Sept. 25, 1934. R. E. BARCLAY 1,974,888

ILLUMINATING DEVICE

Filed Oct. 27, 1930 2 Sheets-Sheet 1

FIG. 1.

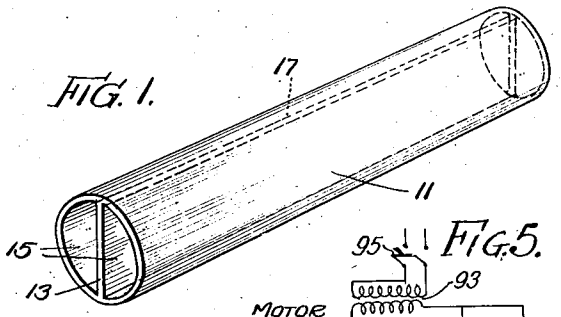


FIG. 2.

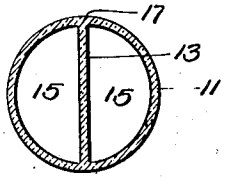


FIG. 5.

FIG. 3.

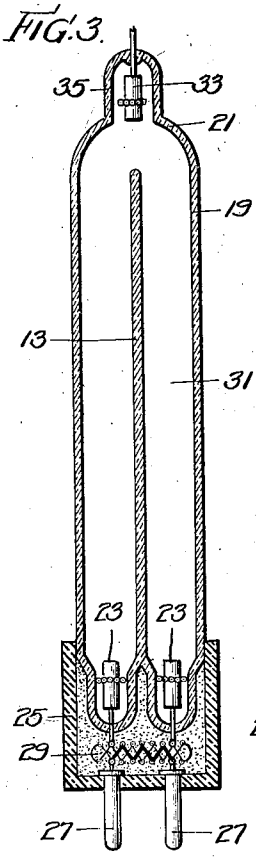


FIG. 4.

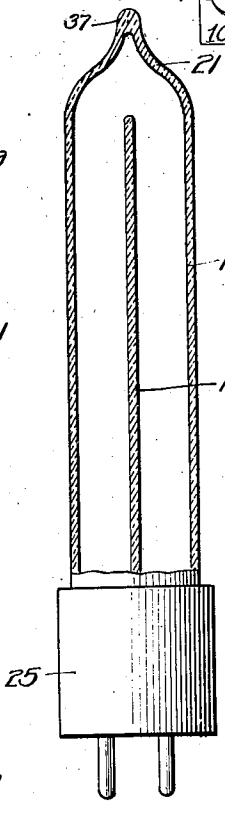
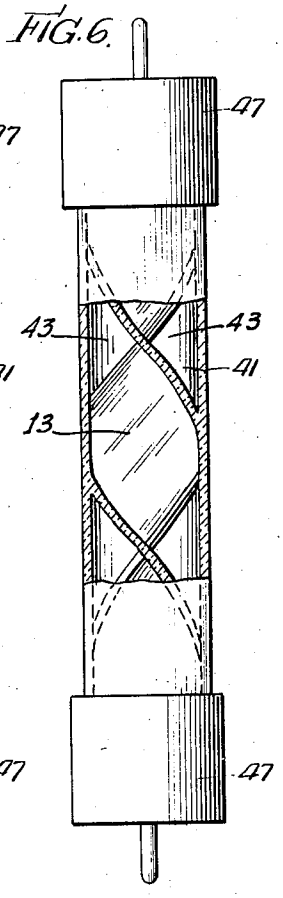


FIG. 6.



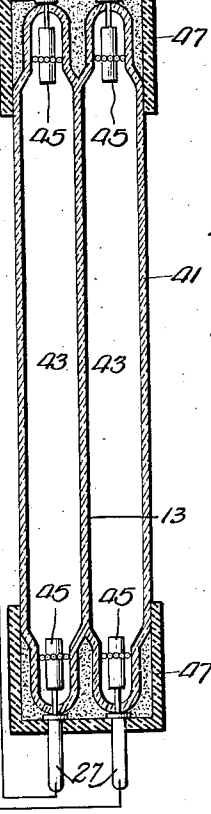


FIG. 7.

