

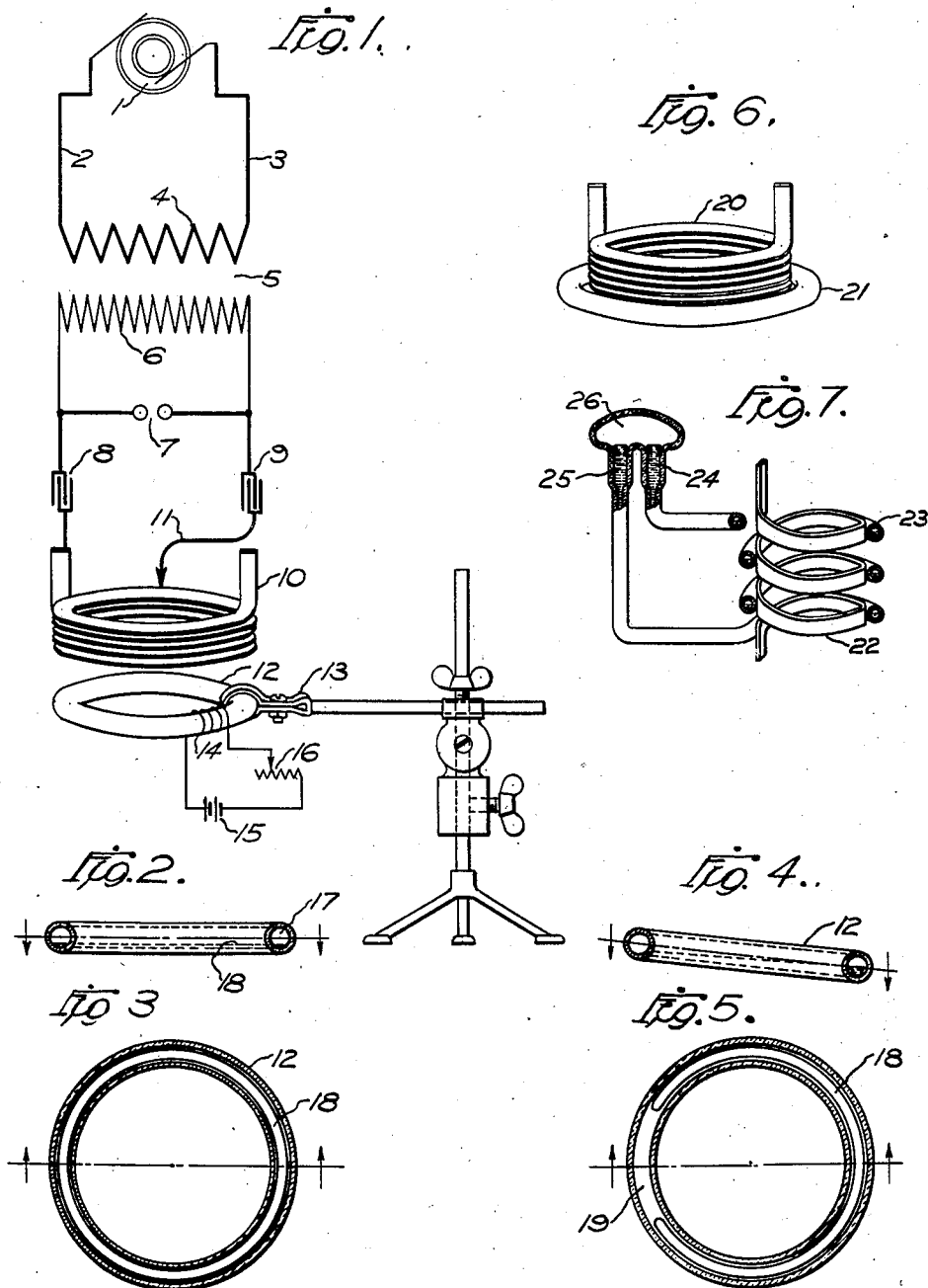
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MERCURY VAPOR LAMP

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MERCURY VAPOR LAMP

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The present invention relates to electric lamps in which the electric excitation for the medium producing the light is induced into that medium without the aid of electrical connection thereto, and the medium may be a vapor, a liquid or a solid or any combination of these and/or may contain any or all of these for the characteristic property which any or all of these materials may contribute to the medium.

