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C. G. SMITH

ELECTRIC LIGHT

Filed Jan. 28, 1918

Fig. 1.

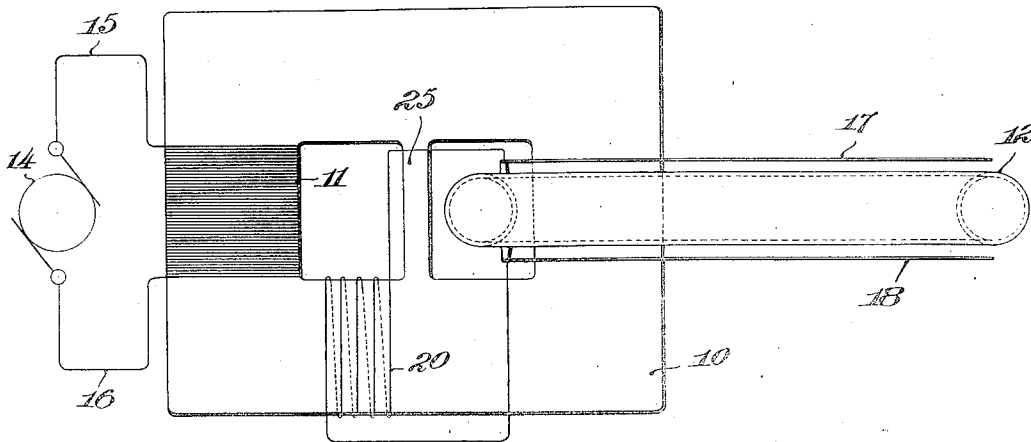
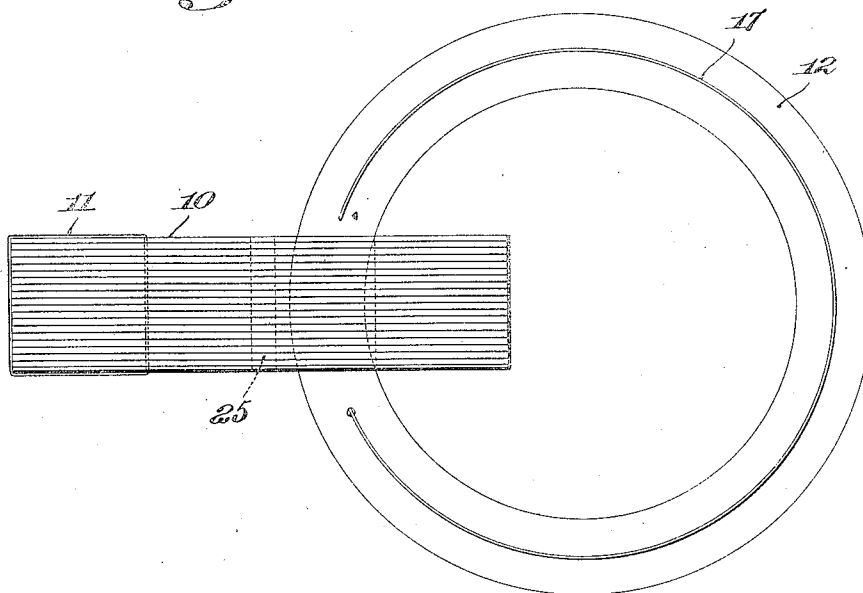


Fig. 2.



Witness

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ELECTRIC LIGHT.

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To all whom it may concern:

Be it known that I, CHARLES G. SMITH, a citizen of the United States, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Electric Lights; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to a method and apparatus for producing luminous effects and more particularly to lights in which the illumination is secured by the passage of a current through a gas.

It has long been recognized that the various forms of electric lights in general use are relatively inefficient and this is equally true whether the illumination is produced by the passage of an electric current through a filament which is caused to glow or by the passage of a current through two spaced electrodes between which an arc passes. Furthermore the efficiency of the lamp and the length of life are directly dependent upon the ability of the electrodes or the filament to stand up under continued use.

It is accordingly an object of the present invention to provide a light of an improved type which operates at a relatively high efficiency as compared with existing forms of light and which dispenses with the usual electrodes or filament.

With this object in view then, a feature of the invention contemplates the provision of an electric light consisting of a transparent container filled with gas made luminous by the passage of a sustained alternating current therethrough. A further feature of the invention consists in locating the transparent container filled with gas in a continuously alternating magnetic field designed to cause the passage of an alternating current through the gas which is driven by an electro-motive force generated by the direct action upon the gas of electro-magnetic induction.

In the simplest and most efficient form of the invention which has yet been devised an alternating current of relatively high voltage and frequency is generated in a primary circuit and a sealed container filled with gas is located in the alternating magnetic field produced by the circuit and acts as a sec-

ondary for the passage of a sustained alternating current through the gas.

The necessity of an alternating current of extremely high voltage and frequency in the primary circuit is avoided by using a core of magnetic material which serves to strengthen the magnetic field produced by the primary circuit and enable this field to produce the necessary alternating current in the gas filled tube so that the latter will become luminous.

