Dec. 15, 1936. A. E. NOBLE 2,064,490

ELECTRIC INCANDESCENT LAMP

Filed April 17, 1936 2 Sheets-Sheet 1

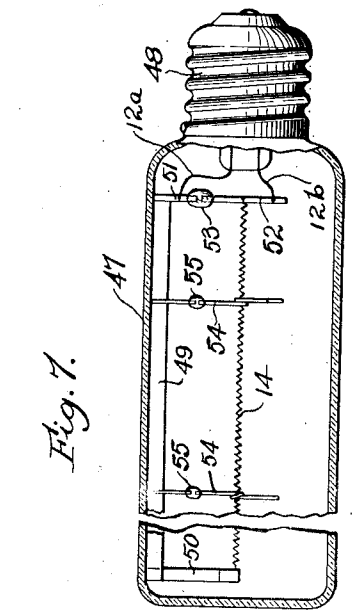


Fig. 7.

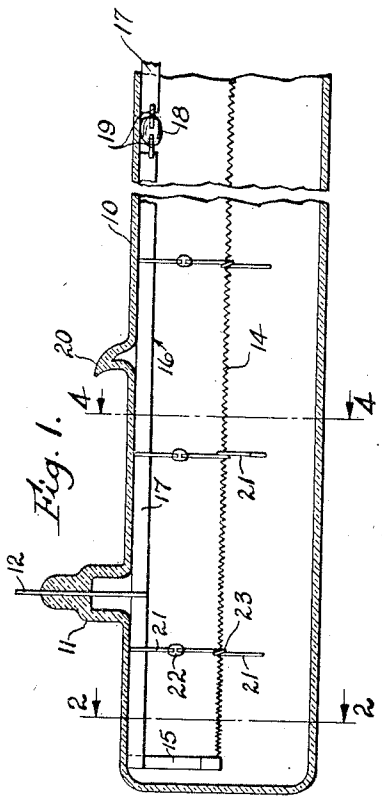


Fig. 1.

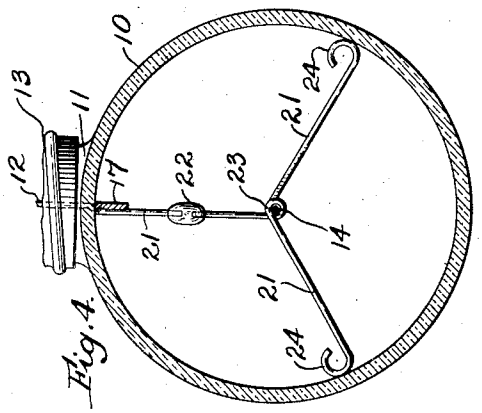


Fig. 4.

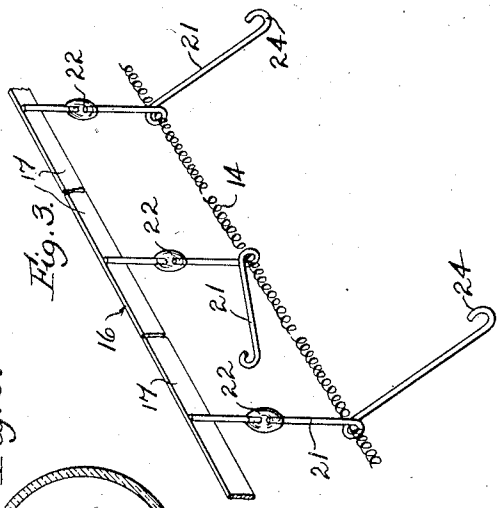


Fig. 3.

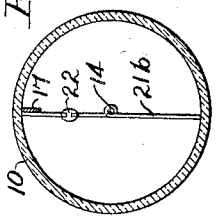


Fig. 6.

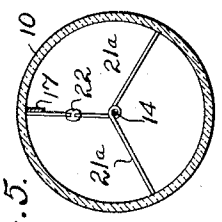


Fig. 5.

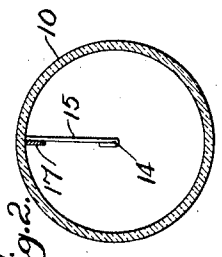


Fig. 2.

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Fig. 8.

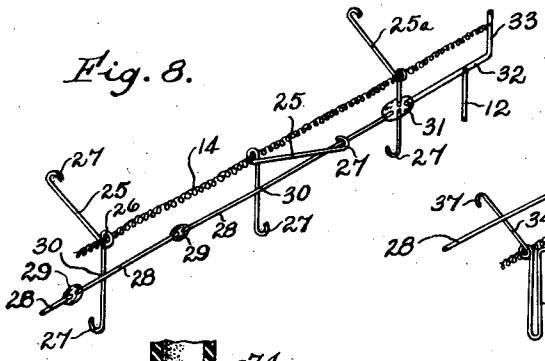


Fig. 9.

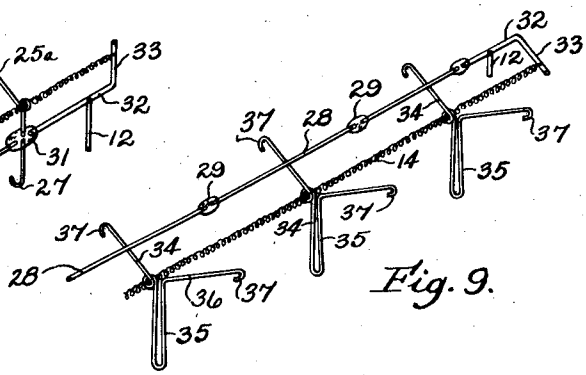


Fig. 17.

