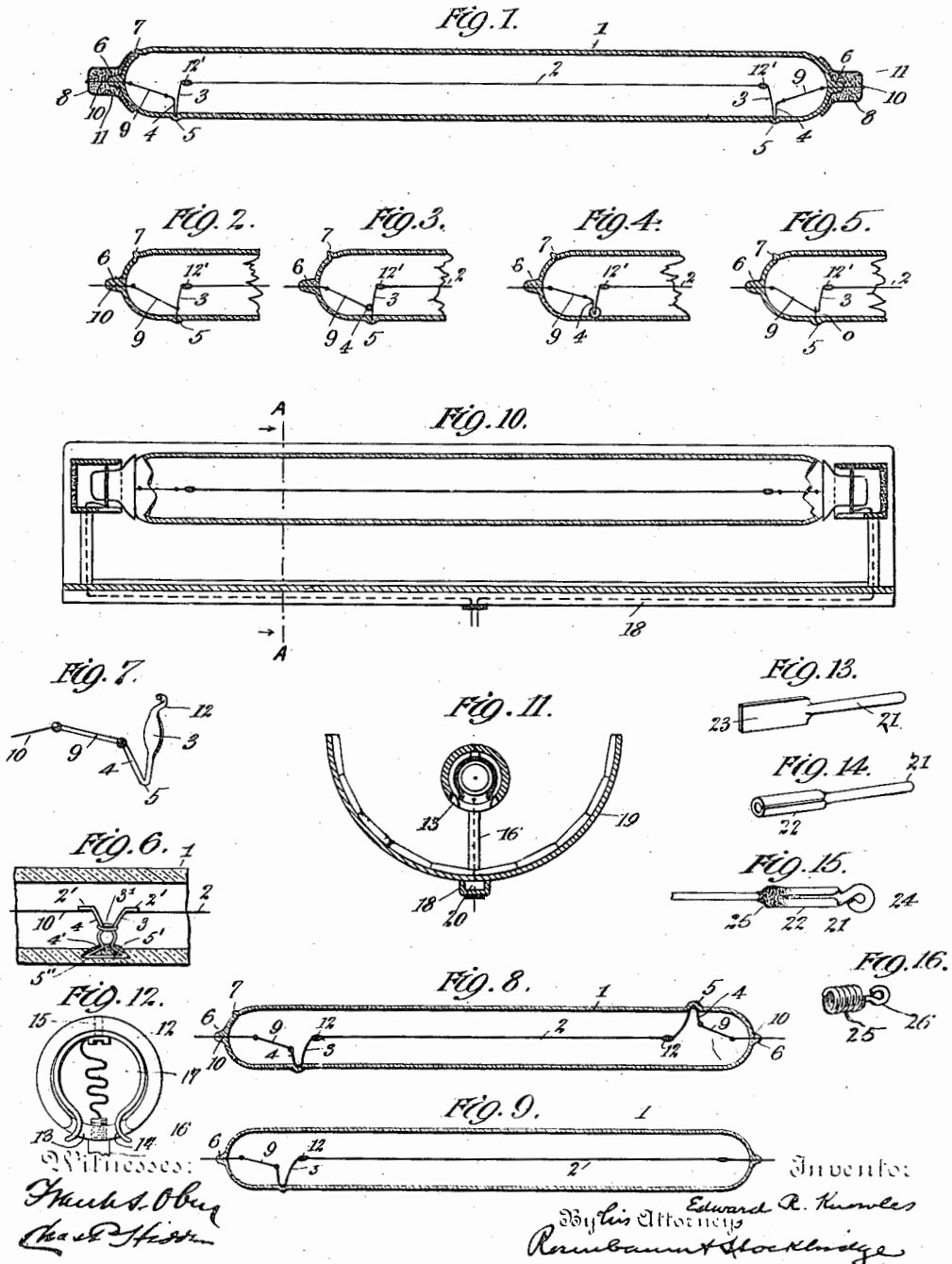


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 TUBULAR INCANDESCENT LAMP.
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Patented June 4, 1912.



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UNITED STATES PATENT OFFICE.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, EDWARD R. KNOWLES, a citizen of the United States, residing at the city of New York, in the borough of Brooklyn and State of New York, have invented certain new and useful Improvements in Tubular Incandescent Lamps, of which the following is a full, clear, and exact description.

10 The present invention pertains to that kind of electric light wherein the body of the lamp consists of an exhausted glass tube inclosing a filament which is disposed centrally in a single longitudinal line therein. 15 In previous lamps of this type there has been great difficulty in so sealing the filament in the tube that it will be truly adjusted in the axis of the tube, securely held in position and kept uniformly straight under all thermal conditions. It has also been difficult to reduce the physical dimensions of such lamps, and to make them in such manner that any number of lamps can be made sensibly the same and so that the cost of 20 manufacture will not be prohibitive.