In the accompanying drawings, Figure 1 is a partially diagrammatic view illustrating the general arrangement of the light and accompanying circuit; and Fig. 2 is a detail illustrating the magnetic core with the torus connected thereto.

It has been found that by properly coordinating the voltage and frequency of the alternating current with the pressure of the gas within the tube the gas may be made to conduct, permitting a current to pass therethrough and causing a strong light to be emitted, the intensity and quality of which depends upon the pressure of the gas and the voltage of the current. According to the present invention the gas is contained at a suitable pressure in a sealed tube of glass or other transparent insulating material and is located in the field of an alternating current circuit of relatively high voltage and frequency.

There are many gases which may be utilized for the purpose of illumination, among which are argon and mixtures of gases, including hydrogen but it is preferred to use pure argon or helium, in other words, monatomic rather than diatomic gases. With all of these gases and mixtures of gases beginning at a very low pressure an increase of pressure up to certain limits produces a corresponding increase in the luminosity or intensity of illumination of the light. As the pressure of the gas is increased above that pressure which gives least apparent resistance to the current, the voltage applied must be likewise increased to produce illumination and the intensity of illumination may be increased to a point just short of that which will fuse the refractory material of which the containing tube is made.

This form of light is extremely efficient as the absence of electrodes eliminates discontinuity in the mode of conduction and consequent space charge which give rise to

large voltage drops at such electrodes and thus the energy losses which are ordinarily incurred at the electrodes are eliminated. The effective life of such a light is practically indefinite if the containing tube is not worked at too high a temperature and the speed of the ions is in general below a disintegrating speed when they collide with the walls of the tube. As a matter of fact the conditions necessary to insure a long life of the container may be easily obtained with well known types of glasses and quartz even though great intensities of illumination are secured.

In the illustrated embodiment of the invention a laminated iron core 10 is provided with primary windings 11 and a secondary consisting of a torus 12. Alternating current at high voltage and frequency is generated in the primary circuit through a generator 14 or other suitable means and is conveyed to the primary windings 11 through leads indicated at 15 and 16. The torus is made of glass or other refractory transparent insulating material that can be hermetically sealed and contains gas at a comparatively low pressure. Among the gases which may be suitably employed are mixtures of gases including air, hydrogen and preferably certain gases taken alone, as for example, argon and helium. The intensity of the light which is given off by the gas is dependent upon the voltage drop around the torus and the pressure of the gas within the torus, and this intensity may be increased to a point just below that at which the heat generated will fuse the containing tube. In the case of argon it has been found that the pressure can be increased sufficiently to give a high intensity of illumination and the voltage varied to give a light of good quality of great intensity without fusing the containing tube.

It is believed according to the information at present available that the best results are secured with a pressure of about 50,000 volts in the primary circuit and a frequency of about 2000 cycles per second. This voltage and frequency with a suitable number of turns in the primary circuit induces a sustained alternating current in the torus of the same frequency and having a drop of about 100 volts per turn.

In the simplest and most efficient form of the invention which has yet been devised the discharge in the tube is started through a device consisting of two open rings 17 and 18 disposed upon opposite sides of the tube and connected with a winding 20 consisting of a few turns of small wire and designed to give a maximum voltage drop between the rings not great enough to spark between 17 and 18 but sufficient to break down the insulation of the gas inside the torus. To ac-

complish this result, the torus is made of large cross section an inch or more and ten or twenty thousand volts are applied between 17, 18. The strong varying electrostatic field set up between the rings 17 and 18 breaks down and ionizes the gas in the tube 12, thus permitting the relatively weak electro-magnetically induced voltage to start a flow of current about the ring. The embodiment of this starting device within the apparatus enables the discharge to be obtained within the tube without necessitating the generation of enormous voltages within the tube. As the energy consumed by the open rings 17 and 18 is negligible they are permanently connected to the winding 20 during the operation of the light.

As the resistance of the gas decreases when heated by the passage of current there-through it is advisable to provide some form of regulation which shall prevent the flow of excessive currents in the torus. To this end the core 10 is provided with a bar 25 having a comparatively small cross section as compared with that of the core. The division of magnetic flux between the leakage path 25 and the secondary leg of the transformer is determined by the relative reluctance of the two paths as well as by the back magnetomotive force caused by the secondary current in the torus. It will be readily seen that as the secondary current increases, more magnetic flux is diverted into the branch path 25. The secondary induced voltage drops by a corresponding amount and the secondary current is accordingly limited to a safe value.

While it is preferred to employ the specific construction and arrangement of parts shown and described, it will be understood that this construction and arrangement is not essential except so far as specified in the claim, and may be changed or modified without departing from the broader features of the invention.

The invention having been described, what is claimed is:

An apparatus for producing light comprising a transformer having a high voltage primary winding, and a secondary consisting of an hermetically sealed torus of transparent insulating material containing a gas adapted to be rendered luminous by electro-magnetic induction when the primary winding is energized, and means for starting the flow of current through the gas consisting of electrodes arranged entirely outside but close to the torus, and connections from the transformer to the electrodes for impressing a voltage between the electrodes sufficient to initiate ionization of the gas without causing actual electrical discharge or breakdown therethrough.

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