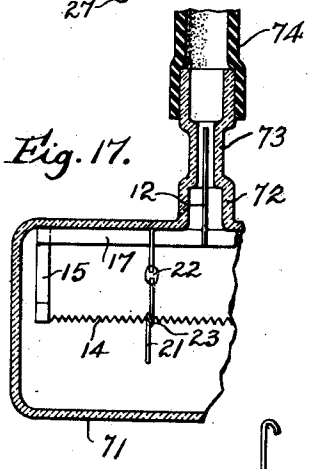


Fig. 18.

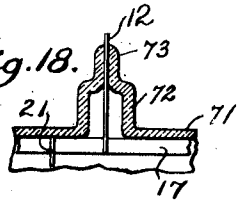


Fig. 19.

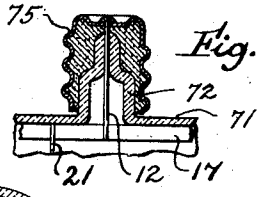


Fig. 16.

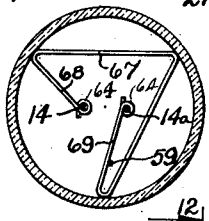


Fig. 10.

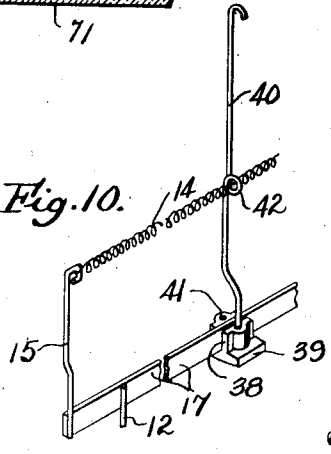


Fig. 12.

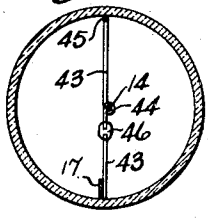


Fig. 11.

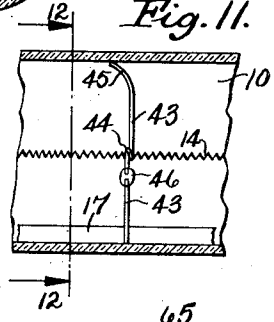


Fig. 14.

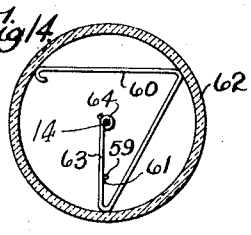


Fig. 13.

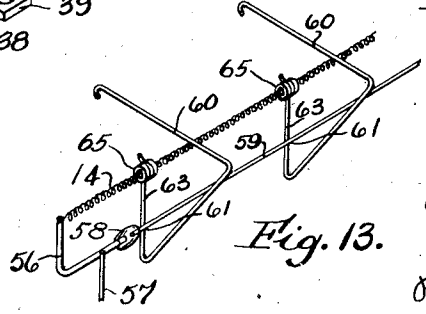
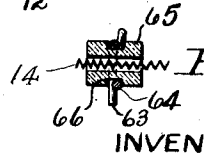


Fig. 15.



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UNITED STATES PATENT OFFICE

2,064,490

ELECTRIC INCANDESCENT LAMP

Aubrey E. Noble, Snyder, N. Y.

Application April 17, 1936, Serial No. 74,953

13 Claims. (Cl. 176—29)

This invention relates to electric incandescent lamps, and particularly to the type in which a filament extends in a direction lengthwise of an elongated glass tube or envelope, and is supported in the tube in spaced relation to the wall of the tube, usually approximately centrally of the bore of the tube.

Heretofore, various lamps of this type have been sold, but they have been objectionable because of the shadows cast by the filament supporting means, or because of the fact that the filament support was fragile and difficult and expensive to manufacture as well as to assemble in a tube.

An object of this invention is to provide improved electric incandescent lamps of this type, with which shadows of the filament supporting means will be reduced to a minimum and be practically nil, with which the filament will be supported and located in the tube in a simple and easily assembled manner, with which the same filament support and locating means will fit tubes that are straight and bent into various shapes, and which will be durable, simple and inexpensive in construction and dependable in use.

Another object of the invention is to provide an improved lamp of this type which may be used in any position without objectionable shadows of the filament support being visible, and with which the connections to the filament may be made either through the standard lamp base or through a plurality of spaced contact terminals adjacent opposite ends of the tube.

Another object of the invention is to provide an improved method for sealing the tube in an exhausted condition without an exhaust tubulation, and for sealing the lead-in wire in the glass envelope or tube.