To obviate these and other defects in lamps of this type as heretofore made, one object of the invention is to provide a novel means of holding up the filament within the tube whereby its accurate adjustment and safe anchorage are secured previously to and without interference from the sealing of the tube, rendering these operations less difficult of accomplishment in the manufacture of this class of lamps. 35

A second object of the invention is to so anchor the filament as to keep it uniformly straight under every thermal or anti-thermal condition, thereby minimizing and preventing its vibration from any cause and further precluding its coming into contact with or getting dangerously near the walls of the surrounding tube, due to flexure, bowing or sagging and this notwithstanding the filament being of greater than ordinary length and corresponding tenuity. 40

A third object is to reduce to the smallest practicable dimensions the metallic contacts needed to place the lamp electrically in circuit and to so locate the same that the lamp may be rotated axially to any position and so that one will see nothing but the glass tube and filament located therein, in whatever position the lamp is placed and when 45 the lamp is lighted there will be seen an unbroken line of light and a luminous sheath

therefor shining brightly from end to end with no furnishings or appendages to break its continuity or impair its brilliancy.

A fourth object is to provide a ready and convenient means of attachment for the lamp whereby it can be suspended, framed or bracketed and held in any desired position in complete safety as regards itself and its mounting. 60

A fifth object is to insure the production of a filament of uniform length having attaching means thereon adapted for engagement with anchoring means in the tube, said attaching means being spaced apart a predetermined distance, the filament and attaching means constituting a unitary structure. 65

Referring to the drawings which form a part of these specifications and in which similar letters or figures are used to designate corresponding parts: Figure 1 is a side elevation of the lamp showing the manner of supporting the filament by spring anchor supports sealed into but not through the wall of the glass tube and the manner of attaching the leading-in wires to the spring anchor supports and of sealing them in the ends of the tube and attaching the metal contact pieces thereto. Figs. 2, 3, 4, 5 and 6 show various ways in which the spring anchor supports can be sealed into but not through the wall of the glass tube and in which the leading-in wires may be attached thereto. Fig. 7 is a perspective view showing the flattened spring form of the anchor support. Fig. 8 is a longitudinal section of the lamp showing the filament supported by two spring anchor supports, sealed into the glass tube at points other than in the same straight line. Fig. 9 is a longitudinal section of the lamp showing the filament supported by one spring anchor support, the other end having its terminal sealed directly through the end of the tube. Fig. 10 is a longitudinal section. Fig. 11 is a transverse section of the lamp and its fixture contacts illustrating the manner of connecting it to the fixture; said section being taken on line A—A of Fig. 10. Fig. 12 is an end view of the fiber socket showing the connecting members therein. Fig. 13 is a view of a filament attaching piece before the same has been rolled up and bent to form a hook thereupon. Fig. 14 is a view of the same after rolling the flattened end thereof to form the filament engaging tube. Fig. 15 75 80 85 90 95 100 105 110

is a view of the same showing the hooked end, and a filament cemented in position in the tubular portion thereof. Fig. 16, is a perspective view of a modified form of a filament attaching piece.

The body of the lamp and the filament thereof are respectively designated by the reference figures 1 and 2. The former consists of a transparent glass receptacle in the shape of a tube, usually straight and sealed at both ends. The latter is a filament, preferably of carbon, similar to those in use in the so called "bulb" type of lamps but run in a single straight line along the axis of its tubular envelop. It may be here noted however that my anchorages are adapted to support filaments of other material than carbon.

In Figs. 1 and 8, V-shaped anchor supports 3, 3 are provided at or near each end of the tubular lamp body 1 for the purpose of sustaining the filament 2 in its correct central position as shown in the various figures of the drawings. These V-shaped anchor supports 3, 3, are each preferably made of platinum in the form of a cylindrical wire formed centrally into a thin flat spring 3 having the upper end 12, turned inwardly at right angles to the spring 3, and the lower end returned on itself forming a V-loop 5 and terminal 4 as shown in Fig. 7. To the returned end 4 of the loop 5 a leading-in wire consisting of a copper section 9 and a platinum section 10 is attached. These spring anchor supports 3, 3, are sealed interiorly at the tip 5 of the V loop, one near each end of the tube and at a predetermined distance apart, into the wall of the glass tube, but not passing through it, the tips 5, 5, being entirely covered with the glass of the tube; or with glass or the like united thereto. The points of sealing of the tips 5, 5, into the wall of the tube 1 may be at any points on the circumference of the tube 1 so long as they are the required distance apart and the hooked points 12, 12, are on the axis of the tube 1, thus obviating any necessity for getting them in the same straight line as in lamps heretofore made. The upper ends 12, 12, of these spring anchors 3, 3, are adjusted, during the process of sealing into the wall of the tube, so that they are exactly in line on the axis of the tube 1.

