

Nov. 3, 1925.

1,560,103

M. SCHMIERER

ELECTRIC DISCHARGE TUBE

Filed Feb. 21, 1921

2 Sheets-Sheet 1

Fig. 1.

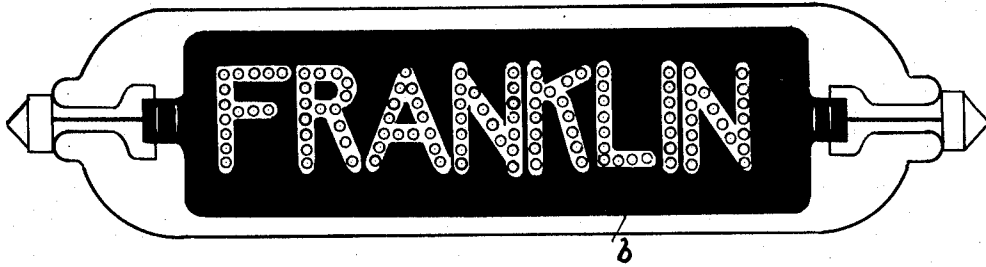
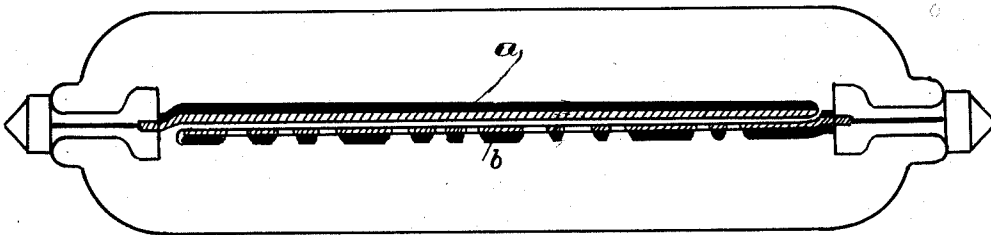


Fig. 2.



Fig. 3.



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Att.

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2 Sheets-Sheet 2

Fig. 4

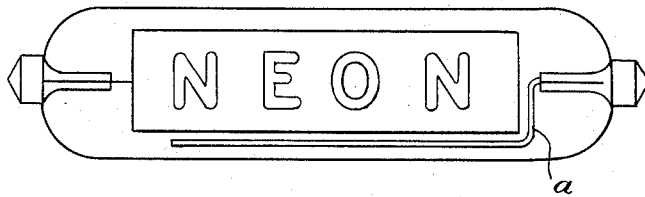


Fig. 5

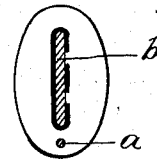


Fig. 6

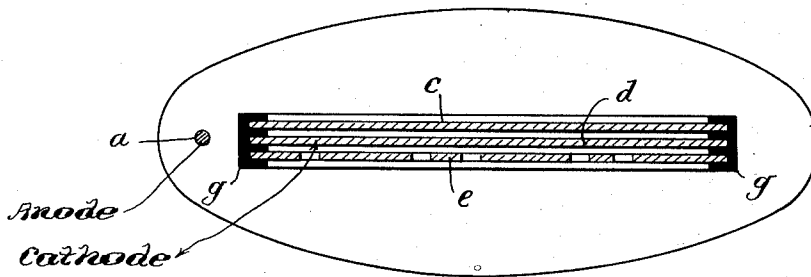
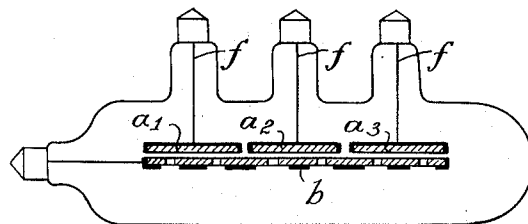


Fig. 7



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Patented Nov. 3, 1925.

1,560,103

UNITED STATES PATENT OFFICE.

MICHEL SCHMIERER, OF FRIEDENAU, NEAR BERLIN, GERMANY.

ELECTRIC DISCHARGE TUBE.

Application filed February 21, 1921. Serial No. 446,973.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, MICHEL SCHMIERER, a citizen of the German Republic, residing at Friedenau, near Berlin, Germany, have invented certain new and useful Improvements in Electric Discharge Tubes (for which an application has been filed in Germany, October 25, 1919, Patent #345,859); 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.

This invention relates to luminous electric discharge lamps for the production of illuminated signs, letters, designs, etc.