Other objects and advantages will appear from the following description of several embodiments of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a longitudinal sectional elevation through a portion of a tube constructed in accordance with this invention, it being understood that the end portion of the lamp not shown is identical with, but reversed from, that shown for the left-hand end;

Fig. 2 is a transverse, sectional elevation of the same, the section being taken approximately along the line 2—2 of Fig. 1;

Fig. 3 is a perspective of a portion of the filament support and locating means of the same, removed from the tube and illustrated on an enlarged scale;

Fig. 4 is a transverse, sectional elevation through the tube at another point thereof, the section being taken approximately along the line 4—4 of Fig. 1;

Fig. 5 is a transverse sectional elevation similar to Fig. 4, but on full size scale and illustrating a slight modification in the filament spacers or supports;

Fig. 6 is another sectional elevation, similar to Fig. 5, but illustrating still another type of filament spacer or support;

Fig. 7 is a longitudinal, sectional elevation through a lamp similar to Figs. 1 to 4 except that the lead-in wires are arranged at one end and connected to the usual standard lamp base on the end of the tube;

Fig. 8 is a perspective of a portion of a filament and its supporting means, also constructed in accordance with this invention but illustrating another embodiment of the invention;

Fig. 9 is a perspective of a portion of a filament and the spacing and mounting means therefor, and illustrating still another embodiment of the invention;

Fig. 10 is a perspective of a portion of a filament and its supporting and spacing means, also constructed in accordance with this invention and illustrating still another embodiment thereof;

Fig. 11 is a longitudinal sectional elevation through a portion of a lamp constructed in accordance with this invention and illustrating still another modification of the filament supporting and spacing means;

Fig. 12 is a transverse sectional elevation of the same, with the section taken approximately along the line of 12—12 of Fig. 11;

Fig. 13 is a perspective of a portion of a filament supported and located in accordance with this invention, but illustrating another embodiment of the supporting and locating means removed from the tube;

Fig. 14 is a transverse sectional elevation through a tube having the filament supported and located in accordance with the embodiment shown in Fig. 13;

Fig. 15 is a longitudinal sectional elevation through an insulator used in Figs. 13 and 14;

Fig. 16 is a transverse sectional elevation through a tube showing the spacers formed to support a plurality of filaments.

Fig. 17 is a longitudinal sectional elevation

through one end of a lamp of the type illustrated in Figs. 1 to 4, and illustrating one step in the improved method of exhausting and sealing the tube around a lead-in conductor in accordance with this invention;

Fig. 18 is a sectional elevation of a portion of the lamp shown in Fig. 17 and illustrating another and subsequent step in the method of exhausting and sealing the tube; and

Fig. 19 is a sectional elevation similar to Fig. 18 but illustrating another subsequent and final step in the same method.

In the embodiment of the invention illustrated in Figs. 1 to 4, the lamp is illustrated as including an elongated glass tube 10 of cylindrical shape, and this tube may be either straight or bent laterally as may be desired, but for simplicity is illustrated as of the straight type. While only one end and an intermediate section are illustrated, it will be understood that the opposite end, not shown, is similar to but reversed from the end which is shown. While the tube 10 may be made of any light transmitting material, glass is the common material employed for that purpose and it may be either clear, frosted, colored, or otherwise treated or prepared, as may be desired.

Adjacent to but spaced from one end, the tube is provided with a tubular projection 11 through which one lead-in wire 12 extends. A metal cap or terminal connector 13 (Fig. 4) is secured in any suitable manner upon the projection 11, such as by cementing it thereover as in standard lamp base constructions, it being understood that the lead-in wire 12 at its outer end which extends beyond the projection 11 is soldered or otherwise connected to the cap or terminal 13, as usual in lamp base constructions, and through which the tube is supported and supplied with a lighting current. A long filament 14 of any suitable construction is disposed within the tube 10, so as to extend approximately centrally thereof and from end to end, the ends being secured in any suitable manner, such as to arms 15 disposed adjacent the ends of the tube. The arms 15 are provided on the ends of a spine 16 which extends approximately from end to end within the tube, and along the wall thereof at the side from which the projection 11 extends.

The spine 16 in this embodiment of the invention is made up of a plurality of ribbon-like strips 17 of metal, such as nickel or the like, which are slender and freely flexible and preferably disposed edgewise against the wall of the tube. A plurality of such strips or ribbons 17 are arranged end to end and connected to one another by insulating beads 18, which are preferably made of glass or transparent material so as not to cast shadows on the wall of the tube. The adjacent ends of each two strips that are arranged in end to end alignment are anchored in the beads in a spaced relation to one another and, for convenience of anchorage in the beads, each ribbon may have a wire 19 secured to and projecting from the end thereof and embedded in the glass bead. This construction is advisable because the wires 19 may be of a material to which the glass bead will adhere firmly throughout various changes in temperature. Materials of this type are disclosed, for example, in United States Patent No. 1,498,908, issued June 24, 1924. Such wires 19 may also be made of tungsten or molybdenum or any other suitable material.

It will be noted that the ribbon sections of the spine are insulated from one another by the interposed bead or beads 18, and any number of such interposed beads 18 and ribbon sections 17 may be employed so long as there is at least one bead employed in order to insulate the filament anchorage arms 15 at opposite ends of the tube from one another, except for the connection between them of the filament 14. Each lead-in wire 12 is secured to an end ribbon section 17, as shown in Figs. 1 and 4, and thus it will be observed that each lead-in wire is connected through an end ribbon section of the spine, to an adjacent end of the filament. When a current is applied to the lead-in wires 12, current will pass through the filament of the tube and heat it to incandescence. It will be understood, of course, that the tube is exhausted and sealed or filled with an inert gas before current is applied to the filament, as usual in this type of lamp, and any suitable means for so exhausting the lamp or tube, or for filling it with any inert gas may be employed.

