O. KRAUSE.

METALLIC FILAMENT LAMP.

APPLICATION FILED OCT. 16, 1909.

1,041,817.

Patented Oct. 22, 1912.

4 SHEETS—SHEET 1.

Fig. 1

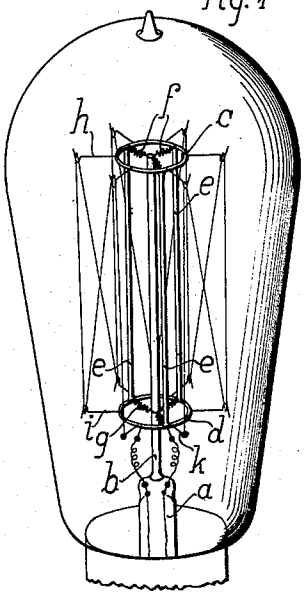


Fig. 2

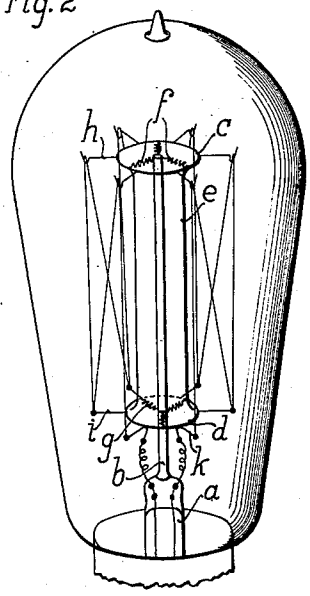


Fig. 3

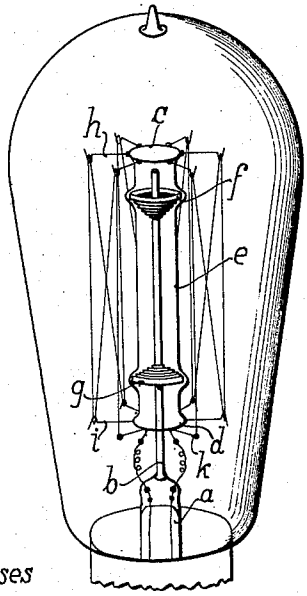
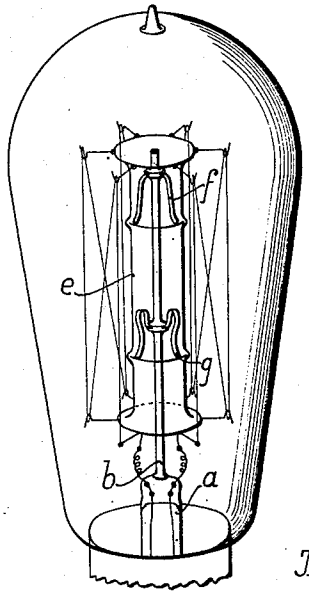


Fig. 4



Witnesses

G. V. Rasmussen

John A. Ellenbeck

Inventor:

OTTO KRAUSE

per Attorney.

Bieser & Knauth

O. KRAUSE.

METALLIC FILAMENT LAMP.

APPLICATION FILED OCT. 16, 1909.

1,041,817.

Patented Oct. 22, 1912.

