July 6, 1926. 1,591,911

C. A. B. HALVORSON, JR

INCANDESCENT LAMP

Filed July 23, 1920

Fig.1.

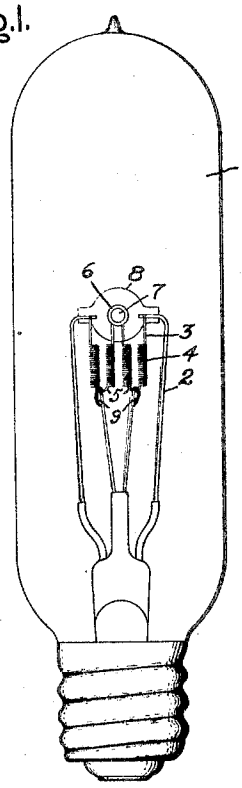


Fig.2.

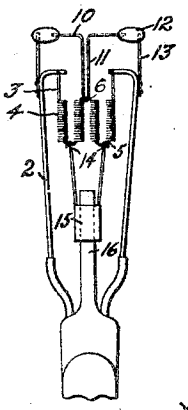


Fig.3.

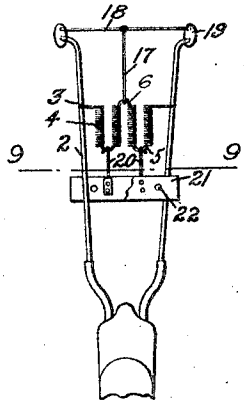


Fig.9

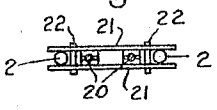


Fig.4.

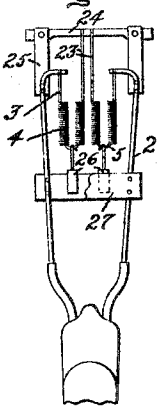


Fig.5.

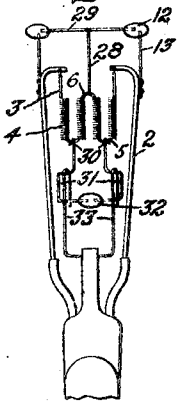


Fig.6.

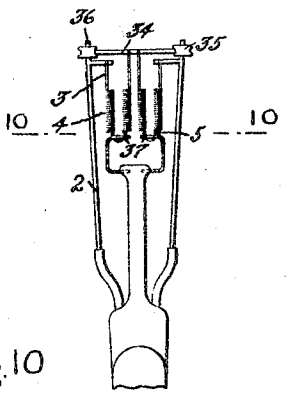


Fig.7.

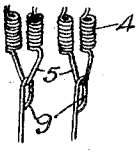


Fig.8.

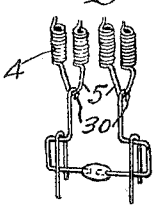
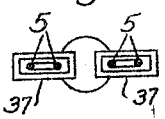


Fig.10



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by Albert G. Davis
His Attorney.

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UNITED STATES PATENT OFFICE.

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INCANDESCENT LAMP.

Application filed July 23, 1920. Serial No. 398,431.

My invention relates to incandescent lamps and more particularly to metal filament incandescent lamps suitable for use in stereopticans, moving picture projectors, and similar devices.

One type of incandescent lamp suitable for use as the source of light in moving picture projectors has a tungsten filament comprising several straight coils placed parallel to and close to one another and in the same plane to constitute a compact light source. The bulb of the lamp is filled with an inert gas, such as nitrogen or argon, and the normal operating temperature of the filament is very high. When lamps of this type and of the customary construction are turned off and on a number of times the straight coils of the filament become bent or bowed and also warp or twist out of alignment and out of focus of the lens of the projector. Apparently the hot and comparatively soft filament is pulled out of shape to a slight extent every time it is lighted, and ultimately the filament becomes so distorted that the lamp is useless.

The object of my invention is to provide an incandescent lamp in which distortion or warping of the filament during the life of the lamp is negligible. Another object is to provide a lamp of this type in which the filament does not sag or distort when the lamp is used in an inclined position. A further object is in general to improve incandescent lamps, particularly those in which the operating temperature of the filament is so high that the metal of the filament is comparatively soft and weak while the lamp is lighted.