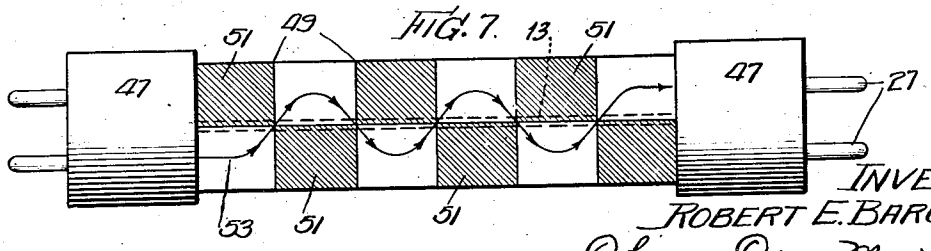


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FIG. 8.

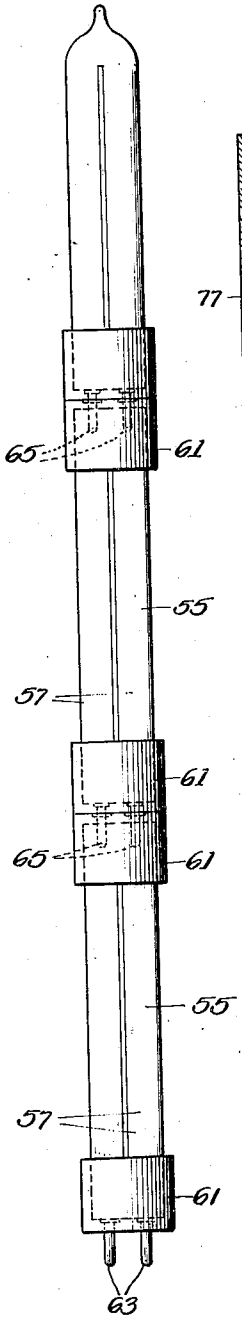


FIG. 9

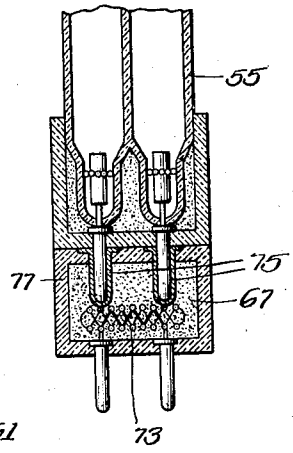


FIG. 10.

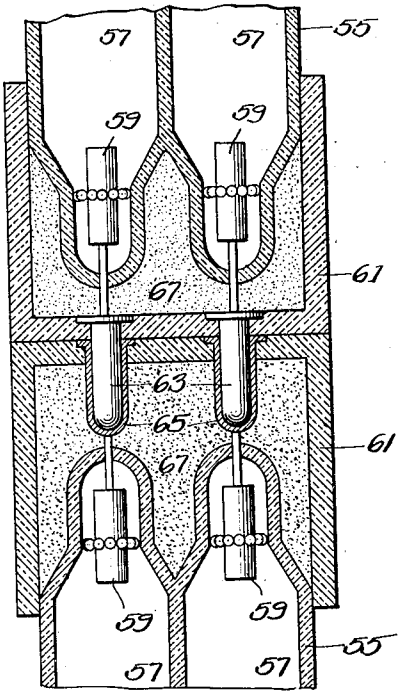


FIG. 11.