In Fig. 1 such exhaustion of the tube is obtained through the usual exhaust tubulation 20, but another method of exhausting the tube and sealing it while exhausted to any desired degree is shown in Figs. 13 to 15 and will be explained hereinafter.

It is important that the filament be supported at a plurality of points intermediate of its ends and for that purpose I provide within the tube, and extending in a direction crosswise thereof, a plurality of spacers or struts 21. In this embodiment of the invention, each spacer or strut 21 is made up of a stretch of round wire of small diameter, such as of tungsten or molybdenum, or any other suitable material, and is formed of two sections disposed in end to end alignment and connected in slightly spaced relation to one another by glass beads or insulators 22. One end of each wire, strut or spacer 21 is secured in any suitable manner, such as by welding or soldering, to the adjacent ribbon strip 17, so as to project radially of the tube, and approximately at the center of the tube each wire strut or filament spacer is provided beyond its bead 22 with a loop 23 through which the filament 14 passes, the wire strut or spacer then continuing beyond the filament into contact with the wall of the tube.

The free end of each strut or spacer may be bent arcuately as at 24 so as to provide approximately point contact with the wall of the tube, as shown particularly in Fig. 4, because by such point contact there will be a minimum of shadows cast by the strut or spacer on the glass tube. Preferably, as shown in Figs. 1 to 4, some of the struts or spacers have their free ends or arms extending in a plurality of different directions from the filament so as to engage with the wall of the tube at a plurality of peripherally spaced points, as shown particularly in Figs. 3 and 4. A simple arrangement is to have the free ends or arms of these struts or spacers extend alternately to opposite sides from the filament and make angles greater than 90° with the arm of the strut or spacer that is connected to the spine 16.

The lead-in conductors 12 anchor the ends of the spine to the tube along one side thereof, and the spacers or arms 21 through their connection to the spine and their contact with the wall of the tube at a substantial distance from the spine provide supporting and locating means for the filament, and thus keeps the filament

located at approximately the center of the bore of the tube, as shown in Fig. 4. The spacers or struts 21 are made of such size that when inserted in the tube, they must be flexed or sprung slightly so as to exert continuing pressure on the inner surface of the tube wall when released in the tube, and for that reason the material of which the struts or spacers are made preferably should have some degree of elasticity or resiliency. Since the struts or spacers are anchored solely to the spine, it will be observed that the spine may be flexed laterally so as to follow the bore or the tube, even when the tube is bent laterally into different shapes, and regardless of the winding character of the tube, the flexed spine and the spacers will support the filament at approximately the center of the bore of the tube throughout its length.

In the embodiment of the invention shown in Fig. 5, the construction is the same as for Figs. 1 to 4, except that the struts or spacers 21*a*, instead of having the bent or looped ends 24 as in Figs. 1 to 4, are merely cut off abruptly at lengths such that the cut off ends abut the wall of the tube as shown in Fig. 5. The wire of which the struts or spacers 21 are formed is preferably cylindrical wire, that is, of circular cross section, which gives substantially point contact between the curved ends 24 of the tube wall, as will be observed from Fig. 4, but when the spacer ends are merely cut off abruptly, as shown in Fig. 5, without the loop or bent end 24, a different area of contact of the abrupt ends with the tube wall may be created. Since the struts or spacers 21*a* are made of small diameter wire and will be of such a size over all that they must be sprung or flexed slightly in inserting them into the tube, they will really engage only on an edge of the blunt or cut off end and thus really give a close approach to point contact with the tube wall in so far as shadows are cast. The elimination of the bent ends 24 thus saves a manufacturing operation and makes the construction shown in Fig. 5 somewhat less expensive. Otherwise the construction is the same as in Figs. 1 to 4 and corresponding parts in Fig. 5 are designated with the same reference characters as in Figs. 1 to 4.

In Fig. 6, the construction is the same as in Fig. 5 except that instead of having the struts or spacers 21*a* alternately make different angles to the ends anchored to the spine strip 17, these corresponding strips 21*b* in Fig. 6 have their free ends extend in almost the opposite direction from the ends connected to the ribbon strips 17. Since the bore of the tube is approximately cylindrical, and since the struts or spacers in this embodiment are large enough over all, or long enough, so that the free ends must be flexed or sprung slightly when being inserted into the bore of the tube, the spacers will be effectively held against lateral movement in the tube, and thus will definitely locate the filament in the bore of the tube.

In the embodiment of the invention shown in Fig. 8, the construction is the same as in Figs. 1 to 4, except that the spine and spacers for supporting and locating the filament intermediate of its ends in the tube are slightly modified. In this embodiment of the invention, the struts or spacers 25 are formed of strips of cylindrical wire bent intermediate of their ends to form loops 26 through which the filament 14 extends, and the opposite ends of the wire strips are bent into arcs as at 27 for engagement with the wall of the tube. These bent ends 27 are similar in function to the bent ends 24 of the spacers 21 of the Figs. 1 to 4.