Luminous electric discharge lamps for the production of illuminated letters, in which the cathode consists of a letter-shaped sheet the back of which is coated with insulating lacquer or the like, have been previously used. On account of the fact that the negative luminous discharge spreads out in all directions from the edges of the letters and only gradually decreases in brightness, the letters do not have sharp outlines. Thin illuminated lines cannot be produced with luminous discharge lamps of this kind, as the smallest representable width corresponds to the double thickness of the negative luminous layer. Accordingly, the practical usefulness of discharge lamps of this type is limited to relatively large and simple letters.

The object of the present invention is, therefore, to produce a luminous discharge lamp in which the characters to be displayed, such as letters, are brought out in sharp outlines, thus making it practicable to provide illuminated signs of small dimensions and clear outlines.

The invention lies in the discovery that if one of the enclosed electrode elements (for direct current, the cathode) is partially coated on its face with an insulating lacquer, the surface which is not so coated becomes illuminated, while the coated surface remains inactive, and that the outlines of the luminous emanations are sharply defined by the boundaries of the uncoated surface.

On direct current operation, the electrode utilized for displayed purposes is generally the cathode, as the best results are obtained from the cathode emanations. On alternat-

ing current operation, both electrodes necessarily function, alternately, as both cathode and anode. For the sake of convenience, however, the electrode bearing the characters to be displayed will be referred to hereinafter as the cathode irrespective of whether the lamp is operated on direct or alternating current.

The cathode, according to this invention, is usually in the form of a plate having an extended surface in which the letters or characters to be displayed may be formed in different ways as will be explained. One of the preferred methods of forming the letters is to drill or punch a series of apertures in the cathode plate corresponding in arrangement to the desired letters. The exposed area of the cathode which it is not desired to have illuminated is covered with a coating of insulating lacquer or a stencil screen of insulating material, leaving an uncoated metallic area or areas corresponding with the letter or letters to be displayed. The apertures through the cathode are disposed within the limits of the uncoated areas. By this method, any form of letter can be produced and the effect is somewhat similar to that of an electric sign in which the letters are formed by the orientation of a plurality of electric light bulbs.

Another method of producing the letters consists in cutting slots through the cathode plate—the slots having the form of the letters. This latter method is not well adapted to the formation of block letters, but is suitable and very effective for script, in which there are no resulting isolated portions—that is portions which would be entirely cut off from the body of the cathode by reason of the slots. In lamps wherein the letters are produced according to the aforementioned methods the anode is preferably in the form of a plate of approximately the same area as the cathode and is disposed in parallel with and at the rear thereof.

According to another method by which the letters can be produced, no apertures or slots are provided in the cathode—the display surface of the latter being merely covered with a coating of lacquer with the exception of the surface areas which form the letters—these latter being left bare. In lamps wherein the letters are formed as last described, the anode may be in the form of

a wire or rod extending parallel to the cathode and disposed near one edge thereof and being suitably spaced therefrom. An important advantage inherent in the present invention lies in the facility with which diacritical marks may be applied to the letters.

The invention is also well adapted to flashing or so-called moving signs. For the latter purpose a plurality of cathodes or anodes may be provided—each being connected through a separate conductor to a suitable flashing switch.

A further advantage is that the inscription is readily legible by daylight, particularly if the insulating layer is colored. With inscriptions composed of separate letter lamps, as in previous practice, the legibility by day became much impaired on account of the numerous reflections from the separate spherical or pear-shaped lamp bulbs. The joint use of a large number of letter lamps has the further disadvantage that the individual lamps do not light up with equal brightness. Even if, by the careful selection of lamps of equal brightness, a certain amount of equality can be obtained at the beginning, the decrease in candle power which occurs in the course of time varies with different individual lamps and the final result is an unequal intensity of light in the various parts of the inscription. With a word-lamp or the like in accordance with the invention, the individual letters, on the contrary, are of equal brightness during the whole life of the lamp.

According to the invention, instead of an insulating layer fitted directly on the surface of the cathode, a stencil-like screen can be arranged at such a short distance from the front of the cathode that at the covered places no passage of current and consequently no luminous discharge can take place owing to the well-known rectifying action. This screen may consist of conducting material provided it is insulated from the cathode. The screen may, in fact, be connected so as to become the anode. The lines of current then emanate from the front side of the anode, that is the side away from the cathode, bend around at a short distance from the face of the anode and making their way through the letter or sign-shaped opening of the anode, finally strike against the surface of the cathode at right angles. The light effect is in this case not materially different, as the anode light is very weak and differs in color from the negative luminous discharge. If the direction of the current is changed, the light effect is dependent on the width of the openings. If these are very narrow, no luminous discharge can appear inside them on account of the rectifying action, while the whole front of the screen, which is now con-