In accordance with my invention the metal supports which engage the filament are so arranged that their expansion when the lamp is lighted causes no change in the relative position of those points on the supports which engage the filament. As the filament supporting points are always in the same relative position, regardless of the temperature of the supports, there is no tendency for the supports to pull the hot filament out of shape. Where, for example, the filament is suspended by its ends from two comparatively heavy leads which supply current and also mechanically support the filament, I prefer to support an intermediate point of the filament by a compensating bridge or anchor which is carried upon the leads and is so disposed and proportioned that it maintains said intermediate point of the filament always in proper relation to the filament ends to prevent distortion of the hot filament. In order that the lamp may be operated in an inclined position I provide guiding anchors which hold the filament loops in the proper plane, but which are so constructed that they are free to move in the plane of the filament. As a result the filament coils can expand or contract and move bodily as long as the movement is in the proper plane. To eliminate twisting or warping of the filament coils, I construct the guiding anchors in such a way that although the filament loops are free to rise and fall, they cannot twist or turn so as to move out of the plane of the filament. As a result the straight coils of the filament remain parallel to one another and in the same plane even though the filament moves bodily to some extent as the leads expand and contract.

My invention will best be understood in connection with the accompanying drawings in which merely for purposes of illustration I have shown some of the various forms in which it may be embodied, and in which Fig. 1 is a view of a lamp which embodies one form of my invention; Figs. 2 and 3 are views of mounts for a lamp of this type embodying modifications of my invention; Figs. 4 and 5 views of mounts showing different forms of guiding anchors constructed to slide and to hold the filament in the proper plane; Fig. 6 is a view of a mount embodying a modified form of sliding guide for preventing twisting of the free ends of the filament loops. Figure 7 is an enlarged detailed view of a part of Figure 1; Figure 8 is an enlarged detail view of a part of Figure 5; Figure 9 is a section along the line 9—9 of Figure 3 and Figure 10 is a section along the line 10—10 of Figure 6.

The particular form of lamp shown in Fig. 1 operates in a vertical position with the tip up, and comprises a glass bulb 1 containing an inert gas such as nitrogen or argon, and provided with two heavy leads 2, usually of nickel, for supplying current to the filament. A coiled tungsten filament is suspended from the leads 2 and has uncoiled ends 3 welded or otherwise securely fastened to them. The filament comprises straight parallel coils 4 in the same plane and as close together as is feasible and con-

nected by two uncoiled lower bends 5 and a middle uncoiled connection or bight 6. The joints between the filament ends 3 and the leads are some distance from the coils 4. The coils 4 must retain their shape and position in order that the filament may remain in the focus of the condensing lens of the projector throughout the life of the lamp.

When lamps of this type as heretofore constructed were turned on and off a number of times during their life the straight coils 4 gradually became bent or bowed, apparently because the filament anchors heretofore used changed their relative position gradually as they heated up by conduction and pulled the hot and comparatively weak filament out of shape to a slight extent. When the current was turned off the filament cooled much more rapidly than the anchors and consequently it hardened in the distorted form into which it was pulled when hot. The distortion produced each time the lamp was lighted was comparatively slight, but was cumulative and soon rendered the lamp useless.

In accordance with my invention, I prevent distortion of the filament by supporting it in such a way that no change in the relative position of the ends 3 and the middle bend 6 occurs when the lamp is lighted. To this end I provide for the middle bend 6 of the filament, an anchor 7 made as a pin of some refractory metal such as molybdenum or tungsten, and mount it on a bridge 8 which is carried by the leads 2. The bridge 8 is of some refractory insulating material, such as mica, and its ends are riveted to the leads 2 close to the ends 3 of the filament. When the lamp is lighted the filament immediately becomes very hot. Gradually the leads heat up by conduction and elongate, but as the leads expand, they carry the bridge 8 with them, and consequently the relative position of the anchor 7 and the joints between the leads and the ends 3 of the filament is unchanged, although the filament is moved bodily by the elongation of the leads. The elongation of the bight 6, which has sides practically the same length as the ends 3, lowers the middle coils 4 adjoining it the same amount as the end coils are lowered by the elongation of the ends 3. The bridge 8 is so constructed and mounted that the effect of its expansion and bodily displacement as the leads expand in displacing the anchor 7 with reference to the joints of the filament and leads is practically nothing, and therefore, the whole filament remains free from distortion.