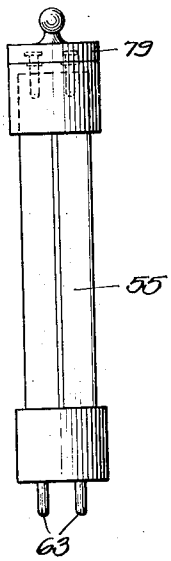
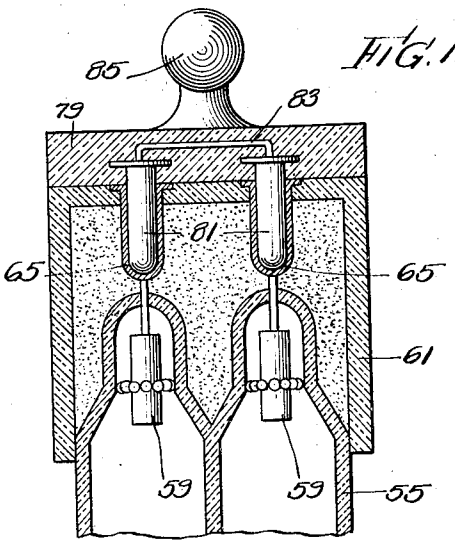


FIG. 12.



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Patented Sept. 25, 1934 1,974,888

UNITED STATES PATENT OFFICE

1,974,888

ILLUMINATING DEVICE

Robert E. Barclay, Chicago, Ill., assignor to Federal Electric Company, Chicago, Ill., a corporation of New York

Application October 27, 1930, Serial No. 491,404

9 Claims. (Cl. 176—14)

My invention relates in general to gaseous conduction devices and has more particular reference to gaseous conduction lamps adapted for use in illumination, the general object of the invention being to provide a gaseous conduction device of increased efficiency and which may be fabricated in the form of a lamp having wide utility because of its capacity to produce novel, eye-arresting, and attractive effects.

An important object is to incorporate reactive means, namely means to provide capacity reactive effects, in a device of the character mentioned whereby its operating efficiency is improved, a further object being to apply the effects of capacity reactance in a gaseous conduction device by arranging the discharge channel of the device with adjacent portions separated by dielectric means affording a condenser having electrostatic effect upon the gaseous conduction medium within the discharge channels whereby to improve the operating efficiency of the lamp and permit the same to function at relatively low voltage.

Another important object is to provide a lamp of the character described having spaced electrodes co-operatively associated with the discharge channel for the purpose of exciting the gaseous conducting medium therein wherein the electrodes are located in relatively closely spaced relationship whereby a unit adapted for detachable insertion in a power outlet socket is provided.

Still another important object of the invention resides in providing a device of the character described wherein the overall size of the unit is reduced while the effective length of the discharge channel is maintained, whereby, among other novel and advantageous results, I am able to provide a compact lamp adapted for use as a unit in a socket receptacle.

Still another important object is to provide a gaseous conduction device of increased efficiency, a further object being to form the lamp with adjacently extending discharge channel portions whereby electrical discharges through the conduction medium in one channel portion may be utilized to promote the ionization of and thus facilitate the establishment of electrical discharges in the medium contained in an adjacent discharge channel portion.

Still another object of my invention is to utilize a partitioned tube as an envelope defining adjacent discharge channel portions in a gaseous conduction device, whereby the device may be arranged to produce novel results and effects, including a traveling or flickering light effect, a multi-color effect including the possibility of causing the device to change color; and including the possibility of producing a lamp for low voltage operation and adapted for detachable mounting in a power outlet socket.

Another important object is to provide a sectionalized lamp comprising a plurality of elements of standard length having connections whereby the units may be arranged in series for operation from a power outlet in the form of a support socket, a further object being to provide an adapter base containing a transformer whereby to operate the lamp from a low voltage socket outlet.

Among other objects of the invention are to provide a novel method of discharge illumination whereby to increase the operating efficiency of this type of lighting without sacrificing the brilliance of the illumination; to produce a discharge lamp, which can be illuminated from the ordinary house lighting circuit; and, in general, to accomplish the numerous valuable advances in the technique of electrical illumination which will become apparent as the invention is more clearly understood from the following description which, taken with the accompanying drawings, discloses a preferred form of the invention.