Tie wires 28 extend in directions lengthwise of the tube, but within the tube, and are disposed in approximate end to end alignment with adjacent ends connected by glass beads or other insulators 29. Each wire 28 has a length which is less than the distance between alternate spacers, and is welded to one arm of the adjacent spacer 25, such as at 30. The wires 28 with the glass insulators 29 thus form a flexible spine corresponding in function to the spine 16 of Figs. 1 to 4, except that the spine of this embodiment is spaced well into the interior of the tube bore, instead of along a wall thereof as in Figs. 1 to 4. The arms of each spacer 25 to which a wire 28 is not connected, extend in different directions from the filament such as alternately in different directions, or to opposite sides of the filament, such as in the same manner shown in Figs. 1 to 4.

Each end spacer 25*a* may have the arm thereof which is connected to the spine formed in two spaced sections that are joined to one another by a glass bead 31, which bead also may be used to join one of the spine wires 28 to a somewhat heavier terminal member 32. Each terminal member 32 is connected to the lead-in wire 12, and has an angular arm or end 33 corresponding to arm 15 of Figs. 1 to 4, to which the adjacent end of the filament 14 is connected. It will be observed that the filament is connected at its ends to the terminals of a metallic spine which is formed in sections insulated from one another, and the intermediate portions of the filament are supported at intervals by the spacers which are also insulated from one another, so that when the lead-in wires 12 are connected to the end members 33 of the spine, a current may be passed through the filament in the same manner as explained for Figs. 1 to 4.

The embodiment of the invention shown in Fig. 9 is similar to that shown in Fig. 8 as above described except that the spacers 34, instead of being formed as shown in Fig. 8, have one of the arms leaving the filament doubled back upon itself toward the filament, as at 35, and then is bent somewhat radially of the tube, to form a third arm 36 which engages with the wall of the tube. The end of the wire section of which each spacer 34 is formed, may be abruptly cut off when expense is to be saved, but are illustrated as having curved or arcuate ends 37, corresponding to the ends 27 in Fig. 8, and ends 24 in Figs. 1 to 4.

It will be observed that each spacer 34, in effect, has three arms radiating from the filament at substantial angles to one another, so as to obtain by the three point contact of the spacer with the wall of the tube, a careful location of the filament in the tube. The bent back portion or arm 35 provides, in effect, a spring action, so that when the spacers are placed in a tube, the bent ends 37 are sprung towards one another slightly in order to get them into a tube, and then when released they will resiliently engage with the wall of the tube and prevent any substantial lateral movement of the spacer and filament in the bore of the tube. It will be noted that in all of these embodiments of the invention, the spine maintains the spacers in positions crosswise of the tube and properly spaced along the length of the tube.

In Fig. 10, the construction is similar to that shown in Figs. 1 to 4 except that the ribbon-like strips 17 are fitted in slots 38 of blocks 39 of insulating material or glass that abut against the wall forming the bore of the tube. The spacers 40 are mounted in and extend from recesses 41 in

the blocks 39 out of contact with the adjacent strip 17, are then bent intermediate of their ends to form loops 42 through which the filament passes, and then extend radially from the filament into engagement with the wall of the tube at substantial peripheral distances from the blocks 39 so as to locate the filament and prevent lateral movement thereof in the tube.

In the embodiment of the invention shown in Figs. 11 and 12, the construction is the same as in Figs. 1 to 4, except that each of the spacers 43 which correspond to the spacers 21 of Figs. 1 to 4, is approximately straight, is anchored at one end to a strip 17 of the spine, extends radially of the tube to the center thereof and is there bent to form a loop 44 through which the filament passes, and then extends beyond the filament to the opposite side of the tube from the strip 17 into engagement with the tube wall. These spacers are made of greater length than the diameter of the tube however, so that the free end of the spacer will be flexed sidewise, as at 45, as the spine with the spacers attached is forced into the tube in a direction endwise of the tube, as clearly shown in Figs. 11 and 12. This provides practically a point contact between the flexed free end of each spacer 43 and the tube wall, and the pressure of the flexed end of such spacer on the wall of the tube at the opposite side of the tube from the spine, prevents any lateral swaying or movement of the spacer, that is, any movement of the spacer crosswise of the tube, such as might carry the filament out of its desired location approximately centrally of the tube. It will be understood however that each spacer 43 is formed with sections that are joined, but insulated from one another, such as by glass beads 46.

In the embodiment of the invention shown in Fig. 7, the tube 47 is somewhat similar to the tube 10 of Figs. 1 to 4, except that instead of having a pair of projections 11 through which the lead-in wires 12 extend, and by which the tube is mounted in a fixture, the lead-in wire connections to the filament are made to a standard electric lamp base 48 which is provided upon one end of the tube 47. The spine 49 which mounts the filament 14, in this embodiment of the invention, is a continuous ribbon-like strip of metal similar to strips 17 of Figs. 1 to 4, but without sections separated by insulating beads. The spine 49 is provided, at one end, with an arm 50 to which one end of the filament 14 is secured, and at its other end is provided with an arm 51 to which one of the lead-in wires, such as the wire 12a is connected.