In order to retain the filament in the proper plane I provide means for guiding the lower bends 5 in such a way that they are free to move in the plane of the filament coils. In this particular construction the bends 5 are guided in anchor loops 9 which hold them in the proper plane, but permit them to rise and fall.

In the form of mount shown in Fig. 2 the middle bend 6 of the filament is supported by an insulated metal bridge bar 10 which at its middle is formed into an anchor loop 11 for engaging the middle bend 6 and at its ends is attached to the leads 2 by means of glass buttons 12 on the upper end of metal pedestals 13 which are welded to and form extensions of the leads. The bridge bar 10 and pedestals 13 are preferably made of the same metal and of substantially the same size. To permit the filament to move upward bodily as the leads 2 elongate, I engage the lower bends 5 by guide anchors 14 secured to a sliding ring 15, preferably of glass, and loosely mounted on a guide rod 16 sealed into the stem of the lamp. When the lamp is lighted the gradual elongation of the pedestals 13 lifts the bar 10 bodily to a slight extent, but the anchor loop 11 elongates sufficiently to compensate for the upward movement of the bar 10, so that the lower end of the anchor loop and the center bend 6 of the filament are always in the same position relative to the filament ends 3, and the filament is not distorted or pulled out of shape.

In the form of lamp shown in Fig. 3, I support the middle bend 6 by a compensating anchor 17 which has a hook at one end to engage the middle bend 6 and is carried upon the leads 2 by means of a bridge bar 18 which in turn is supported upon but insulated from the leads 2 by insulating buttons 19. When the lamp is lighted the filament immediately becomes very hot and comparatively soft. Gradually the anchor 17 and the leads 2 heat up by conduction from the filament and elongate due to expansion. The elongation of those portions of the leads between the ends 3 of the filament and the buttons 19 lifts the bar 18 and carries the anchor 17 upward. This raising of the anchor would move the middle bend 6 of the filament with reference to its ends 3 and thereby distort the filament were it not that the anchor 17, which is preferably of the same metal as the leads, elongates enough to compensate for the upward movement of the bar 18 with the result that the hook on the lower end of the anchor 17 is always in substantially the same relation to the ends 3 of the filament. The filament may rise and fall as a whole as leads 2 expand and contract, but there is no distortion because there is no relative movement between the ends of the filament and the middle bend 6.

To guide the lower bends 5 I provide guide anchors or links 20 carried on a crosshead 21 which is slidably mounted on the leads 2 which act as guide members. The

crosshead is made of two sheets of mica or similar insulating material riveted to the links or anchors 20 and spaced apart a distance slightly greater than the diameter of the leads 2. Sidewise movement of the crosshead is prevented by guide pins 22. The crosshead not only rises and falls freely with the filament as the leads 2 expand and contract but also by means of the links 20, which are fixed to the crosshead and engage the filament at different points, prevents twisting or warping of the coils 4 out of the plane of the filament.

In the mount shown in Fig. 4, the filament is made in two parts, each consisting of two coils. The two adjacent straight ends 23 are electrically connected and mechanically supported by a metal cross bar 24, which in turn is carried upon insulating pedestals 25 preferably of mica and riveted to the leads 2. The relative length of the ends 23 and of the insulating pedestals 25 is such that the upward movement of the cross bar 24, due to the expansion of the pedestals, is compensated for by the elongation of the straight ends 23 of the filament so that the coils 4 are always in the same relative position to each other and to the ends 3 which are attached to the leads.

Vertical movement of the lower bends 5 is permitted, but twisting or warping of the coils is prevented by means of flat sided blocks 26 secured to the bends 5 and freely movable between two guide plates 27 of mica firmly secured to the leads 2. The slide blocks can rise and fall with practically no friction, but can not rotate about a vertical axis.

In the form of mount shown in Fig. 5, the filament is suspended by its ends from the leads 2 and supported at the middle by an anchor 28 secured to a bridge bar 29 which has its ends embedded in the glass buttons 12 on the upper ends of the pedestals 13. The expansion of the anchor 28 compensates for the expansion of the pedestals, and distortion of the filament is prevented.