4 SHEETS—SHEET 2.

Fig. 5

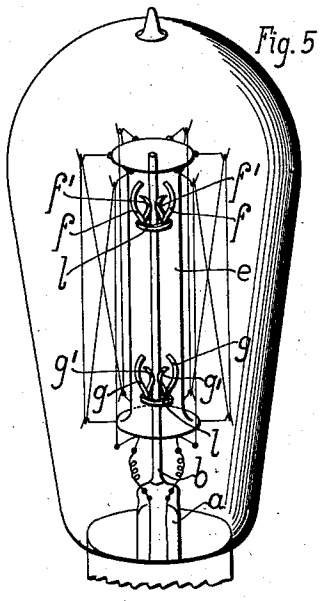


Fig. 6

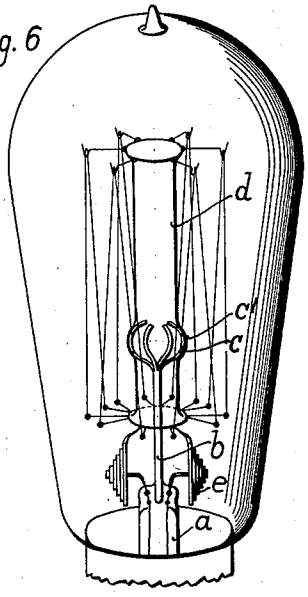


Fig. 7

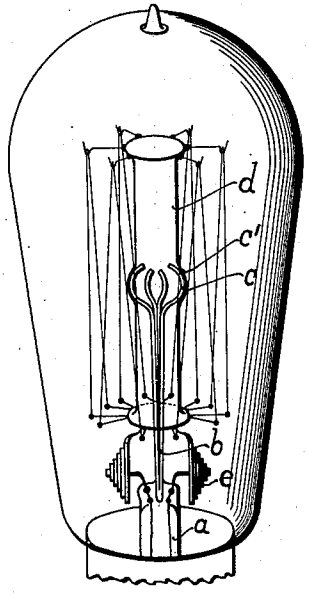
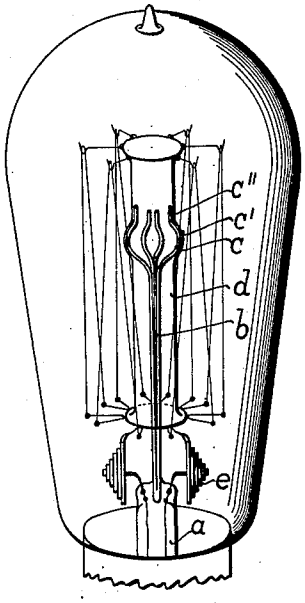


Fig. 8



Witnesses

G. V. Rasmussen

John A. Tellenbeck.

Inventor

OTTO KRAUSE

per Attorney

Briesen & Knauth

O. KRAUSE.

METALLIC FILAMENT LAMP.

APPLICATION FILED OCT. 16, 1909.

1,041,817.

Patented Oct. 22, 1912.

4 SHEETS—SHEET 3.

Fig. 9

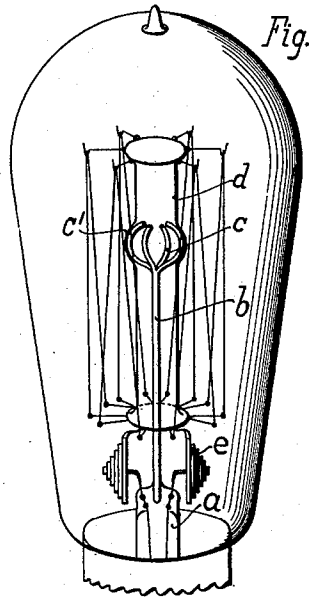


Fig. 10

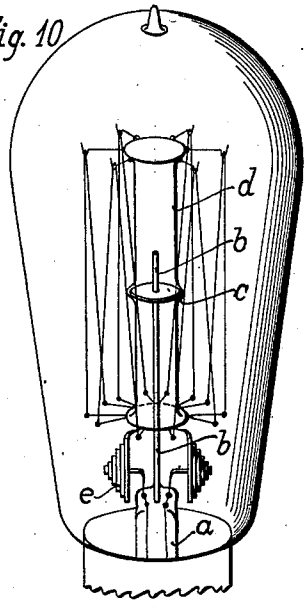
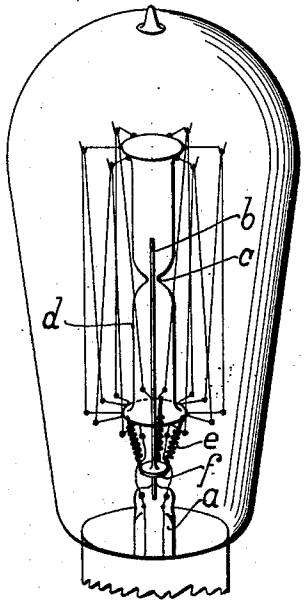


Fig. 11



Witnesses

G. V. Rasmussen

John A. Ethenbert.

Inventor

OTTO KRAUSE

per Attorney

Briesen & Knauth

O. KRAUSE.

METALLIC FILAMENT LAMP.

