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Bottone et al.

[11] **3,909,653**

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[54] **COMPACT ELECTRIC INCANDESCENT LAMP HAVING PLANAR FILAMENT AND IMPROVED MOUNT**

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[22] Filed: **May 19, 1972**

[21] Appl. No.: **255,196**

Related U.S. Application Data

[63] Continuation of Ser. No. 859,531, May 2, 1969, abandoned, which is a continuation of Ser. No. 641,250, May 25, 1967, abandoned.

[52] **U.S. Cl.** **313/271;** 313/273; 313/277; 313/220

[51] **Int. Cl.²** **H01J 1/88;** H01J 19/42

[58] **Field of Search** 313/271, 278, 220, 222, 313/50, 273, 274, 276, 277

[56] **References Cited**

UNITED STATES PATENTS

1,955,396	4/1934	Unk et al.	313/50
2,159,794	5/1939	Hagen et al.	313/220
2,338,855	1/1944	Leighton	313/332
2,605,440	7/1952	Gero	313/276 X
2,644,102	6/1953	Stone	313/276
2,883,571	4/1959	Fridrich et al.	313/222 X
3,314,331	4/1967	Wiley	313/315 X
3,484,644	12/1969	Pertwee	313/222
3,622,832	11/1971	Schlessel	313/222

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[57] **ABSTRACT**

A light source, such as biplane tungsten filament, is suspended within a compact halogen-containing lamp by an elongated mount assembly that is anchored in one end of the lamp envelope. The mount assembly has resilient wire supports that hold the planar filament at a predetermined location within the envelope and the relative dimensions of the planar filament and envelope are such that the inner surfaces of the envelope walls are heated to the temperature required to maintain the halogen-tungsten cycle when the lamp is operated.

20 Claims, 6 Drawing Figures

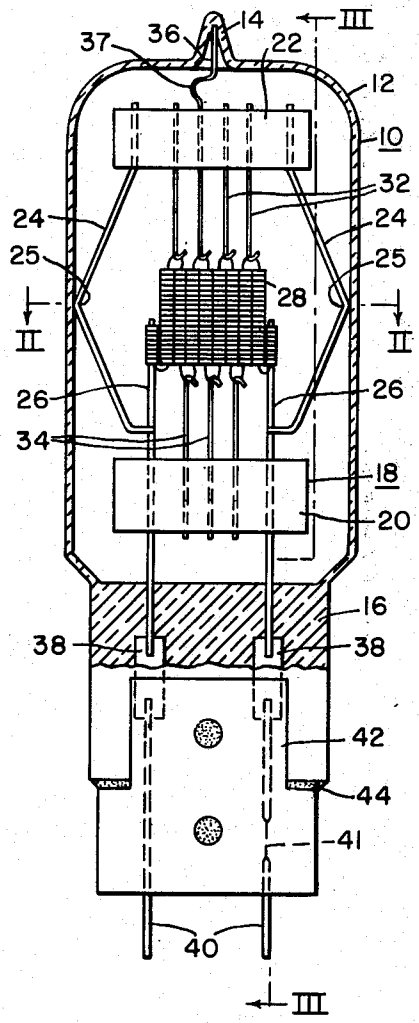


FIG. 1.

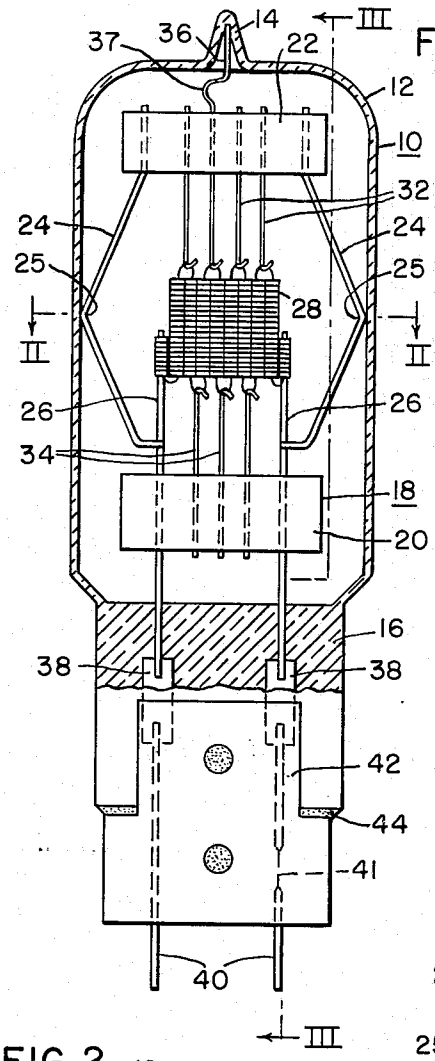
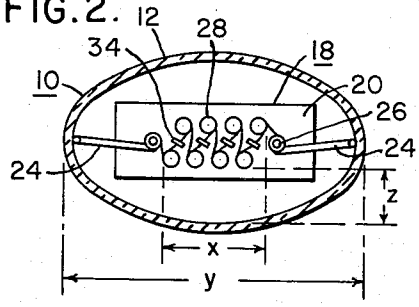


FIG. 2.