While the tube 1 is open at both ends and after the spring anchors 3, 3, are adjusted therein, the filament 2 is introduced into the tube 1 and securely attached at its end to the inturned ends 12, 12 of the spring anchors by a suitable cement joint 12' or in any other approved manner. My preferred form of attaching the filament will be hereinafter described.

After the filament is secured in position to the spring anchors one or both of the spring anchors are bent outwardly toward the open

ends of the tube thus putting a tension on the filament and holding it tense and straight in the axis of the tube. As the spring of the anchors will relax outwardly or inwardly in the inclosing tube, it is evident that the filament will always be kept straight by and between them, the filament acting when cold or contracted to keep the anchors under a greater or less tension and when hot or expanded having its slack taken up by the springs becoming relaxed thus keeping a tension on the filament and maintaining it straight, thus securing a single line illuminator that can be of almost any length without a corresponding increase in cross sectional area, and whose length is in fact, only limited by the voltage to be carried. The use of springs at each end permits the use of wire therefor of a fair degree of stiffness since the springs act in unison. The glass tube 1 is then sealed on the platinum sections 10, 10 of the leading-in wires, an exhausting tube being added at 7 for connection to the vacuum pumps and the lamp finally sealed up at 7, after exhaustion.

Figs. 2 to 6 inclusive show various methods of sealing the tip 5 of the V or substantially V-shaped anchor support into the tube 1. In Fig. 2 the anchor support consists of a straight portion 3 to which is attached at a point above its terminal 5 the leading-in wire 9, 10, the terminal 5 being sealed into but not through the wall of the tube 1.

In Fig. 3 the anchor supports consist of a straight portion 3 in which is a loop 4 through which is hooked the leading-in wire 9, which is in turn secured to connection 10.

In Fig. 4 the tip 5 of the V-shaped anchor is first sealed into a glass bead X which in turn is attached to the wall of the tube 1.

In Fig. 5 the V-shaped anchor may be made of any spring material, mechanically fastened at its tip to a platinum wire O which in turn is sealed at its tip 5 into but not through the wall of the tube 1.

In Fig. 6 a modification of the V-shaped anchor is shown, in which a substantially flat bottom portion 5' is provided for the anchor. Inwardly bowed arms 4' upwardly extending from 5' are in turn united to the respective arms 3 and 4, the latter corresponding to arms 3 and 4 in the several modifications above described. A recess 5'' is preferably formed with under-cut walls which may be pressed into the body of the tube on the inner side thereof, by a suitable tool. The flat portion 5' of the anchor is then sprung into this recess and any suitable material may then be used to seal the anchor in place. A small ring or oval 3' may be provided in connection with this form of device and is adapted to be sprung up over the shouldered portions of the arms 4' to engage the recesses thereabove when it is de-

sired to place the arm 3 under tension. This form of construction may be of advantage at times, when it is desired to avoid the use of platinum, since a securing material or cement may be selected which will have substantially the same coefficient of expansion as the material of which the wire forming the V-shaped anchor in this case is composed.

By this method of manufacture it will be seen that all of the work involved in securely anchoring and adjusting the filament can be accurately performed before the tube needs to be closed at either end and yet all of the advantages of an end seal of the leading-in wires is obtained whereby the lamp can be placed in any position and without there being any attachment on the lamp to interfere with or obscure the light. By this method of manufacture it is also possible to place the spring anchors at the same distance apart in all lamps, to use the same length filaments in all lamps and to seal all lamps to precisely the same length.

To adapt the lamp for connection in an electric circuit the ends 6, 6 are inclosed in metal caps 8, 8 which are cemented or fastened to the body of the lamp by the cement 11, 11 the leading-in wires 10, 10 being soldered or fastened to the caps 8, 8.

In Figs. 10 and 11 I have shown a form of connector forming part of a reflector or fixture by means of which the lamp can be quickly introduced into or removed from the electric circuit and can be securely held in place when so introduced into the electric circuit. The small sections of fiber tube 12 are slotted partly through at one side, as at 13, said slot being sufficiently wide to admit a cap 8 therethrough. To the inside of these tubes are secured spring clips 14 which may be formed simply of strips of wire, united to the said fiber tubes by screws 15. Tubular uprights 16 are screwed into each of said tubes, preferably for appearance, in the portion thereof adjacent to and in alinement with the slot therein, and conductive wires extend upward through the uprights, and in turn are secured to screws 15. The outer ends of the fiber tubes may be plugged with small shives of cork 17. The above affords a very simple and inexpensive, but efficient means for making connection with and maintaining the lamps in position. Uprights 16 are secured by soldering, or in any other suitable manner, to a hollow base bar 18, which for ornamental purposes may be of brass. Upon the side of this bar adjacent the lamp sockets is secured a reflector 19. This may be of polished metal or may have secured to the inner sides thereof, strips of porcelain, glass or the like. If the transverse section of the reflector be semi-circular as shown, the lamp sockets should preferably be placed well below the edges there-