APPLICATION FILED OCT. 16, 1909.

1,041,817.

Patented Oct. 22, 1912.

4 SHEETS—SHEET 4.

Fig. 12

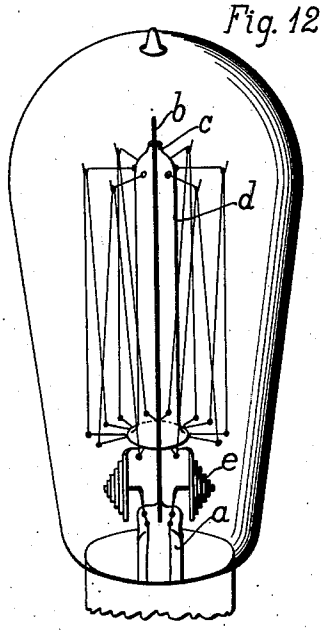


Fig. 13

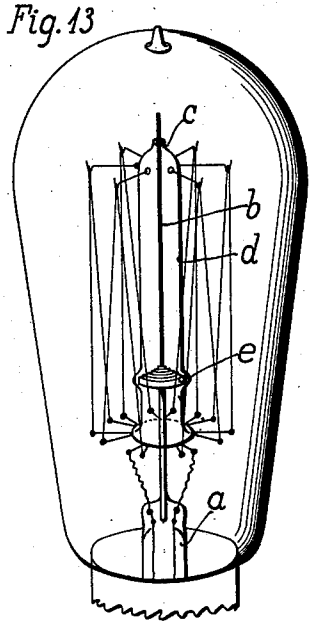
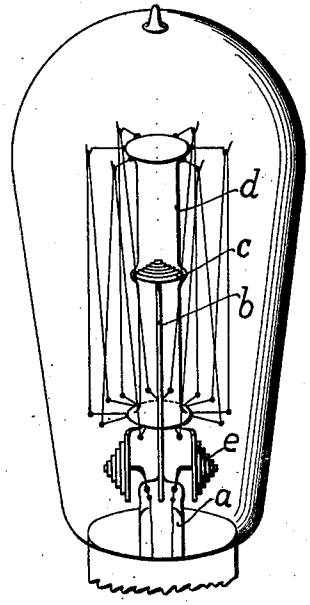


Fig. 14



Witnesses

G. V. Rasmussen

John A. Tekkenbeck.

Inventor

OTTO KRAUSE

per Attorney

Briesen & Knauth

UNITED STATES PATENT OFFICE.

OTTO KRAUSE, OF BERLIN, GERMANY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

METALLIC-FILAMENT LAMP.

1,041,817. Specification of Letters Patent. Patented Oct. 22, 1912.

Application filed October 16, 1909. Serial No. 522,910.

To all whom it may concern:

Be it known that I, OTTO KRAUSE, a subject of the Emperor of Germany, and a resident of Berlin, Germany, have invented certain new and useful Improvements in Metallic-Filament Lamps, of which the following is a specification.

This invention relates to the construction of incandescent electric lamps and particularly such as employ metallic filaments and has for its object the construction of such lamps wherein the metallic filaments are mounted upon filament carriers independent of the lamp body, the filament carrier being elastically supported upon or in connection with the lamp body, or some part thereof.

The methods hitherto known for arranging elastic filament carriers in metallic filament glow lamps are imperfect for several reasons.

If the center glass rod is elastically connected with the foot of the lamp by means of a spring and with the tip of the lamp by a second spring it involves considerable difficulties in the manufacture, viz., in the handling of the filament carriers and also during the sealing of same into the glass bulbs. If the spring is dispensed with at the tip of the lamp it frequently happens that vibrations of the whole of the filament carriers of a nature similar to those of a tuning fork may cause amplitudes of movement which allow the filament to touch the walls in ordinary sized lamp bulbs and thus easily lead to the destruction of the whole lamp. The use of extensions of the center rod in the form of elastic wires which reach the tip of the bulb has also failed to give satisfactory results, as the manufacture becomes more difficult and cracks which may occur in the glass influence the safety of the air tight sealing off of the bulbs. Furthermore in lamps the carrier of which is only connected with the foot of the lamp by a spring, the length of such spring is very small in the direction of the axis relative to the axial length of the filament carrier. The amplitudes of the oscillations of the part of the filament carrier which is distant from the spring are therefore a multiple of the amplitudes of the oscillations of that part of the filament carrier which is near the spring. In consequence the spring is either not sufficiently elastic in regard to the parts of the carrier near the spring or too elastic regarding the more remote parts. The present invention removes this difficulty.