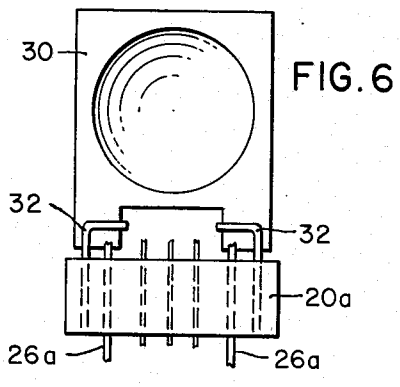


FIG. 6

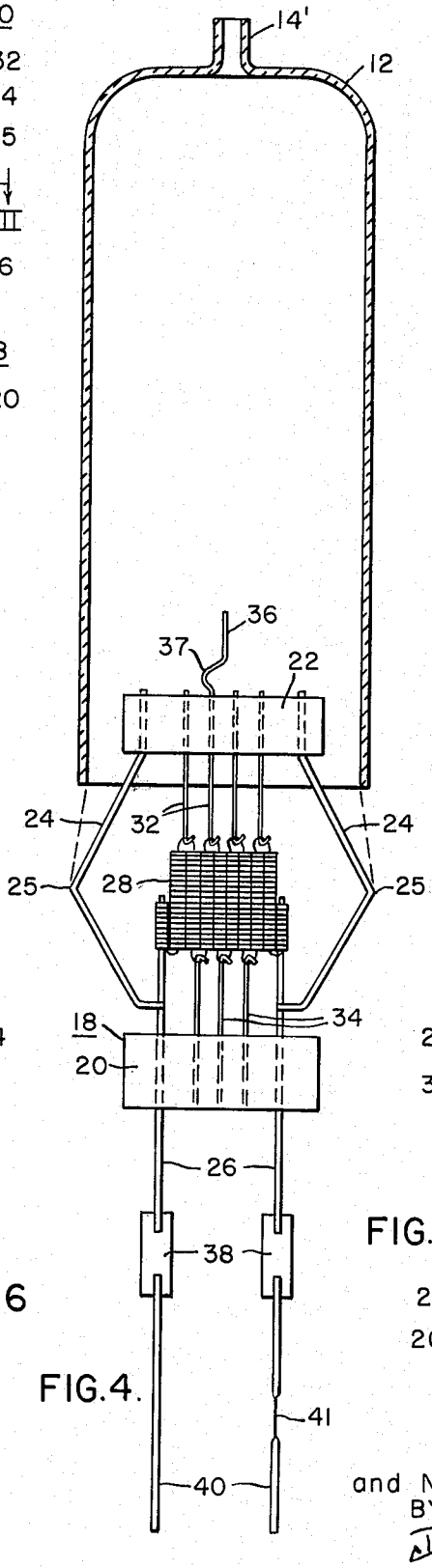
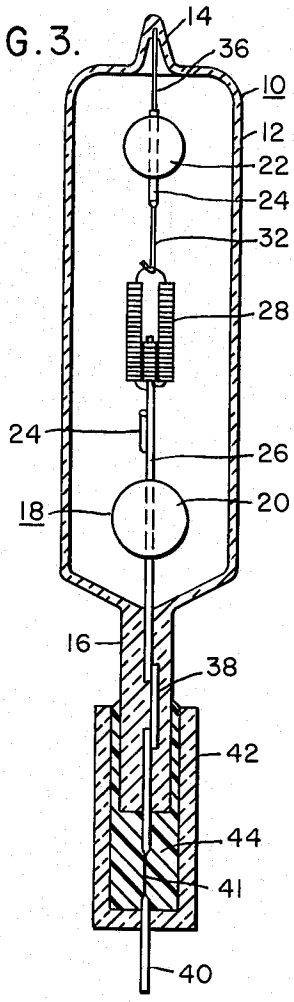


FIG. 4.

FIG. 3.