Referring to the drawings:

Figure 1 is a perspective view of a double channel member embodying my invention;

Figure 2 is a cross section through the tube shown in Figure 1;

Figure 3 is a vertical section through a luminescent element or lamp adapted for operation from a low voltage power outlet, the lamp comprising tubing of the style shown in Figs. 1 and 2 and being provided with a temporary bombarding electrode for bombarding the element in a novel manner during its manufacture in order to remove impurities from the electrodes and tube, prior to introducing the gaseous contents;

Figure 4 is a vertical section through the lamp shown in Figure 3 after the temporary bombarding electrode is removed;

Figure 5 is a vertical section through a luminescent element embodying longitudinally extending partition means defining a plurality of separate channels within the envelope in accordance with my invention whereby multi-color and travelling light effects may be accomplished;

Figure 6 is a perspective view partially in section of a modified form of the device shown in Figure 5;

Figure 7 shows the lamp of Figures 5 and 6 arranged to produce travelling light effects;

Figure 8 is a perspective view of a sectional lighting element comprising a plurality of luminescent elements embodying my invention mounted in end to end relationship by means of a novel connection;

Figure 9 is a vertical cross section through the base of a device embodying my invention showing how the same may be provided with a removable transformer so that any number of sections in series with one power outlet may be easily accommodated by simply supplying a base having the correct transformer base;

Figure 10 is a vertical section through the intermediate connections in the sectional lighting element of Figure 8;

Figure 11 is a perspective view showing the use of a single section as a lighting unit; and

Figure 12 is a vertical section through the connection at the top of the device shown in Figure 11.

The lamps are formed preferably of glass tubing 11 provided with longitudinally extending partition means 13 dividing the tube into a plurality of parallel channels 15. The partitioned member 11 may be made from standard glass tubing by inserting a partition into the tube and fusing its edges to the walls of the tube at 17, as by means of heat, or the partitioned member may be molded with an integral partition in a mold provided with suitable removable cores for forming the parallel channels in the finished product.

Figures 3 and 4 illustrate a high efficiency discharge lamp embodying my present invention and operable from a low voltage source of electrical power.

The lamp consists of a body 19 comprising a double channel tube, the upper end of which is provided with a dome 21 which closes and forms a connection between the upper ends of the channels. The lower end of each channel of the pair is sealed in the usual manner and provided with an electrode 23 having a connection extending out of the tube to permit discharge producing power to be applied between the electrodes. The lower end of the tube may be set in a base 25 of any usual or preferred construction whereby the lamp may be connected in a power outlet socket, the base having terminals 27 adapted to engage and form connections with the terminals of the outlet socket. If the lamp is to be used in a high voltage circuit, that is to say, a circuit providing electricity at sufficiently high voltage to set up and maintain the discharge in the lamp, the terminals 27 may be directly connected with the outlet connections from the lamp electrodes 23, it being understood that the terminals 27 must be sufficiently widely spaced in the base to prevent arcing therebetween. However, I propose to operate the lamp from a low voltage source of electrical power and therefore the lamp is preferably provided with a small transformer having a suitable ratio, which transformer 29 is arranged in the base 25 and having the opposite ends of its primary winding connected to the terminals 27, while the opposite ends of the secondary winding of the transformer are connected with the electrodes 23. The transformer 29 of course may be formed in any suitable or convenient manner, but I prefer to form the transformer as a so-called pancake coil device, wherein the primary and secondary windings are arranged in the form of flat interwoven coils which occupy a minimum of space in the socket base. Of course, the exact ratio of the transformer 29 will depend upon the available voltage in the house wiring circuit, and the dimensions of the discharge channel 31 provided in the lamp, it being understood that the voltage necessarily applied between the terminals 23 to produce a desired brilliance in lamps of this general character has a definite ratio which varies in accordance with the length and cross sectional area of the discharge channel so that the size of the discharge path provided in the lamp and the voltage of the power supply will determine the ratio of the transformer 29.

The parallel channels 15, as aforesaid, are connected at their upper ends by the dome shaped portion 21 and form an inverted U-shaped channel. During the manufacture of devices of this general character, it is necessary to bombard the channel and the electrodes 23 by passing a high voltage current through the tube between the electrodes, in order to remove the impurities therein.