It consists in attaching to the foot of the lamp a center rod which is arranged axially and is surrounded concentrically by a cylindrical or prismatical part which forms the filament carrier. The connection between the center rod and the filament carrier proper is formed by springs, or the stem itself consists of an elastic material.

The manner of carrying out my invention may vary in very many respects as will presently be described. Common to all is the thought that the upper part of the filament carrier and the lower part which is near the foot of the lamp perform essentially amplitudes of the same length, so that the danger of an injury to the filaments by their touching the walls of the lamp bulbs is avoided.

In the drawings Figure 1 illustrates the invention as applied in the form of a cylindrical frame elastically supported at each end; Fig. 2 in the form of a cylindrical tube, Fig. 3 illustrates a modification of Fig. 2 showing a special form of spring; Figs. 4, 5, 6, 7, 8, and 9 illustrate various modifications of the elastic support; Fig. 10 illustrates a modification in which the spring connections lie outside of the cylindrical frame; Fig. 11 illustrates a frame provided with a central constriction; in Figs. 12 and 13, the frame is shown as constricted or reduced in size at its extreme end and Fig. 14 illustrates a lamp in which the spring support is located at the center of gravity of the filament carrying frame and having special springs serving as current conductors outside of the filament carrier.

As a mode of carrying out this invention Fig. 1 shows a lamp foot *a* on which the center rod *b* is fixed. This rod, say a glass rod is surrounded by a cylindrical frame consisting of two circular end pieces *c* and *d* which are connected by several axially arranged rods *e*. This frame is for instance connected with the center rod by two groups

each having three springs *f* and *g*. The filament holders *h* and *i* and the leading-in wires *k* are fixed to the circular end pieces *c* and *d*.

As shown in Fig. 2 the rigid center rod is surrounded by a cylindrical tube *e* of glass or any other suitable material while the elastic connection is made in a manner similar to that shown in Fig. 1.

It is advantageous to make the stem *b* somewhat longer than heretofore and to arrange the springs *f* and *g* for supporting the filament carrier in a slightly inclined position. The stem may also be hollow which will facilitate the fixing of the springs.

The mode of carrying out the invention shown in Fig. 3 differs from the above examples in that the elastic connection between the center rod and the filament carrier surrounding it concentrically is made by means of pieces of watch spring and which also insure the vibration of the filament carrier causing a parallel displacement of the whole frame.

Fig. 4 shows two other examples of suitable simple springs *f* and *g*. Each of these springs actually consists of three or more parts and not of two parts only as appears from the illustration. Two divided springs can be used as shown in *f* or two springs also consisting of several parts may be applied as illustrated in *g*. These springs are fixed to the axial stem *b* and their free ends are adapted to slide along the inner walls of the tubular filament carrier *e* until they find their seats in annular pockets of the same.

Fig. 5 illustrates another example of the elastic arrangement. Springs *f* and *g* extending outward and springs *f'* and *g'* extending inward are fixed respectively on rings *l*, *l*, each of a diameter smaller than that of the tube *e* but larger than that of the rod *b*. The former set of springs touches the filament carrier, the latter touch the stem. Only two springs are shown in the illustration, in practice however at least three springs are used. The springs are advantageously formed in such a way that at the point where they touch the glass rod they are in contact not at individual points but for a considerable extent of surface. It is also advantageous that the stem *b* be somewhat constricted at the points where the springs are applied, and that the filament carrier *e* be somewhat enlarged at such points.

The two rings *l*, *l*, in Fig. 5 are shown as independent of each other but they may, if desired, be connected directly one with the other so as to produce a single spring piece *f*, *f'*, *l*, *g*, *g'* instead of two separate and disconnected spring pieces *f*, *f'*, *l* and *g*, *g'*, *l*.