To prevent twisting I hold the lower bends 5 of the filament by a sliding guide anchor comprising a sliding member formed of two anchor wires 30 and each provided with an offset bend 31 and joined at their ends by a glass button 32. A guide, preferably in the form of a rather flat hook on the end of a guide wire 33 sealed into the stem, is provided for each offset bend 31, and permits it to rise and fall freely but prevents rotation of the coils about a vertical axis. The coils are firmly held in the proper plane but are free to move in the direction of their axis.

In the modification shown in Fig. 6 the filament is of the same construction as in Fig. 4. The cross bar 34 is secured to the leads by insulating buttons 35, mounted on projections 36 of the leads 2. Twisting of the coils and rotation of the bends 5 about a vertical axis is prevented by two horizontal guide anchors 37 of some metal such as molybdenum sealed to the stem of the lamp and each having a rectangular slot of a width slightly greater than the diameter of the the wire of which the filament is made, and of a length greater than the outside dimensions of the bends. Each bend projects into the slot in the anchor and as a result the bend cannot rotate about a vertical axis, although it is free to rise and fall in the plane of the filament.

To determine whether the compensating bridge and compensating anchor for holding the middle of the filament is properly proportioned I may project on a screen a greatly enlarged image of the filament by means of a projector such as is used for moving pictures, the filament of the lamp to be tested being placed in the position occupied by the film when pictures are being projected. When the current is turned on any changes produced in the various metal parts of the lamp by the heat are easily observed in the greatly enlarged filament image on the screen. If the compensating anchor does not elongate enough to fully compensate for the expansion of the other parts of the bridge, the middle point 6 of the filament will be lifted out of its proper relative position to the ends 3 of the filament, but if there is overcompensation because the compensating anchor elongates too much the middle point 6 lags behind the upward movement of the ends 3 of the filament.

I have illustrated my invention as embodied in a lamp having a common form of filament but the principle of supporting the filament in such a way that the points of support maintain the same relative position during temperature variations of the metal parts of the lamp so that distortion of the filament is prevented may be applied to many other forms of filament than that illustrated. That feature of my invention which relates to positively holding the coils of the filament in such a way that they are free to expand and contract but cannot twist or turn out of the proper plane may also be utilized in many other forms of filament than that illustrated and, therefore, I do not wish my invention to be restricted to the particular embodiment shown in this application, but intend to cover all modifications and changes which may come within the spirit of my invention and the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. An incandescent lamp comprising two leads, a filament having an intermediate portion comprising several substantially identical coiled sections mounted close together

and side by side in the same plane to constitute a compact light source and having uncoiled ends joined to said leads with an uncoiled bight between adjoining ends of two of said sections, and an anchor secured to said leads and in engagement with said uncoiled bight to support it, the anchor and the bight being of such relative lengths and co-efficient of thermal expansion that movement in said plane of the ends of the sections which adjoin said bight away from the joints between said leads and said ends and produced as the resultant of the bodily displacement of the anchor with reference to said joints and of its thermal expansion combined with the thermal expansion of said bight is equal in amount and direction to the similar movement of the sections adjoining the uncoiled ends due to expansion of said ends whereby said intermediate portion of the filament remains undistorted.

2. An incandescent lamp comprising two adjacent leads, a filament having coiled sections side by side in the plane of the leads with uncoiled ends attached to said leads and an uncoiled bight joining the adjacent ends of two adjacent coils, an anchor mounted upon said leads to support said bight and so proportioned that the bodily movement and thermal expansion of said anchor together with the expansion of said bight in said plane produce in that plane a resultant movement of the coils adjoining said bight away from the joints between said ends and said leads equal in extent and direction to the similar movement of the coils adjoining said ends in the same plane and direction due to elongation of said ends.

3. An incandescent lamp comprising a pair of leads, a filament having two coils arranged side by side with two uncoiled ends attached to said leads with said coils in the plane of the leads and other ends joined by an uncoiled connection, an anchor fixed to said leads and in engagement with said connection to support it and so proportioned that its bodily movement due to heating of said leads and thermal expansion combined with the thermal expansion in said plane of said connection causes the coils adjoining said connection and the coils adjoining said ends all to have equal simultaneous movements in said plane equal in extent and direction whereby the filament coils are undisturbed.