In my present invention bombardment may be accomplished by inserting a bombarding electrode 33 in the upper end of the dome 21, which is preferably provided with an enlarged socket 35 for the purpose of actuating the bombarding electrode. The discharge channel 31 is then subjected to the action of an exhaust pump, in order to create a partial vacuum therein and high tension electrical currents are passed through the arms of the channel between the electrode 33 and the electrodes 23. These currents are maintained until the electrodes 23 are heated just short of the melting point. This causes the impurities in the electrode and also such impurities as may be clinging to the inner side walls of the channel 31, to be dislodged. After the bombarding current has been maintained for a sufficient length of time, the channel 33 may be flushed with dry air, in order to remove the impurities and the bombarding process repeated until the channel 31 and the electrodes are thoroughly purified. The channel 31 is then filled with a suitable gas, such as neon, argon, mercury vapor, etc., for the purpose of providing an ionized path for the discharge created between the electrodes 23 and through the channel 31. The channel may be conveniently filled with gas through an opening formed in the top of the dome 21 and after the tube has been bombarded and filled, the electrode 33 and the opening through which the gas is introduced into the channel 31 may be removed and the openings sealed off to form a rounded point 37, as is well known in the glass blowing art, to form a sightly finish for the element. The finished lamp is shown in Figure 4 and in shape is similar to the ordinary candle. In use the discharge extends in the channel 31 between the electrodes 23 so that the entire unit is illuminated above the base 25.

I have found that a device made as shown in Figures 3 and 4 of the drawings provides a desired brillance of illumination with less consumption of power than a similar illumination generated in discharge elements of the type hereinbefore provided. I believe this can be partially explained by the fact that the parallel and adjacent discharge channels separated by the partition 13 conserve the heat generated by the passage of the discharge through the channel 31 and apply the conserved heat in promoting the ionization of the gaseous discharge path. In

other words a part of the heat generated by the discharge in both legs of the channel 31 is transferred to the partition 13 which is heated and which in turn gives back the heat to the adjacent legs of the discharge path. The element, therefore, in and of itself heats the discharge path to a greater extent than devices heretofore provided. Apparently, the heating of the gases promotes ionization so that the discharge is maintained more easily through the more fully ionized path with the result that less power is required to maintain the discharge at a given brilliance and my invention contemplates the promotion of efficiency in discharge illumination by heating the discharge path.

This heating of course may be accomplished by any suitable means, but in the devices particularly illustrated herein, the heating of the discharge paths is accomplished by arranging the paths adjacently in a single element, the paths being separated by a partition giving a maximum heat transfer area between the paths so that a portion of the heat generated and liberated in one path may be utilized to heat up the adjacent path through the intervening partition.

A more important reason why the illustrated invention promotes the operating efficiency resides in the fact that the partition forms a condenser between the legs of the discharge channel, which applies a reactive capacity effect upon the discharge channel and improves the power factor of the device. As a result of the improvement in power factor, I have found that the current density in the discharge channel during operation is much greater than the current density in a straight channel of equivalent length and bore. Furthermore, I have found that the current density in the channels of the multi-channel lamp during operation is larger at points remote from the electrodes at which the actuating power is applied. This is caused, I think, by the reactive effect provided by the partition acting as a condenser throughout the length of the discharge device. The increased current density moreover, when the device is used for a lamp, produces increased luminosity. Devices embodying my present invention require substantially less voltage to initiate the discharge than single channeled lamps of equal length and bore and this feature is of advantage since less complicated and bulky equipment is required to operate the devices embodying my present invention.

Another feature of advantage residing in the construction hereinbefore set forth is the production of a relatively wide luminous object without increasing the power consumption required for the illumination. The power necessary to pass a discharge through a given path varies approximately as the square of the cross sectional area of the path. The luminous effect produced by the device of my invention, however, extends throughout the diameter of the tube 11, the partition 13 being practically indiscernible when the lamp is illuminated. Especially when the lamp is viewed from a direction normal to the plane of the partition 13, the partition is indiscernible.