It is unnecessary to describe further analogous ways of carrying out the invention as the inventive idea is made sufficiently clear by the examples above described. The springs may have any desired form and touch at any suitable points thus answering the purpose of effecting an approximately parallel movement of the filament carrier in case it should be exposed to shock.

Sometimes modifications of the said inventive idea prove advantageous whereby the connection between the tubular filament carrier and the stem placed axially within it is formed by a joint which may be fixed at any point of the tubular part of the filament carrier but preferably at its center.

The inner part *c* of the movable or joint like connection such as a ball and socket joint can advantageously be formed by three or more arms or ribs bent in a circular form which arms touch the inner side of a globular enlarged part *c'* of the filament carrier *d* (Figs. 6, 7, 8 and 9).

In Figs. 6, 7 and 8 modifications are illustrated in which the arms of the ball like connection are cup shaped and consist of an elastic material, such as metal wire or metal strip. In the arrangement as shown in Fig. 9 the arms of the inner part of the joint *c* which have the form of a segment of a circle are of such dimensions that they will only allow the filament carrier to slide over the stem for the purpose of manufacture, but which do not appreciably yield in consequence of shocks inflicted on the lamps.

The axle stem *b* may be either rigid (see Fig. 6) or inherently elastic, as shown for instance in Figs. 7 and 8. In these last two figures the axle stem is shown as composed of flexible arms joined near the lamp foot and terminating at their free ends in the ball like spring connections. In Fig. 8, the terminal spring fingers *c* have a short straight extension *c''* lying snugly against the inner face of the tubular frame and thus serve to limit oscillations thereof.

All these modifications have in common an elastic connection between the lower part of the filament carrier with the lamp foot *a* consisting of special springs *e* which as shown in the illustrations serve at the same time as current conducting wires. The effect of this arrangement remains the same when springs of other suitable forms particularly in groups of two or more are used for the connection of the filament carrier with the lamp foot, or with that part of the axial stem near the foot of the lamp. In the latter case it is sufficient if the leading-in-wires are flexible.

With regard to the point where the joint connection of the filament carrier with the axial stem is to be placed comparative experiments have proved the superiority of such arrangements where this joint is placed at the center of gravity of the filament carrier or in immediate proximity thereto.

Instead of enlarging the tubular filament carrier it may also be provided with constrictions. In such case the wires forming the inner part of the joint are bent concavely in order to fit the constrictions.

For esthetic reasons the filament carrier can be made of opal glass instead of clear glass. The action will be similar if the axial stem itself consists of an elastic material such as metal wire of suitable dimensions.

In consequence of the elasticity of the stem the immediate transmission of shocks to the filament carrier concentrically surrounding it, or to the filaments fastened thereon will be obviated. The surface of the axial stem acts as a guide to the filament carrier surrounding it in such a manner that a slight inclination may take place between the stem and the filament carrier.

Fig. 10 illustrates such a form of carrying out the invention, the axial stem being placed through the central bore of the disk *c* which in itself is suitably connected with the tubular part of the filament carrier *d*.

Figs. 11, 12, and 13 show the tubular part of the filament carrier with a constriction. This constricted part is arranged near the middle of the tube (Fig. 11). It can however also be placed near the end of the tube *d* (Figs. 12 and 13).

Such oscillations of the elastic stem as are transmitted to the filament carrier are taken up and deadened by the action of special springs *e*, which connect the filament carrier with the lamp foot *a* or with a part of the axial stem near the foot of the lamp. In the modification shown in Fig. 10 this effect is produced by the use of spiral springs *e* which at the same time serve as current conductors to the filament carrier and which can be made of any suitable material such as copper, nickel, etc.

Fig. 11 illustrates an arrangement in which the filament carrier *d* is elastically connected with a glass disk *f* fixed to the lower part of the stem by means of a group of three spiral springs *e*.

The springs as shown in Fig. 12 are arranged similarly to those in Fig. 10 while in Fig. 13 the connection between the filament carrier and the stem consists of a single spiral spring.

Those modifications have proved most effective in carrying out this invention in which the point at which the filament carrier is guided by means of the axial stem (starting from the lamp foot) is at or as near as practicable to the center of gravity of the filament carrier.