This invention has particular reference to induction lamps in which the frequency employed is of an order above that necessarily requiring iron in the induction circuit.

Among the objects of my invention are; to produce an electric lamp which operates without the use of sealed-in electrodes, to produce a gaseous conduction or vapor lamp which has no critical starting voltage, to produce an arc lamp in which the arc length may be varied at will and thereby vary the arc characteristics associated therewith, to produce an induction lamp in which the heated energy can be confined to definite circuits, and to produce an induction lamp in which the heating circuit can be resonated with the other associated circuits, thereby obtaining a maximum energy for that circuit under a given set of conditions.

Other and further objects will be obvious and pointed out in the specification, but the novel features of my invention are more particularly set forth in the claims.

In this specification, the term "vapor" and its derivatives are used to include also the conception of gas.

In the accompanying drawings, I have shown one embodiment of my invention with some variations therein, in which Fig. 1 is in part an elevation and in part a diagrammatic drawing of a simple embodiment of my invention.

Figs. 2, 3, 4 and 5 are some of the explanatory details in Fig. 1, Figs. 6 and 7 are modifications of some of the elements of Fig. 1.

In Fig. 1, 1 is an alternating current generator which, through leads 2 and 3, supplies energy to primary 4 of the step-up transformer 5, the secondary 6 of which is

shunted by a suitable spark gap 7 and also connected to condensers 8 and 9, the opposite plates of which are connected to a helix having a fraction of one or more turns of conductor 10. This much of the figure illustrates a common high frequency circuit employing a Tesla transformer, the primary of which is formed by the helix 10. A flexible connector 11 is provided for the purpose of adjusting the reactance of the circuit for tuning.

The lamp proper, in its simplest form, is illustrated by 12, which is a hollow toroid of non-conducting translucent material which, in the figure, is held by the clamp 13 and has upon its annular surface a coil or wire 14, which is connected in circuit with a battery 15 and a means for adjusting the current in the circuit thereof 16.

The term "translucent material" is used to mean that some part, of the element of the device referred to, is constructed of translucent material but not necessarily entirely of translucent material.

In this specification the term "lamp" is used to mean substantially the entire apparatus shown in Fig. 1 or the lamp proper which is member 12 of that figure, depending upon which is applicable.

In Fig. 2 is shown a vertical cross section of the hollow toroid 12 which may contain within its hollow space 17, a vapor, a liquid, a solid or any combination of these.

For purposes of illustrating one embodiment of my invention, I will describe a lamp containing mercury. In the lower part of the hollow toroid 12 will be observed in Fig. 2 a mercury level 18.

If the geometrical figure of the hollow toroid 12 as illustrated, contains a sufficient amount of mercury, when this toroid is held in a horizontal position, the mercury will assume a continuous ring, forming a complete circuit of electrical conductor as illustrated in Fig. 3, which is a horizontal cross section of Fig. 2, showing the mercury surface 18 from this point of view.

It will be appreciated by those familiar with the art to which my invention appertains that the exact geometrical form of my

lamp is not an essential element of my invention. A circular lamp is described merely for clearness and simplicity any suitable geometric figure whatever may be used, provided it comes within the scope of my claims.

Referring to Fig. 4, which is a cross section similar to Fig. 2, it will be observed that when the toroid 12 is tilted slightly, the mercury will part at 19, as illustrated in Fig. 5, which is a cross section similar to Fig. 3, but held in the position shown in Fig. 4. By suitably positioning the toroid 12, Fig. 1, I may obtain a complete metallic electric circuit or I may break it at some point at will, as shown in the figure.

This permits the lamp to be started with a continuous electrical conductor and later permits the conductor to be broken for the purpose of producing an arc, and later permits, by proper tilting, the arc length at 19 to be adjusted.

Further if and when desired only such an amount of mercury may be contained within hollow member 12, as to permit its complete vaporization during starting of the lamp allowing the lamp to start with a complete circuit of mercury and operate on pure mercury vapor or mercury vapor mingled with such inert gases as I may choose to introduce into the chamber 17 before sealing the envelope 12 hermetically. Among the suitable gases which may be used sometimes to advantage in member 12, may be mentioned; argon, krypton, neon and xenon. Such gases may be so proportioned as to assist in providing desirable electrical operating characteristics for the lamp or to influence the spectrum of the light emitted by the lamp or both.