4. An incandescent lamp comprising a pair of leads, a filament loop with its ends secured to said leads and its sides substantially parallel with said leads, and an anchor having a support for a bight of said filament end attached to said leads at a distance from the ends of the filament, said anchor being so proportioned that its expansion due to the heat of the filament moves said support in a direction opposite to the bodily movement of said anchor away from the filament due to heating of said leads and to an extent sufficient to maintain the filament undistorted.

5. An incandescent lamp comprising a pair of leads, a filament loop attached to and in the plane of said leads, and a filament anchor fastened at one end to a lead at a distance from the filament end and provided at the other end with a filament support, said anchor being proportioned to impart to said filament support by the expansion of the anchor due to heat from the filament a component of movement opposite in direction to the displacement of the fastened end of said anchor with reference to the filament caused by expansion of said lead and sufficient in amount to maintain said filament undistorted.

6. An incandescent lamp comprising a pair of leads, a filament loop attached to said leads with its sides substantially parallel thereto, a bridging member secured to said leads at a distance from the ends of the filament and an anchor secured at one end to said bridging member and at the other end to the bight of said filament, and proportioned to elongate an amount equal to the bodily movement of said anchor away from the ends of the filament as the anchor and leads expand due to heat from the filament.

7. An incandescent lamp comprising two leads, a filament loop with its ends attached to and its sides parallel with said leads, metal extensions of the leads projecting beyond the ends of the filament, and an anchor mounted on said extensions and provided with a support for engaging the bight of said filament, said anchor being so proportioned that its elongation due to heat of the filament is opposite in direction and equal in amount to elongation of said extensions whereby the bight of the filament is maintained in unchanged relation to the remainder of the filament.

8. An incandescent lamp comprising a pair of leads, a filament loop secured to said leads and mounted in the plane thereof, insulating supports on said leads adjacent the ends of the filament, and an anchor mounted on said insulating supports and having a portion parallel to said leads with one end of said portion in engagement with a bight of said filament at an intermediate point to support it, said portion being so mounted and of such a length that its elongation due to heat of the filament is opposite in direction to the bodily movement of said supports away from the filament and is sufficient in amount to maintain the bight of said filament in fixed relation to the remainder of the filament.

9. An incandescent lamp comprising a filament having parallel sections in substantially the same vertical plane and connected

in series, an anchor engaging said filament at two points spaced apart horizontally, and means for permitting free vertical movement but preventing horizontal rotation of said anchor.

10. An incandescent lamp comprising a filament having parallel sections in substantially the same plane and connected in series, an anchor engaging said filament at two points spaced apart in said plane, and guiding means for said anchor for permitting it to move freely in the plane of the filament and for preventing rotation thereof about an axis in said plane.

11. In an incandescent electric lamp mount, a coiled filament supported therefrom in a pendent position, said filament being composed of several sections, and means for confining the movements of said sections to a predetermined path, said means including guide members and links, the latter being connected to said filament, said guide members being associated with said links in a manner to permit relative reciprocating motion of said guide members and said links.

12. In an incandescent electric lamp mount, a coiled filament supported therefrom in a pendent position, said filament being composed of several sections, and control means for restricting all movements of said filament caused by temperature changes to those taking place in a predetermined path, said means comprising links fixed with relation to each other and secured to the movable portion of said filament in a manner to prevent oscillatory movement of the sections of said filament while said links are in the plane of the filament, and guide members cooperating with said links to hold them in the plane of said filament and restrain them to substantially only reciprocating motion in said plane and upon said guide members.

13. A mount for an incandescent electric lamp comprising a stem, supporting members extending in approximately an axial direction therefrom, a filament consisting of a plurality of coiled sections separated by a relatively straight portion and disposed substantially parallel and provided with terminal portions connected to the supporting members, and guiding means cooperating with said straight portion of said filament to permit it to reciprocate axially only and to resist rotation thereof and thereby prevent distortion of said filament.

In witness whereof, I have hereunto set my hand this 19th day of July, 1920.

CROMWELL A. B. HALVORSON, Jr.