of. I have therefore shown a neat unitary structure for supporting the lamp, and one in which obviously the lamp may be inserted merely by snapping it into position without regard to the particular disposition of any side thereof. An insulating thimble 20 is provided midway of the length of the base bar and conductive leads are inserted therethrough and respectively extend through the hollow base bar and unite or may be integral with the wires leading downwardly through the uprights at the ends of the reflector.

The preferred form of attaching the filament to the anchor devices hereinbefore referred to involves the use of small hooked members 21 preferably having a tubular filament-engaging portion 22. I prefer to construct these in the following manner. A short piece of wire is flattened or rolled down at one end 23 as shown in Fig. 13. The flattened wire is then drawn through a die to roll up the flattened portion into tubular form as shown in Fig. 14; and finally the wire end is bent into the form of a hook or loop 24. The filament end is then introduced into tubular portion 22, which is slightly pinched together thereupon and cement applied thereto, which makes a firm connection and affords excellent electrical contact. The loops 24 are slipped over hooks 12 of the anchors when assembling and cement 12' is applied to the jointure in the manner aforesaid. It is obvious that my filament may be joined to the anchor which may in such case have straight ends by merely cementing the respective ends of said filament and anchor together without interposing the tubular connecting piece, and this form of construction has been indicated at 2' in Fig. 6. I may also make the attaching member simply by rolling wire into a helical coil as at 25 in Fig. 16 and then bending an end of said coil into a hook as at 26.

Having described my invention, what I claim is:

1. In an incandescent lamp, a filament anchor forming a current conductor comprising two members having free extremities, the portion of the anchor adjacent the point of union between the members being anchored on the bulb of the lamp, a filament connected with the free extremity of one member, and a leading-in wire connected with the extremity of the other member.

2. In an incandescent electric lamp, a filament anchor consisting of a current conductor anchored at a point intermediate its ends on the bulb of the lamp to form a pair of free members, a filament connected with one member, and a leading in wire connected with the other member.

3. In an incandescent electric lamp, a filament anchor consisting of a current conductor bent at a point intermediate its ends

in the form of a V and having its bend anchored on the wall of the bulb of the lamp, a filament connected with one free extremity of the anchor and extending in one direction therefrom, and a leading-in wire connected with the other free extremity of the anchor and extending oppositely to the filament.

4. In an incandescent electric lamp, a filament anchor forming a current conductor comprising two members having free extremities, one member constituting a spring, the portion of the anchor adjacent to the point of union between the members being anchored on the bulb of the lamp, a filament connected with the free extremity of the spring member and a leading-in wire connected with the extremity of the other member.

5. In an incandescent electric lamp, a filament anchor consisting of a current conductor anchored at a point intermediate its ends on the bulb of the lamp to form a pair of free members, one member thereof constituting a spring, a filament connected with the spring member and a leading-in wire connected with the other member.

6. In an incandescent electric lamp, a filament anchor consisting of a current conductor bent at a point intermediate its ends in the form of a V and having its bend anchored on the wall of the bulb of the lamp, one member of the anchor constituting a spring, a filament connected to the free extremity of the spring member of the anchor and extending in one direction and a leading-in wire connected to the other free ex-

tremity of the anchor and extending oppositely to the filament.

7. In an incandescent electric lamp, a filament anchor consisting of a current conductor bent at a point intermediate its ends in the form of a V, and having its bend anchored on the wall of the bulb of the lamp, one member of the anchor constituting a spring, and provided with a hook at the extremity of the spring member, a filament provided with an eye attached to each end of said filament, and attached to the free extremity of the free member of the anchor and extending in one direction, and leading-in-wires connected to the other free extremity of the anchor extending oppositely to the filament.

8. In an incandescent electric lamp, a filament anchor consisting of a current conductor bent at a point intermediate its ends in the form of a V and having its bend anchored on the wall of the bulb of the lamp, one member of the anchor constituting a spring, a filament provided with an eye attached to each end of said filament, and attached to the free extremity of the free member of the anchor and extending in one direction, and leading-in-wires connected to the other free extremity of the anchor extending oppositely to the filament.

In witness whereof I subscribe my signature, in the presence of two witnesses.

EDWARD R. KNOWLES.

Witnesses:

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WILLIAM C. LARY.