the gas in the space between the electrodes 204 and 206. Thus the few positive ions are created in that space which tend to diminish the space charge between said electrodes. Since, however, the space between said electrodes is of the order of the mean free path of the vapor, substantial ionization will not occur in said space and the conduction between said electrodes will be maintained primarily by the stream of electrons coming through the meshes of the screen 204. The grid 205 placed between the screen electrodes 204 and 206 controls the discharge between these electrodes exactly in the same manner as in the ordinary three-element vacuum tube. It will be noted that the oscillating circuit, of which the coil 222 forms a part, is exactly the same as that shown for the device as illustrated in Fig. 1. Thus when the tube in Fig. 7 is energized in the manner described, oscillations will be produced in the oscillatory circuit, which oscillations appearing in the coil 222 will induce a discharge in the atmosphere within the light-generating region 220.

It is of course possible in the device as shown in Fig. 7 in a manner similar to that described in Fig. 1, to mount the various elements of the oscillating circuit within the envelope 200 in order to produce a more compact device. However, since the amount of apparatus outside the envelope 200 is not very extensive even in the arrangement as shown in Fig. 7, it can be mounted as a compact unit associated with the envelope 200 itself. Although I have shown the envelope 22 as being exposed to the outer atmosphere, it may sometimes be desirable to mount this envelope together with the coil 222 in an outer evacuated or gas-filled envelope in a manner similar to that described for Figs. 1 and 5. The advantages of so enclosing the envelope has been set forth in the explanation of these two figures.

The invention is not limited to the particular details of construction, materials or processes described above, as many equivalents will suggest themselves to those skilled in the art. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. A lamp comprising a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an oscillator, including a cathode, an anode and a control electrode for generating said oscillatory currents, a sealed envelope enclosing said gaseous atmosphere and said electrodes, said envelope being provided with a space adjacent to and clear of said electrodes in which said luminous discharge is adapted to take place, and means for separating said space in which said luminous discharge is adapted to take place from the space containing said electrodes.

2. A lamp comprising a sealed container filled with a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an oscillator for generating said oscillatory currents, said oscillator including a cathode, an anode, and a control electrode, and a sealed envelope enclosing said container and said electrodes.

3. A lamp comprising a sealed container filled with a gaseous atmosphere, a coil adapted to be fed with oscillatory currents associated with said container, an oscillator for generating said oscillatory currents, said oscillator including a cathode, an anode, and a control electrode, and a sealed envelope enclosing said container, said coil, and said electrodes.

4. A lamp comprising a gaseous atmosphere in which a luminous discharge is adapted to be maintained by high frequency currents, an oscillator for generating said oscillatory currents, said oscillator including a cathode, an anode, and a control electrode, and an oscillatory circuit associated therewith, said oscillatory circuit including capacity and inductance elements, and a

sealed envelope enclosing said atmosphere, said electrodes, and all of the capacity, and inductance elements of said oscillatory circuit.

5. A lamp comprising a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an oscillator for generating said oscillatory currents, said oscillator including a cathode an anode, and control electrode, and an oscillatory circuit associated therewith, a voltage-dividing means for supplying voltages of the proper potential to said oscillator, a single unitary tube incorporating all of the foregoing elements, a base on said tube, a couple of contacts on said base connected to said voltage divider, said contacts being adapted to be connected to the terminals of a source of potential.

6. A lamp comprising a sealed envelope containing a gaseous atmosphere, an oscillator including a cathode, an anode and a control electrode between them; said electrodes being mounted within said container in said gaseous atmosphere, said cathode and anode being spaced apart a distance of the order of the mean free path of the molecules in the gas, high frequency means for maintaining a luminous discharge in said atmosphere, and means for supplying oscillatory currents from said oscillator to said high frequency means.

7. A lamp including a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an envelope enclosing said atmosphere, a cathode and an anode within said envelope, a control electrode for controlling a discharge between said cathode and anode, said cathode, anode and control electrode being part of an oscillator for generating said oscillatory currents, and means for hermetically separating the space containing said atmosphere from the space containing said cathode and anode.

8. A lamp including a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an envelope enclosing said atmosphere, a cathode and an anode within said envelope, a control electrode for controlling a discharge between said cathode and anode, said cathode, anode and control electrode being part of an oscillator for generating said oscillatory currents, and means for hermetically separating the space containing said atmosphere from the space containing said cathode and anode, the space containing said cathode and anode being highly evacuated.