nected as cathode, is illuminated. The signs therefore appear dark on an illuminated background. If the line width is greater, the negative discharge is also formed inside the opening and these appear to be more brightly illuminated than the surface of the screen because the illuminated signs, as observed from the front, appear thicker, namely by the amount of the plate thickness of the screen. If the line width of the opening is less than the total width of the negative luminous layer but not, however, so small that the valve or rectifying action can occur, the lines of current hardly intersect, and the light effect at the places in question is particularly powerful. With a slit-shaped opening, for example, the line of a letter, a particularly brilliantly illuminated line appears in the middle or, with a somewhat greater width of slit, a double line. Correspondingly with a circular opening in the same, a particularly brilliantly illuminated point or circle is formed in the center. With greater width of slit there remains in the middle of the space between the brightly illuminated edges, a dark space in which the anode light is scarcely perceptible. If a luminous discharge lamp of this kind is supplied with alternating current, the light effects corresponding to the two directions of current overlap to form a characteristic new light effect. For alternating current supply the width of slit must be so great that the valve action cannot take place, otherwise when the current is flowing in the one direction the openings would be illuminated and the front surface of the screen would remain dark; and in the other direction of flow the reverse would occur, so that the total effect would be that the signs to be represented would almost disappear. With a greater width of slit the total effect results in any case in a more powerful illumination of the opening. A width of slit greater than the double thickness of the negative luminous layer produces a less effective light. The light effect then really consists in that the edges of the sign appear to be more brightly illuminated than the background and the sign itself.

By means of lamps of this kind, therefore, several light effects can be obtained. These can be still further increased if the front side of the screen is covered with an insulating layer. In this case the sign appears bright on a dark background. If the insulating layer is not brought to the edge of the opening but is stopped at a short distance from it, new light effects are again obtained. The signs appear uniformly bright if the rear electrode is connected as cathode. When the current flows in the reverse direction, the light effect inside the openings is the same as in the case when the insulating layer is not present. The edges again ap-

appear, however, to be surrounded by a weak band of light which arises from the negative luminous discharge which is visible over the edges of the signs unprotected by the insulating layer. With single current supply both light effects supplement one another and the signs then appear to be composed of brightly illuminated single or double lines which are surrounded by a less bright and a still weaker border. Obviously dark signs on a light background can be produced in the same manner. Also in one and the same lamp different kinds of light effects can be produced next to one another by means of openings of different width and by only partially coating the screen.

The manufacture of the stencil screen with the opening presents no difficulties as long as the signs to be represented possess no closed lines, as, for example, the letter "o" in roman type. If letters with closed lines have to be represented, the difficulty can be met as in stencils for marking purposes by providing connecting bars which make the connection between the enclosed parts of the screen with the surrounding parts or of the signs may be composed of apertures arranged close together. In this latter case a particularly bright light effect is produced, the lines of the sign appearing to be composed of illuminated points. There are kinds of script, as, for example, roundhand, in which closed lines do not occur at all or can easily be avoided without producing an ugly effect. By employing a script of this kind the manufacture of screens can be considerably facilitated.

Referring to the accompanying drawings,

Fig. 1 shows a luminous discharge lamp designed to display the word "Franklin", the letters of which are formed by suitably oriented apertures and outlined by a coating of lacquer on the cathode plate;

Fig. 2 illustrates a luminous discharge lamp designed to display the word "Reklame", the several letters of which are formed by cutting slots of suitable width through the cathode plate. As in Fig. 1, the cathode plate is coated with an insulating lacquer; the coating extending to within a narrow margin of the edges of the slots which form the letters;

Fig. 3 is a longitudinal cross sectional view illustrating the structure and particularly the electrode elements of the lamps shown in Figs. 1 and 2;

Fig. 4 shows a glow lamp designed to display the word "Neon" and illustrates a further alternative method of inscribing the letters of the word to be displayed on the surface of the cathode plate;

Fig. 5 is a cross-sectional view through the middle portion of the lamp shown in Fig. 4;

Fig. 6 is a longitudinal cross section

through a luminous discharge lamp illustrating an alternative method of construction; and

Fig. 7 is an elevational view partly in cross section illustrating a luminous discharge lamp adapted for use as a flasher, or, in other words, for moving sign purposes.

In the structures shown in Figs. 1 to 3 inclusive, *a* is one of the electrode elements which will be referred to as the anode although it does not necessarily function as the anode on all occasions. *b* is the second electrode element which will be referred to herein as the cathode, which, like the anode, does not in all instances function in the capacity indicated by the terminology employed. Inasmuch as better results are obtained, however, especially on direct current operation with the electrode *a* functioning as anode and the electrode *b* functioning as cathode, the terminology employed is thought to be consistent.