The coupling between primary 10 and secondary 12 is adjusted by moving the secondary with reference to the primary or visa versa and thereby adjusting the energy input into the secondary 12, thereby affecting the light output of the lamp.

The envelop member 12 may be made by any suitable method, depending upon what is desired with reference to spectrum and electrical operating characteristics.

The pressure in the chamber 17 may have any desired value and may be even super-atmospheric.

The coil 14 in Fig. 1 forms one means for adjusting the temperature of the lamp. That is, instead of providing an excess input energy into the lamp and then providing cooling means for radiating some of the excess heat, I may in some instances provide, by induction, heat energy for the lamp less than that required for proper operation, and adjust the temperature of the lamp by means of current adjustor 16.

The intensity of the light emitted by the lamp is dependent, for one thing, upon the

lamp temperature, therefore the heat absorbed by the lamp from the heat source 14, serves to adjust the light emitted.

It will be appreciated that when the oscillator shown in Fig. 1, is set into operation, the closed circuit of the lamp 12 forms a secondary for the Tesla transformer 10. An electric current is induced into closed lamp circuit within 12.

It may be pointed out that between my present invention and induction lamps of the prior art the essential difference lies in the fact that the induced E. M. F. must exceed a certain critical voltage known as the ionization potential before vapor becomes conducting in induction lamps of the prior art, whereas in my invention no such critical voltage is present.

In my invention, the lamp, starting out with a continuous circuit conductor, has an arc instituted as soon as the conductor is broken by tilting the lamp, whereas in lamps of the prior art it is necessary to operate the lamp itself within a very intense magnetic field, and this field intensity must reach a critical value before the lamp will operate at all.

In the present invention the lamp is further characterized and differentiated from the prior art induction lamp by the fact that my lamp proper does not have to be located within an intense magnetic field and may be in cases, to a considerable advantage, located outside of the field.

The heating in the induction lamp of the prior art is analogous to the heating of the core by eddy currents in a transformer whereas in the present invention the heating is related to a short-circuited conductor around the core of a transformer.

The use of a definite circuit for the lamp conductor path, as embodied in my invention, whether the conducting medium be vaporous, liquid or solid, has the effect of producing electrically a clean-cut reactance not present in induction lamps of the prior art. This reactance element of my invention permits the lamp circuit to be tuned by means of adjusting the other reactance associated with the lamp, for instance by moving conductor 11 in Fig. 1. By so doing the whole oscillator and circuit, including the lamp circuit, can be brought into resonance providing a maximum energy input into the lamp for a given set of conditions, as well as a higher overall efficiency for the system.

Fig. 6 shows a modification of the lamp above described in which the helix 20 is internal of the lamp proper 21, which permits certain advantages in some cases.

While I have described in the foregoing embodiment a single turn of electrical conductor, this is quite obviously not a limitation of the invention, and in Fig. 7, I have

illustrated a lamp containing a primary 22 composed of several convolutions and a lamp secondary 23 composed of several similar convolutions and placed closely adjacent thereto.

In this case the convolutions 23 can be made of very small tubing, and inexpensively. The tubing 23 is brought out to wells 24 and 25. When the lamp illustrated in Fig. 7 is tilted to a certain position, the conductor in tubing 23 becomes continuous, and when tilted to a second position the conductor is broken at the space 26 providing the arc for the lamp. A contact between electrodes 24 and 25 is accomplished by tilting the lamp away from the reader, as will be understood from inspection of the drawings. The arc length is determined by the operating position of the lamp, which determines the level of the mercury in the chamber 26, the chamber being so formed that the level of the mercury is affected by the angle of the lamp.

I have described one embodiment of my invention, and, therefore, I claim:

1. In a luminous discharge device, a hollow translucent hermetically sealed envelope containing a medium subject to conduction of electric current, a source of magnetic field energy inductively associated with said medium, and a source of heat adjacent said envelope whereby the mean operating temperature of the said device is partly determined by the said field energy and partly determined by the said source of heat.