I have therefore provided a lamp producing a wide streak of light with a power consumption substantially less than that required to produce an equivalent streak with lamps of the type heretofore provided. This advantage of course is in addition to the several other advantages apparent in my lamp and which include the advantages flowing from the provision of the lamp capable of operation from a low voltage circuit, a lamp operable from a socket as is the common incandescent lamp and the advantages flowing from the economy provided by heating the discharge path and applying capacity reactance in order to promote operating efficiency.

In Figures 5, 6 and 7 of the drawings I have illustrated the use of a multi-channel tube for the purpose of creating luminescent elements capable of producing various sightly and eye arresting effects, including a travelling light effect and numerous effects produced by employing gases producing differently colored lights in the several channels of the tube as illustrated in Figures 5, 6 and 7, the luminescent element consists of a tube 41 provided with longitudinally extending partition means dividing the tube into a plurality of parallel and adjacent channels 43. The ends of each channel are sealed off and provided with electrodes 45 so that each channel provides a separate discharge path. The ends of the tube 41 also may be provided with sockets 47 whereby the electrodes 45 may be connected in suitable electrical circuits.

The luminescent element construction just described may be employed in producing a number of highly attractive and useful effects. If the element is made with two channels 43, the two channels may be filled with gases capable of creating light therein of different colors. For instance, one channel may be filled with neon gas to produce therein a red light, while the adjacent channel may be filled with neon and mercury vapor to produce a blue light. The luminescent element may then be connected through suitable switching apparatus to a source of electrical power so that the channels may be lighted alternately. When such a luminescent element is viewed from a direction normal to the plane of the partition the element alternately flashes red and then blue light throughout its entire width and it is impossible to perceive any shifting of the path.

Still another multi-color effect which can be obtained with lamps of this general character is produced by twisting the partition so that the channels 43 extend helically around each other in the unit as shown in Figure 6. The unit may be made with either two or more twisted channels and a multi-color barber pole effect created. Obviously a traveling light effect may be produced in the form having twisted channels by exciting the channels alternately as hereinafter mentioned in connection with the form shown in Figure 7.

In Figure 7 of the drawings I have illustrated the possibility of employing an element of the type described to create a travelling light effect. This effect may be produced with a unit having two or more channels, although in the drawings I have illustrated the accomplishment of the effect within a unit having two discharge channels. The travelling effect is accomplished by dividing the outer surface of the tube 41 into preferably equal sections by lines of demarcation 49 and by painting out alternate sections of the channels 43 by applying black paint or other suitable pigment which will not pass the colored light rays, to the outer surface of the channels 43 between the lines 49 as indicated by the cross-hatching 51 in the drawings. If an element so prepared is illuminated by alternately discharging electrical power through the adjacent channels of the element, a travelling light effect as a

streak of light moving as indicated in the spiral line 53 will be created as an optical illusion.

Alternate or successive excitation of the gaseous medium in the several channels may be accomplished by means of a flasher 87 comprising a wheel of conducting material connected by means of a brush contact to one side of the secondary 89 of a transformer 91, the primary 93 is connected as by means of the switch 95 with a suitable power source. The other side of the secondary is or may be connected to the terminals 27 of the electrodes 45 disposed at one end of the lamp unit. The conducting wheel of the flasher may be selectively or alternately connected through brush contacts 97 and 99 with the several terminals connecting the electrodes 45 at the ends of the channels opposite from the electrodes which are connected with the transformer secondary 89. The brushes 97 and 99 bear upon the circular periphery of the wheel, which carries an insulating strip 101 so that the brushes alternately engage the conducting portion of the wall and are insulated therefrom at intervals during the rotation of the wheel. While the brushes are in electrical contact with the conducting portions of the wheel, the channels, with which the brushes are electrically connected, will be excited and while the brushes engage the insulating strip 101, excitation of the channels will be prevented. By disposing the brushes 97 and 99 at suitable intervals, the channels associated therewith may be alternately and successively excited. In these parallel channel forms, as well as in the candle form shown in Figures 3 and 4, the operating efficiency of the device is improved it is thought by the capacity effect of the integral partition 13, and the heat conserving effect of having the channels separated by an integral partition.