9. A lamp including a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an envelope enclosing said atmosphere, a cathode and an anode within said envelope, a control electrode for controlling a discharge between said cathode and anode, said cathode, anode and control electrode being part of an oscillator for generating said oscillatory currents, means for hermetically separating the space containing said atmosphere from the space containing said cathode and anode, and a gas in the space containing said cathode and anode, said cathode and anode being spaced apart a distance of the order of the mean free path of the molecules in said gas.

10. A lamp including a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, a sealed envelope enclosing said atmosphere, an oscillator for generating said oscillatory currents, said oscillator including an electrode, a cooperating anode, and a control grid between said electrode and anode, said electrode being such that electrons pass from it into the space between said electrode and said anode, said electrode and anode being within said gaseous atmosphere at a distance of the order of the mean free path of the molecules in said atmosphere from each other.

11. A lamp including a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, a sealed envelope enclosing said atmosphere, an oscillator for generating said oscillatory currents, said oscillator including an electrode, a cooperating anode, and a control grid between said electrode and anode, said electrode being such that electrons pass from it into the space between said electrode and said anode, said electrode and anode being within said gaseous atmosphere at a distance of the order of the mean free path of the molecules in said atmosphere from each other, said envelope being provided with a space adjacent to and clear of said electrodes in which said luminous discharge is adapted to take place.

12. A lamp including a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, a sealed envelope enclosing said atmosphere, and an oscillator for generating said oscillatory currents, said oscillator including a cathode, a screen electrode, a cooperating anode, and a control grid between said electrode and anode, said screen electrode and anode being within said gaseous atmosphere at a distance of the order of the mean free path of the molecules in said atmosphere from each other, said cathode being spaced from said screen electrode so as to support an ionizing discharge between said cathode and said screen electrode, said screen electrode being provided with openings, whereby electrons pass from the discharge space between said cathode and screen electrode to the space between said screen electrode and said anode.

13. A lamp comprising a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an oscillator including a set of electrodes for generating said oscillatory currents, and a sealed envelope enclosing said gaseous atmosphere and said set of electrodes, said envelope being provided with a limited portion in which said luminous discharge is adapted to take place and said set of electrodes in said envelope lying entirely outside of said limited portion of said envelope, the space of said luminous gas discharge being hermetically segregated from the space enclosing said set of electrodes.

14. A lamp comprising a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an oscillator including a set of electrodes for generating said oscillatory currents, and a sealed envelope enclosing said gaseous atmosphere and said set of electrodes, said envelope being provided with a limited portion in which said luminous discharge is adapted to take place and said set of electrodes in said envelope lying entirely outside of said limited portion of said envelope, the space of said luminous gas discharge being hermetically segregated from the space enclosing said set of electrodes, and the pressure in the space of said set of electrodes being substantially lower than in the space of said gas discharge.

15. A lamp, including a gaseous atmosphere, in which a luminous discharge is adapted to be maintained by oscillatory currents, a sealed en-

velope enclosing said atmosphere, and an oscillator for generating said oscillatory currents, said envelope being provided with a limited portion in which said luminous gaseous discharge is adapted to take place, said oscillator including a set of electrodes, said set of electrodes in said envelope lying entirely outside of said limited portion of said envelope, said set of electrodes comprising a cathode having an extended penetrable electrode surface, an anode having an electrode surface lying on one side of said cathode surface spaced therefrom, a control electrode between said anode and said cathode surface, the distance between said cathode and anode surface being of the order of the mean free path of a molecule in said gas, means for supplying electrons through said cathode to the space lying opposite the anode, and barrier means for preventing entrance of said electrons into spaces between said set of electrodes through which extend electrostatic field paths sufficiently long to produce an independent discharge in said space.

16. A lamp comprising a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory currents, an oscillator including a set of electrodes for generating said oscillatory currents, and a sealed envelope enclosing said gaseous atmosphere and said set of electrodes, said envelope being provided with a limited portion in which said luminous discharge is adapted to take place and said set of electrodes in said envelope lying entirely outside of said limited portion of said envelope.

17. A lamp comprising a gaseous atmosphere in which a luminous discharge is adapted to be maintained by oscillatory frequency, an oscillator including a set of electrodes for generating said oscillatory currents, and a sealed envelope enclosing said gaseous atmosphere and said set of electrodes, the device having the said set of electrodes lying within one portion of the envelope and being adapted to have the luminous discharge take place within another portion of the envelope.

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