The cathode *b* shown in Fig. 1 is a metallic plate and the letters of the word "Franklin" displayed thereon are formed, as shown, by drilling or punching suitably oriented apertures through the plate. The exposed surface of the cathode is coated with a suitable insulating lacquer as indicated by the black area. The white area surrounding the apertures is the uncoated metallic surface of the cathode.

In Fig. 2 the formation of the letters "Reklame" is effected by continuous slots instead of by a plurality of apertures as in Fig. 1. The lacquer coating in Fig. 2 extends over the entire exposed surface of the cathode with the exception of the narrow margins extending from the edges of the slots forming the letters of the word. The rear surface of the anode *a* is also preferably coated with insulating lacquer, as indicated in Fig. 3. The thickness of the lacquer both on the back of the anode and the front of the cathode, as shown in Fig. 3, is greatly exaggerated for the purpose of illustration. When a source of current of suitable voltage is applied across the external electrodes which connect with the respective internal electrodes, namely, the anode and cathode, the letters are clearly and sharply illuminated and stand out distinctly against the remaining surface of the cathode.

In the case of the lamp shown in Fig. 1, if the rear electrode *a*, the back of which is covered with lacquer, is connected as cathode and the electrode *b* as anode, the space inside the holes is illuminated with uniform brightness. The letters then appear to be composed of illuminated points arranged side by side, and approximately the same lighting effect is obtained as with an ordinary electric sign the letters of which are composed of separate incandescent lamps arranged close together. When the current

flows in the reverse direction, the parts of the electrode which are not coated with lacquer, namely the lines of the letters, are uniformly brightly illuminated. The intensity of the light is greater in the holes and becomes more so as the thickness of the electrode *b* is increased. When the diameter of the holes is relatively small, their centers are particularly brightly illuminated owing to the intersection of the lines of current. With alternating current supply the two lighting effects supplement one another and the total effect is that of illuminated letters in the middle of which there appears especially bright points.

Referring to Fig. 2, if the rear electrode *a* is connected as cathode, the slit-like openings are illuminated and the impression is given of a completely uniform script. When the direction of current is reversed, particularly bright letters appear in the middle of the slit, while the edges which are not coated with lacquer are more weakly illuminated. With alternating current supply the two effects again supplement one another.

As may be seen from Fig. 3, the distance between the electrodes *a* and *b* is so small that no passage of current can take place in the space between the electrodes owing to the valve action. In order to prevent this with certainty the back of the electrode *b* may also be coated with lacquer.

In the luminous discharge lamp shown in Figs. 4 and 5, the anode *a* consists of a wire or rod which extends parallel to and along the one edge of the cathode *b*—being suitably spaced therefrom. The cathode *b* is not drilled or slotted as in Figs. 1, 2 and 3, but is coated with insulating lacquer over its entire surface with the exception of the areas representing the letters of the word "Neon".

In the longitudinal cross-sectional view of Fig. 6 there is illustrated an embodiment of the invention in which a stencil-like plate *e*, which may be made of conductive or non-conductive material, is arranged at so slight a space from the front of the cathode plate *d* that it is impossible for any glow light to originate in the intermediate space but only in the perforations or holes of the plate *e*. *c* is a plate of conductive or non-conductive material which in consequence of the slight

distance from the cathode plate *d* prevents the occurrence of glow light on the reverse side of the cathode plate *d*. All three plates *d*, *e* and *c* are held together by the frame *g*, which is preferably made of insulating material. The anode *a* can be made of any desired shape and arranged at any desired point and may consist, for instance, of the wire as represented in cross section.

In the structure of Fig. 7 there are shown three anode elements *a*₁, *a*₂, *a*₃, each of which is separately connected to an external contact member through conductors *f* and a single cathode element *b*. The lamp of Fig. 7 may be utilized effectively for flashing or moving signs in conjunction with a suitable switching mechanism whereby the individual anode elements may be brought into operation alternately.

I claim:

1. An electric discharge tube for the production of illuminated signs, designs and the like comprising an anode, a cathode cooperating therewith having extended front and back surfaces, said front surface being provided with means for outlining a sign or design and adapted to prevent the emanation of a negative luminous discharge from said surface other than that in the form of the said sign or design.

2. An electric discharge tube for the production of illuminated signs, designs and the like comprising an anode, a cathode having extended front and back surfaces, said front surface being provided with a layer of lacquer outlining the sign or design and adapted to prevent the emanation of a negative luminous discharge from said front surface other than that outlined by the said sign or design.

3. An electric discharge tube for the production of illuminated signs, designs and the like comprising an anode, a cathode having extended front and back surfaces, said front surface being provided with a layer of material in the form of a stencil like screen and adapted to prevent the emanation of a negative luminous discharge from said front surface other than that outlined by the stencil screen.

In testimony whereof I affix my signature.

MICHEL SCHMIERER.