In Figures 8–12, I have shown how the device of my invention may be standardized so as to operate lamps of different size from a single socket. Standardization is accomplished by providing a unit element comprising partitioned member 55 to provide adjacent discharge channels 57 with opposed ends sealed, and having suitable electrodes 59 in their ends. The upper and lower ends of the elements are preferably secured in housing sockets 61 of any suitable or convenient configuration, but preferably cup-shaped as illustrated, the sockets at the lower end being provided with terminals 63 while those at the upper end have terminals 65 formed to co-operate with the terminals 63 and form an electric connection therewith. The terminals may be of any suitable size, shape and configuration but preferably are as shown in the drawings, i. e., the terminals 63 comprise prongs while terminals 65 comprise sockets adapted to receive prongs to make a detachable electric connection therewith. The electrodes 59 are each connected with a corresponding pronged or hollow terminal 63 or 65 and the ends of the members 55 are secured in place in the cup-shaped socket members with suitable cement material 67.

With a number of such standardized elements, a luminous sectional element such as shown in Figure 8 may be assembled by simply arranging the elements in end to end relation with the abutting ends interconnected as shown in Figure 10 whereas the lower terminals 63 of an upper section are engaged by the terminals 65 of a lower section.

In order to operate a sectional light of the sort shown in Figure 8 from a standard or constant voltage power outlet, I provide an adapter socket 67 as shown in Figure 9. This adapter consists of a housing 77 provided with a pair of pronged or other suitable lower terminals 71 adapted to form a connection in a standard power outlet socket. The terminals 71 are connected to the opposite ends of the primary winding of a step up transformer 73, secondary winding of which is connected to shaped terminals 75 set in the upper face of the housing 77 in position to receive the terminals 63 at the bottom of the lower most section of the assembled lighting element. Any number of sections may be employed in the sectional element, the transformer 73 in the adapter base as the proper ratio to supply power at the necessary high voltage to operate the sectional lighting element, it being understood that the longer the path through which a discharge takes place the higher must be the voltage applied to the ultimate terminals.

In Figure 11 and Figure 12, I have shown a connector cap 79 for use in connecting the upper electrodes 59 of a standard section when it is desired to use the section alone to provide a light unit operated from a power outlet. The cap 79 merely consists of a base supporting downwardly extending terminals 81 electrically connected by the conductor 83 and supported in position to engage the upper terminals 65 of the section. The cap may be provided with a knob 85 to facilitate manipulation and improve appearance.

In Figure 8, I have shown the uppermost section as comprising an element similar to the one shown in Figure 4, but it is obvious that the standard section with the cap as shown in Figure 11 could equally well be utilized.

The capacity effect of the partition means is particularly important in the sectional lamp arrangements shown in Figures 8–12, since the efficiency promoting reactive effect increases with the length of the discharge column so that length, which in prior devices is of no advantage in the promotion of efficiency, becomes a virtue in lamps embodying my present invention.

I do not claim herein the multi-channelled tubing shown in Figures 1 and 2, nor the method of making it since the same form the subject matter of my co-pending application Serial No. 555,244, filed August 5, 1931, now Patent No. 1,904,348, issued April 18th, 1933; nor do I claim herein the modifications shown in Figures 3 and 4, save in the combination illustrated in Figure 8, since the same form the subject matter of my co-pending application Ser. No. 541,390 filed June 1st, 1931, now Patent No. 1,963,961.

It is thought that the invention and numerous of its attendant advantages will be understood from the foregoing description and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of my invention or sacrificing any of its attendant advantages, the form hereinbefore described being a preferred embodiment for the purpose of illustrating my invention.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A discharge illuminating element comprising translucent means forming adjacent discharge channels extending longitudinally in the element, means rendering portions of said adjacent channels substantially opaque at staggered intervals therealong and means for discharging electricity through the adjacent channels in succession, whereby a travelling light effect may be created.