A terminal member 52 is disposed in end to end alignment with the arm 51, but spaced therefrom slightly, and a glass or other insulating bead 53 joins the adjacent ends of the arm 51 and the member 52, so that the member 52 in effect forms an insulated extension of the arm 51. The other lead-in wire 12b is connected to the member 52 and the filament 14 is also connected to this member 52. Thus when a current is applied to the lead-in wires 12a and 12b, it will flow through the filament and the spine 49. The spacers 54 may be of any suitable type, such as those shown in Figs. 1 to 4, with the insulating beads 55 in the portions thereof that are connected to the spine 49. The lead-in wires 12a and 12b are connected to the metallic sleeve and center terminal of the standard lamp base 48 in the manner that the filament connections or lead-in wires are connected to the standard lamp base in ordinary incandescent electric lamps.

In the embodiment of the invention illustrated in Figs. 13 to 15, the filament 14 is anchored at each end to an angular arm 56 (only one shown) to each of which arms 56 a lead-in wire 57 is connected, as in Figs. 8 and 9. Each arm 56 is connected by a bead or insulator 58 to the adjacent end of a spine wire 59 which corresponds to the spine wire 28 of Figs. 8 and 9 except that it need carry no insulating beads, except at its connection to arms 56, and may be a continuous metal wire or ribbon. The spacers 60 are formed of separate lengths of wire bent into the shapes shown, disposed crosswise of the tube at intervals along the length of the filament, and each welded or otherwise secured intermediate of its ends to the spine wire 59 as at 61. The wire 59 and arms 56 together may be considered as a complete spine for supporting the filament.

Each spacer 60 has two arms forming between them a V-angle and constituting chords of the circle of the bore of the tube 62, as shown particularly in Fig. 14. The free ends of the V, as well as the junction of the chords or arms, bear on the inner wall of the tube at different points spaced apart around more than half the inner peripheral surface of the tube. Each spacer 60 also has a third arm or stretch 63 extending from the free end of one arm of the V radially or toward the interior of the tube bore where it is coiled to form a loop 64 which releasably encircles a spool-shaped button 65 of insulating or ceramic material in a peripheral groove 66 thereof. The filament 14 extends through the bore of the spool and is hence insulated from the bent metal wire forming the structure or frame of the spacer. The button 65 may be formed or molded of any heat resisting and insulating ceramic material or any other heat resisting and insulating material, such as mica, for example, as may be desired.

If more than one filament is to be supported in each tube, each wire spacer 67 (Fig. 16) is bent to form a plurality of chords of the tube bore, with arms 68 and 69 extending from the ends of the chords into spaced relation to one another in the interior of the bore as shown in Fig. 16, and terminating in loops which encircle filament supporting spools of insulating material like the spools 65 of Figs. 13 to 15, and through which the different filaments 14 and 14a extend. Obviously other loops for filament supporting spools may be formed in any portions of the spacers in order to provide for the support of still more filaments, if such should be desired. The end of any spacer arm which engages the tube wall may be bent, curved or rounded as at 70 in Figs. 13 and 14, to give approximate point contact with the tube and reduce shadows on the tube wall.

Referring now to the Figs. 17 to 19, an improved method of exhausting and sealing the tube after the introduction of the filament will be explained. The tube 71 is similar to the tube 10 except that the exhaust tubulation 20 is omitted. Adjacent to but slightly spaced from one of its ends, the tube is provided with a projection 72 in place of the projection 11 of Figs. 1 to 4, and this projection 72 has a reduced neck portion 73 drawn therein between its ends. A hose 74 is connected between the free end of the extension 72 and a suitable device, not shown, for exhausting the air of the tube. The filament 14 in the tube is supported for example in any suit-

able manner, such as shown for example in Figs. 1 to 4, and similar parts are given similar reference characters. The lead-in wire 12 extends from the spine strip 17 outwardly in the extension 72 at least to a position at the outer end of the neck 73 as shown in Fig. 17. With the filament and its supports properly positioned in the tube, and with the terminal projection 11 provided at one end as shown in Figs. 1 to 4, and the projections 72 of Fig. 17 provided in place of the other terminal projection 11, the exhaustion of the tube is now started.

When the air of the tube has been drawn out or exhausted to the desired extent, heat is applied to the neck 73 until the glass of the neck can be drawn, at which time the glass of the neck portion is drawn together and around the terminal lead-in wire 12, which closes the projection 72 and seals the terminal wire 12 in the closed neck. The outer end of the projection 72 is then broken or fused off and the projection given the shape shown in Fig. 18. The partial vacuum in the tube aids in drawing the heat softened glass in the neck tightly around the wire 12, as shown particularly in Fig. 18. At this step in the process the outer end of the wire 12 projects beyond the sealed neck of the projection 72. A metallic terminal cap 75, such as the cap 13 of Fig. 4, is then applied over the closed projection 72 of Fig. 18, and cemented or otherwise anchored thereon, as shown in Fig. 15.

The metallic cap 75 is provided in its outer end with an aperture through which the free end of the wire 12 extends and this projecting end of the wire 12 is then upset against the outer end face of cap 75 or is otherwise anchored thereto such as by soldering it to the cap 75, as also shown in Fig. 19. By this procedure the exhaust tubulation 20 of Figs. 1 to 4 can be omitted and avoided.

If it is desired to fill the tube, after exhaustion, with an inert gas such as nitrogen or any rare or inert gases, this can be done through the projection 72 and the hose 74 after the air has been exhausted from the tube and before the neck 73 is heated and sealed around the lead-in wire 12.