2. In an induction lamp, a source of alternating current of a frequency in excess of 5000 cycles per second, a primary inductance coil electrically associated with said source, a hollow translucent tube formed into an endless hermetically sealed envelope located adjacent said coil, said envelope containing an electrically conductive medium cooperating inductively with said coil, the path of the current in the said medium due to said inductive cooperation having a predetermined electrical self-inductance under operation, whereby the energy in the said medium under operation is partly determined by the electrical reactance of the current in the circuit of the said medium upon the current in the circuit of the aforesaid primary coil and partly by the characteristics of the primary circuit.

3. In an induction lamp, a source of oscillating current of a frequency in excess of 5000 cycles per second, a primary inductance coil electrically associated with said source, a hollow translucent tube formed into an endless hermetically sealed envelope located adjacent said coil and having a geometrical form possessing an inductance value of at least several per cent of that of the aforesaid primary coil, said envelope containing an electrically conductive medium cooperat-

ing inductively with said coil and luminescent under electrical excitation, whereby the natural period of the current of the aforesaid source is determined over a range of several per cent by the reactance of the current flow in the said tube under operation.

4. In an induction lamp, a source of oscillating current of a frequency in excess of 5000 cycles per second, a primary inductance coil electrically associated with said source, a hollow translucent tube formed into an endless hermetically sealed envelope located adjacent said coil and having a geometrical form possessing an inductance value of at least several per cent of that of the aforesaid primary coil, said envelope containing an electrically conductive medium cooperating inductively with said coil and luminescent under electrical excitation, whereby the frequency of the alternations of the current of the aforesaid source is dependent upon the relation of the reactance proper of the current in the luminescent medium to the total reactance of the combined circuits over a range of several per cent thereof, under operation.

5. In an induction lamp, a source of oscillating current of a frequency in excess of 5000 cycles per second, a primary inductance coil electrically associated with said source, a hollow translucent tube constituting an endless hermetically sealed envelope, said tube containing a medium conductive to electric current, luminescent under electrical excitation, and inductively associated with aforesaid coil, said tube being formed to include within said medium a minimum of the alternating magnetic field flux of said coil and to embrace a maximum thereof, under operation.

6. In an induction lamp, a source of oscillating current of a frequency in excess of 5000 cycles per second, a primary inductance coil electrically associated with said source, a hollow translucent tube constituting an endless hermetically sealed envelope, said tube containing a medium conductive to electric current, luminescent under electrical excitation, and inductively associated with aforesaid coil, said tube being formed to include within said medium a lesser amount of the alternating magnetic field flux of said coil than the amount thereof embraced by the said tube, under operation.

7. In an induction lamp, a source of alternating current of a frequency in excess of 5000 cycles per second, a primary inductance coil electrically associated with said source, a hollow translucent tube formed into an endless hermetically sealed envelope located adjacent said coil, said tube containing an electrically conducting liquid partly completing the circuit of the said tube and further containing an electrically conducting vapor, said conducting liquid

and said vapor cooperating inductively with said coil, whereby the conduction of electric current in the circuit of the said tube under operation is partly through said liquid and partly through said vapor.

5 8. In an induction lamp, a source of alternating current of a frequency in excess of 5000 cycles per second, a primary inductance coil electrically associated with said source, a hollow translucent tube formed
10 into an endless hermetically sealed envelope located adjacent said coil, said tube containing a complete circuit of liquid in an unexcited state which said liquid is conductive
15 to electric current by induction from said primary coil, whereby the said liquid becomes completely vaporized under operation and the electrical conduction in changes from liquid conduction to vaporous conduction under operation.

20 9. In an induction lamp, a source of alternating current of a frequency in excess of 5000 cycles per second, a primary inductance coil electrically associated with said source, a hollow translucent tube formed
25 into an endless hermetically sealed envelope located adjacent said coil, said tube containing an electrically conducting solid partly completing the circuit of the said tube
30 and further containing an electrically conducting vapor, said conducting solid and said vapor cooperating inductively with said coil, whereby the conduction of electric current in the circuit of the said tube under
35 operation is partly through said solid and partly through said vapor.

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