2. A discharge illuminating device comprising

a translucent envelope having a plurality of adjacent longitudinally extending discharge channels, a gas glow medium in each channel, said channels each having spaced light transmitting portions capable of transmitting sensible light to an observer, said light transmitting portions of the several channels being relatively staggered, and means comprising electrodes for exciting the media in said channels successively.

3. A discharge illuminating device comprising a translucent envelope having a plurality of adjacent longitudinally extending discharge channels, a gas glow medium in each channel adapted, when excited, to emit light of a desired color characteristic different from the color of the light emitted by the glow medium in another of said channels when electrically excited, said channels each having spaced light transmitting portions capable of transmitting sensible light to an observer, said light transmitting portions of the several channels being relatively staggered, and means comprising electrodes for exciting the media in said channels successively.

4. A discharge illuminating device comprising a translucent envelope having a plurality of adjacent longitudinally extending channels containing a gas glow medium, said channels being in relatively helically twisted relationship, and means comprising electrodes for exciting media in the several channels.

5. A discharge illuminating device as set forth in claim 4, wherein the gaseous medium in each of the discharge channels, is adapted, when electrically excited, to emit light of a color characteristic different from that emitted by the gaseous medium in another of said discharge channels when excited.

6. A discharge illuminating element comprising an integral translucent envelope having a plurality of adjacent longitudinally extending discharge channels containing each a gas glow medium adapted when electrically excited to emit light having a color characteristic different from that of the light emitted by the gas glow medium in another of said channels, said channels being in relatively helically twisted relationship, and electrode means to electrically excite the medium in the several channels.

7. A sectional lamp comprising a plurality of elements electrically connected together in end to end relationship, said elements comprising each a tubular element of translucent material having longitudinally extending partition means dividing the member into a plurality of adjacent longitudinally extending channels, sealing means at the opposite ends of the tubular member for sealing the channels thereof, a gaseous atmosphere in each channel adapted to be electrically excited to glow and spaced electrodes for electrically exciting the gaseous atmosphere in each channel, means to detachably electrically connect one of the electrodes of each channel with an electrode of the channel of an adjacent section element whereby corresponding channels of adjacent section elements may be electrically connected together in series and electrical connector means operably associated with the free electrodes of the end most sections of the series whereby to connect the series with a source of electrical power.

8. A sectional lamp comprising a plurality of elements electrically connected together in end to end relationship, said elements comprising each a tubular element of translucent material having longitudinally extending partition means dividing the member into a plurality of adjacent longitudinally extending channels, sealing means at the opposite ends of the tubular member for sealing the channels thereof, a gaseous atmosphere in each channel, electrodes for electrically exciting the gaseous atmosphere in each channel, means to detachably electrically connect one of the electrodes of each channel with an electrode of the channel of an adjacent section element whereby corresponding channels of adjacent section elements are electrically connected together in series, electrical connector means detachably associated with the free electrodes of an end section of the series, said connector means comprising a tubular envelope formed to provide a sealed U-shaped channel having arms separated by integral parts of the envelope forming a partition between said arms, said U-shaped channel containing a gaseous atmosphere adapted to be electrically excited to glow and an electrode in the extremity of each arm of the U-shaped channel, and means to electrically connect said electrode with the free electrodes of the end-most section of the series, and means to connect the free electrodes of the section at the opposite end of the series in an external electrical circuit.

9. A sectional lamp consisting of a plurality of elements electrically connected together in end to end relationship, said elements comprising each a tubular element of translucent material having longitudinally extending partition means dividing the member into a plurality of adjacent longitudinally extending channels, sealing means at the opposite ends of the tubular member for sealing the channels thereof, a gaseous atmosphere in each channel to be electrically excited to glow, and spaced electrodes for electrically exciting the gaseous atmosphere in each channel, means to detachably electrically connect one of the electrodes of each channel with an electrode of the channel of an adjacent section element whereby corresponding channels of adjacent section elements may be electrically connected together, and means to electrically excite the gaseous atmosphere in said adjacent channels whereby the reactive effect provided by the partition means, acting as a condenser between the adjacent channels may improve the operating efficiency of the device.

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