Tubes made in accordance with this invention in which the filament is supported in any of the forms shown, when lighted, will show little or no shadow of the filament supports, especially when enclosed in a suitable translucent tube, such as an opal glass tube. When the tube is lighted, the spine appears only as a very thin and indistinct shadow line or thread from the ribbon type of spine shown in Figs. 1 to 7, 10, 11 and 12, but when the wire spine spaced from the tube wall, as shown in Figs. 7 and 8 for example, is used, we get no noticeable shadows on the tube wall and hence this particular type of spacer and spine, such as shown in Figs. 7 and 8, may advantageously be employed in a tube such as shown in Fig. 7 when the tube is hung down from a socket or used in a position where all of the tube surface is readily visible. The type of tube shown in Fig. 1 with the projections 11 is preferable where a plurality of such tubes are to be disposed end to end in order to obtain a substantially continuous line of light, or the appearance of a single long tube of light.

It will be obvious that various changes in the details, materials and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim as my invention:

1. An electric incandescent lamp comprising a light transmitting glass tube, a filament in said tube and extending approximately from end to end of the tube, a unitary spine within the tube and formed of sections insulated from one another, and extending in the direction of the filament, the ends of the filament being connected to and supported by the end sections of said spine, conductors connected to the end sections of the spine and extending through and anchored in the wall of said tube, for anchoring said spine at the end sections to said tube, and individual, unitary wire-like spacers disposed within and crosswise of the tube at intervals along the length of the filament, each spacer having a portion engaging and supporting the filament, and having arms extending crosswise of the tube from the filament directly and approximately to a plurality of different points on the tube wall that are spaced a substantial distance apart on the transverse periphery of the tube for locating the spacer and filament in the bore of the tube.

2. An electric incandescent lamp comprising an elongated glass tube, a flexible unitary spine within the tube and formed of sections of slender ribbons of flexible metal disposed end to end and connected by glass balls, the ribbons being disposed edgewise to the adjacent portion of the wall of the glass tube, arms carried by the ends of the spine, a filament extending between and supported by said arms and receiving current therefrom, a conductor connected to each end section of the spine and extending outwardly through the wall of the tube and anchored therein to anchor the spine edgewise with respect to the tube wall, wire-like unitary spacer arms extending from the spine crosswise of the tube at intervals along the spine, and each having a loop through which the filament passes, then extending from the loop beyond the filament into contact with the wall of the tube at a distance from the spine for further locating the filament in the tube.

3. An electric incandescent lamp comprising an elongated glass tube, a unitary flexible spine within the tube and formed of sections of slender, relatively thin ribbons of flexible metal disposed end to end and connected by glass balls, the ribbons being disposed edgewise with respect to the adjacent portion of the wall of the glass tube, arms carried by the ends of the spine, a filament extending between and supported by said arms and receiving current therefrom, a conductor connected to each end section of the spine and extending outwardly through the wall of the tube and anchored therein to anchor the spine to the tube in a position edgewise with respect to the adjacent portion of the tube wall, wire-like, unitary spacer arms extending from the spine in directions transversely of the tube at intervals along the spine, and each having a loop through which the filament passes then extending beyond the filament directly into contact with the wall of the tube at a distance from the spine for further locating the filament in the tube, the portion of each spacer connecting the filament to the spine being formed of spaced wire sections connected by a glass ball to insulate the intermediate portions of the filament from the spine.

4. An electric incandescent lamp comprising an elongated glass tube, a flexible spine within the tube and formed of sections of slender rib-

bons of flexible metal disposed end to end and connected by glass balls, the ribbons abutting edgewise against the wall of the glass tube, arms carried by the ends of the spine, a filament extending between and supported by said arms and receiving current therefrom, a conductor connected to each end section of the spine and extending outwardly through the wall of the tube and anchored therein, to anchor the spine edgewise against the tube wall, spacer arms extending from the spine crosswise of the tube at intervals along the spine, and each having a loop through which the filament passes then extending beyond the filament into contact with the wall of the tube at a distance from the spine for further locating the filament in the tube, the portions of the spacer arms that extend beyond the filament making a plurality of different angles to the portions connected to the spine so as to engage the tube at a plurality of different peripheral positions with respect to said spine and thus further locate the filament in the tube.

5. An electric incandescent lamp comprising a light transmitting tube, a filament in said tube and extending endwise thereof, a plurality of spacers within the tube and distributed at intervals along the filament, each spacer extending crosswise of the tube and formed of an individual stretch of wire bent upon itself to provide arms projecting across the interior of the tube and into contact with the wall of the tube, and also provide a portion extending well into the interior of the tube and supporting an intermediate zone of said filament, and a slender spine extending lengthwise of the tube and tied to each spacer for holding the spacers crosswise of the tube and properly spaced along the tube.

6. An electric incandescent lamp comprising a light transmitting tube, a filament in said tube and extending endwise thereof, a plurality of spacers within the tube and distributed at intervals along the filament, each spacer extending crosswise of the tube and formed of an individual stretch of wire bent upon itself to provide arms projecting across the interior of the tube and into contact with the wall of the tube, and also provide a portion extending well into the interior of the tube and supporting an intermediate zone of said filament, an insulating element carried by each of said filament supporting portions and through which said filament passes, and a slender spine extending lengthwise of the tube and tied to each spacer for holding the spacers crosswise of the tube and properly spaced along the tube.