A simplified manner of obtaining the desired object consists in a modification whereby in the interior of the tubular filament carrier a single spiral spring is arranged as near as possible to the center of gravity for the purpose of establishing an elastic connection with the axial stem, while special springs which may advantageously serve as current conductors are placed outside the filament carrier take up the remaining oscillations of the filament carrier.

Fig. 14 is an illustration: *a* is the foot of the lamp, *b* the axial stem which is fixed to the lamp foot, *c* is a spiral spring for the connection of the stem and the tubular filament carrier *d* and *e* are the special springs which connect the lower part of the filament carrier with the foot of the lamp and serve at the same time as the current conducting wires.

I claim:

1. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder, said stem being normally out of contact with said holder and an elastic support to maintain said holder in the lamp.

2. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open filament holder having a cylindrical tubular form, said stem being normally out of contact with said holder and an elastic support to maintain said holder in the lamp.

3. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder, said stem being normally out of contact with said holder and an elastic support to maintain said holder in the lamp, said elastic support comprising a plurality of springs operating on different portions of said holder.

4. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder, said stem being normally out of contact with said holder and an elastic support to maintain said holder in the lamp, said elastic support comprising a plurality of springs operating on different portions of said holder, each spring having several gripping surfaces.

5. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder, said stem being normally out of contact with said holder and an elastic support to maintain said holder in the lamp, said elastic support being interposed between the stem and the filament holder.

6. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder, said stem being normally out of contact with said holder and an elastic support to maintain said holder in the lamp, said elastic support being interposed between the stem and the filament holder and consisting of springs, an elastic portion

of which presses inwardly against the stem and an elastic portion of which presses outwardly against the filament holder.

7. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder, said stem being normally out of contact with said holder and an elastic support to maintain said holder in the lamp, said elastic support comprising an elastic connection between the filament holder and the stem and an elastic connection between the filament holder and the lamp body.

8. The combination of an axially open filament holder, a filament wholly supported on said holder, an elastic stem projecting into said open holder and an elastic support carried by said stem and connecting with said holder and an elastic support consisting of springs connecting the holder with the lamp body near the lamp foot.

9. The combination of an axially open filament holder, a filament wholly supported on said holder, an elastic stem projecting into said open holder and adapted to contact with a rigid portion of said holder and an elastic support connecting the holder with the lamp body near the lamp foot.

10. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder and an elastic support to maintain said holder in the lamp, said elastic support being arranged at approximately the center of gravity of the filament holder.

11. The combination of an axially open filament holder, a filament wholly supported on said holder and an elastic support to maintain said holder in the lamp, said elastic support comprising as a unit an axial stem projecting into the open holder, said stem terminating in a number of flexed strips, said strips making contact with the filament holder.

12. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder and leading-in wires connected with the filament and formed into springs for elastically maintaining the holder in the lamp.

13. The combination of an axially open filament holder, a filament wholly supported on said holder, a stem projecting into said open holder, means located approximately at the center of gravity of the holder for cooperation with the stem and an elastic support to maintain said holder in the lamp.

14. The combination of an axially open holder, a filament wholly supported on said holder, and means for resiliently supporting said holder in the lamp comprising a stem projecting into said open holder and normally out of contact therewith.

15. The combination of an axially open holder, a filament supported on said holder, and means for resiliently supporting the holder in the lamp comprising parts adapted to operate on different parts of the holder, said means including a stem projecting into the holder and normally out of contact therewith.

16. The combination of an axially open filament holder, a filament wholly supported on said holder, and means for resiliently maintaining said holder in position in the lamp comprising a stem projecting into the holder and normally out of contact therewith.

17. The combination of a hollow filament holder, a filament wholly supported on the exterior of said holder, and yielding means for maintaining said holder in the lamp which acts thereon through engagement with its interior and includes a supporting means projecting thereinto but normally out of contact therewith.

18. The combination with an incandescent lamp foot, a hollow holder, a filament wholly supported on the exterior of said holder, and means for resiliently supporting said holder from the lamp foot comprising a part projecting into the holder, said means including elastic parts by which vibration of said holder with reference to the lamp foot is allowed, parts of said holder equally distant from a point within its interior vibrating through equal amplitudes.

In witness whereof I have hereunto signed my name this twenty-second day of September 1909 in the presence of two subscribing witnesses.

OTTO KRAUSE.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.