7. An electric incandescent lamp comprising an elongated light transmitting tube, a unitary spine within, and extending in a direction lengthwise of the tube, said spine comprising a plurality of sections of a metallic ribbon disposed in end to end relation, with adjacent ends connected by an insulating button which spaces apart and insulates those ribbon sections, each ribbon section in cross section having materially greater breadth than thickness so as to be freely flexible in one direction and relatively rigid in the other direction, a filament in and running in a direction lengthwise of said tube, means supporting the ends of said filament from the end portions of said spine, means for anchoring the ribbon sections to the tube with the ribbon disposed edgewise with respect to the adjacent portion of the tube wall and for providing current connections to the ends of the filament, a plurality of individual, unitary, flexible, wire-like spacers carried by said spine at intervals therealong, each spacer having one wire portion formed to support the filament and another portion formed to engage the wall of the tube at a point spaced angularly about the longitudinal axis of the tube from said spine, to locate the filament in the tube.

8. An electric incandescent lamp comprising an elongated tube of light transmitting material, a slender, flexible, metallic spine disposed in said tube and running lengthwise therein, a filament in and running lengthwise of said tube, and a plurality of individual spacers within the bore of said tube and distributed at intervals therealong, each spacer being formed of a length of slender, flexible, metallic wire contacting directly with and secured to the metal of said spine, projecting therefrom across the bore of the tube into contact with the wall of the tube, and having a portion formed to support an intermediate section of said filament, said spine and spacers having the metal thereof broken and joined by insulating means sufficiently to insulate the filament engaging portions of the spacers from one another.

9. An electric incandescent lamp comprising an elongated tube of light transmitting material, a slender, flexible, metallic spine disposed in said tube and running lengthwise therein, a filament in and running lengthwise of said tube, and a plurality of individual filament rectilinear supports within the bore of said tube and distributed at intervals therealong, each support being formed of a length of slender, flexible, metallic wire contacting directly with and secured to said spine, projecting therefrom across the bore of the tube into contact with the wall of the tube, and having a portion formed to support an intermediate section of said filament, said spine being divided into a plurality of individual sections insulated from one another by insulating means so as to avoid short circuiting of the filament through the spine.

10. An electric incandescent lamp comprising an elongated tube of light transmitting material, a slender, flexible, metallic spine disposed in said tube and running lengthwise therein, a filament in and running lengthwise of said tube, and a plurality of individual rectilinear spacers within the bore of said tube and distributed at intervals therealong, each spacer being formed of a length of slender, flexible, metallic wire contacting directly with and secured to said spine, projecting therefrom across the bore of the tube into contact with the wall of the tube, and having a portion formed to support an intermediate section of said filament, each spacer being interrupted between its ends, and the sections at the interruption connected to one another by insulating means, so as to insulate the spacers from the spine and thereby adjacent spacers from one another, and avoid short circuiting of the sections of the filament between adjacent spacers.

11. An electric incandescent lamp comprising an elongated tube of light transmitting material, a slender, flexible, metallic spine part disposed in said tube and running approximately parallel to the bore thereof, a filament in and running lengthwise of said tube, means supporting said filament at its ends from said spine part, and a plurality of individual spacer parts within the bore of said tube and distributed at intervals therealong, each spacer part being formed of a length of slender, flexible, metallic wire contacting directly with and secured to said spine part, projecting therefrom across the bore of the tube

into contact with the wall of the tube, and having a portion formed to support an intermediate section of said filament, one of said parts having zones thereof broken apart and joined by insulating means sufficiently to insulate the filament engaging portions of the spacer parts from one another.

12. An electric incandescent lamp comprising an elongated tube of light transmitting material, a normally straight, slender, flexible, metallic spine part disposed in said tube and running approximately parallel to the axis of the bore thereof, a filament in and running lengthwise of said tube, and a plurality of individual rectilinear spacer parts within the bore of said tube and distributed at intervals therealong, each spacer part being formed of a length of slender, flexible, metallic wire contacting directly with and secured to said metallic spine part and projecting from the spine part directly in a direction across the bore of the tube to the filament, there formed with a loop supporting said filament, and then continuing beyond the filament into contact with the wall of said tube at a point spaced angularly about the bore of the tube from said spine, one of said parts having the metal thereof broken apart and joined by insulating means sufficiently to insulate the filament engaging portions of the spacer parts from one another.

13. An electric incandescent lamp comprising an elongated tube with light transmitting material, a normally straight, slender, flexible, metallic spine part disposed in said tube and running approximately parallel to the axis of the bore thereof, a filament in and running lengthwise of said tube, a plurality of individual rectilinear spacer parts within the bore of said tube and distributed at intervals therealong, each spacer part being formed of a length of slender, flexible, metallic wire contacting at one end directly with and secured to said spine part, projecting therefrom directly in a direction across the bore of the tube to said filament, there formed to support the filament, and then continuing from the filament into direct contact with the wall of the tube at a point spaced angularly about the bore of the tube from said spine, each spacer part being broken the filament and said spine part, and with the ends at the point of breaking connected by insulating means which slightly spaces the broken ends from one another, so as to electrically insulate the filament supporting portions of the wire of each spacer part from the spine part.

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