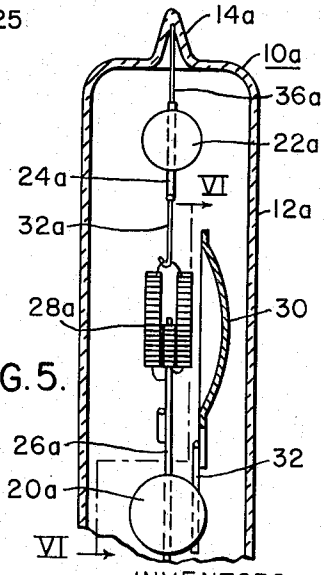


FIG. 5.

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COMPACT ELECTRIC INCANDESCENT LAMP HAVING PLANAR FILAMENT AND IMPROVED MOUNT

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Ser. No. 859,531 filed May 2, 1969, which application in turn was a continuation of application Ser. No. 641,250 filed May 25, 1967, both of which are now abandoned

BACKGROUND OF THE INVENTION

This invention relates to electric lamps and has particular reference to a compact halogen-cycle incandescent projection lamp.

One of the major problems in the design and manufacture of electric lamps of the type intended for use with optical systems is the provision of an economical and reliable means for supporting the light source in the proper position within the lamp envelope. In the case of incandescent projection lamps, this problem is compounded by the fact that a coiled filament thermally expands and contracts and thus tends to become distorted during the life of the lamp. In addition, the filament wire recrystallizes and becomes rather brittle as the lamp burns. Thus, the filament will break if the lamp is subjected to excessive mechanical shock or vibration during use. Since such lamps are used in conjunction with the optical system of the film projector, the filament must be accurately positioned within the envelope so that it will be properly oriented with respect to the film gate aperture and lenses etc., when the lamp is placed into its socket.

In the prior art it was accordingly necessary to carefully adjust the position of the filament mount relative to the envelope during the sealing-in operation and correct any misalignments before the seal cooled and the glass seal became rigid. The sealing-in operation was thus a very critical and time consuming one.

The filament-distortion problem was overcome in the prior art lamps by a so-called "floating bridge" assembly wherein one end of the multi-coil filament was supported in such a way as to accommodate the longitudinal expansion and contraction of the coils when the lamp was operated. A representative floating-bridge type mount is disclosed in U.S. Pat. No. 2,721,291 issued Oct. 18, 1955 to N.J. Rainone. It is also known in the prior art to laterally stabilize a filament mount and dampen vibrations by securing both ends of the mount structure to the envelope by resilient members such as wire springs. An incandescent lamp of this type is disclosed in U.S. Pat. No. 980,703 issued Jan. 3, 1911 to E. Thomson.

While the foregoing and similar prior art structure achieved the desired objectives, they were rather complicated and expensive and did not solve the filament-positioning problem or allevaite the criticality of the sealing-in operation. These unsolved problems, coupled with the stringent space limitations of compact halogen-cycle lamps, prevented the use of biplane or monoplane type filaments in such lamps.

It is accordingly the general object of the present invention to overcome the foregoing and other problems of the prior art by providing a simple inexpensive structure for accurately positioning a light source within a lamp envelope and protecting it from mechanical shocks and the like.

Another object is the provision of a practical halogen-cycle projection lamp having a biplane or monoplane filament.

A more specific object is the provision of a compact incandescent projection lamp having a mount structure incorporating components that serve more than one function and resiliently suspend a relatively large coiled filament in a predetermined position within the lamp envelope and also permit the filament to expand and contract freely when the lamp is in use.

The foregoing and other objects which will become apparent as the description proceeds are achieved in accordance with the present invention by utilizing parts of the mount structure and the inner surfaces of the envelope walls to properly orient and resiliently suspend the filament within the envelope before, during and after the sealing-in operation.

According to a preferred embodiment, a relatively large biplane filament is held in a predetermined position within a compact halogen-cycle projection lamp by a unitary mount structure having resilient compressible members that support an upper bridge assembly in "floating" relationship with the filament and engage the curved side walls of an oval or partly flattened tubular enelope. The resulting compression of the resilient support wires of the mount assembly by the concave inner surfaces of the bulb automatically positions the biplane filament centrally within the envelope with the planar faces of the filament disposed toward the flat wall portions of the bulb. If desired, the resilient support members can also be disposed in heat-receptive proximity to the filament so as to expand and contract along with the filament coils—thus automatically adjusting the position of the upper bridge member and providing the desired floating-bridge action. The resilient support members thus serve as supports for the upper bridge structure and as lateral stabilizing and positioning means for the filament. The foregoing and additional features are described in detail below

BRIEF DESCRIPTION OF THE DRAWING

A better understanding of the invention will be obtained by referring to the accompanying drawing, wherein:

FIG. 1 is a front elevational view of a 500 watt projection lamp embodying the present invention, the upper portion of the envelope being shown in section to more clearly illustrate the construction of the mount;

FIG. 2 is a cross-sectional view through the lamp along the line II—II of FIG. 1;

FIG. 3 is a longitudinal sectional view along the line III—III of FIG. 1;

FIG. 4 is an exploded view of the unitary mount assembly and the envelope just before the mount is inserted therein;

FIG. 5 is a fragmentary sectional view of an alternative lamp embodiment incorporating a proximity reflector, and,

FIG. 6 is an elevational view of the reflector assembly along the line VI—VI of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. 1–3 there is illustrated a 500 watt halogen cycle incandescent projection lamp 10 constructed in accordance with this invention. As shown, the lamp 10 consists of an envelope 12 of generally oval cross-

section that has a tipped-off remnant **14** of a vitreous exhaust tube at one end and a press seal **16** at its opposite end. The envelope is fabricated from quartz or a suitable high-temperature glass such a Vycor and can be readily made by partly flattening a cylindrical section of tubing made from such material. The term "oval" as used herein and in the appended claims accordingly includes within its scope envelopes of elliptical cross-section (shown in FIG. **2**) as well as envelopes having substantially flat walls joined by rounded side walls.

Centrally disposed within the body portion of the envelope **12** is a unitary filament mount **18** consisting of a lower transverse bridge member **20** that is joined to a similar upper bridge member **22** by a pair of compressible members such as resilient support wires **24** and a pair of upstanding rigid lead-in conductors or wires **26.** As is shown in FIGS. **1** and **3,** the lead-in wires **26** are embedded in the press seal **16** and in the lower bridge member **20** and are each fabricated from a single piece or length of wire. The lower ends of the resilient support wires **24** are spot welded to the rigid leads **26** and have their opposite end embedded in and joined by the upper bridge member **22.** The filament **28** is of biplane construction and consists of a plurality of joined coiled sections of tungsten wire arranged in parallel spaced relationship with the coil sections extending parallel to the envelope axis. The short end coils are slipped over and fastened, as by welding, to the inner ends of the leadin wires **26** and the intermediate portions of the filament between the main coil sections are engaged by the hooked ends of auxiliary support wires **32** and **34** that depend from the bridge members **22** and **20,** respectively.

If desired, the inner end of the mount structure **18** may be stabilized by a spud wire **36** that has a flexible bend **37** therein to allow the upper bridge **22** to move longitudinally and float. The spud wire **36** can comprise an extension of one of the auxiliary wire supports **32,** as shown, and is sealed within the tipped-off segment **14** of the exhaust tube.

As will be noted in FIG. **1,** the resilient wire supports **24** are of shallow V-shape so that the apex **25** of each of the wires effects substantially sliding point contact with the concave inner side walls of the envelope **12.** In addition, these intermediate portions **25** are located directly abreast of the filament **28** and are thus heated to a relatively high temperature when the filament is energized. This heating, in conjunction with the angled configuration of the support wires **24,** causes them to expand and contract along with the filament coil section and automatically alter the axial spacing between the bridges **20** and **22** to accommodate the variations in the length of the coiled sections that occur when the lamp **10** is operated. The sliding pointcontact between the resilient support wires **24** and the concave inner surfaces of the envelope side walls automatically centers the mount assembly **18** within the envelope, as shown in FIGS. **2** and **3.** The filament **28** is thus aligned with the longitudinal axis of the enelope **12** and is disposed in a common plane along with the various components of the mount structure **18.**

As will be noted in FIGS. **1** and **2,** the biplane filament **28** is quite large compared to the envelope **12.** In order to maintain the operating temperature of the inner walls of the envelope within the 250° to 1200°C range required to sustain the halogen gettering cycle, the ratio of the width of the biplane filament **28** to the maximum cross-sectional dimension of the envelope **12** is at least 1:3. The width of the filament is denoted by dimension x in FIG. **2** and is equal to the distance between the outermost side edges of the main coiled sections of the filament **28.** The maximum cross-sectional dimension of the envelope **12** is denoted by dimension y in FIG. **2.** In addition, the maximum spacing between each of the planar faces of the filament **28** and the oppositely disposed wall of the envelope **12** (dimension *z* in FIG. **2**) is preferably less than the width of the planar filament.

As illustrated in FIGS. **1** and **3,** the lead-in wires **26** are fastened to ribbon conductors **38** which are, in turn, joined to rigid outer leads **40** that extend through and beyond a suitable base member **42** that is attached to the press seal **16** by high-temperature cement **44.** The protruding ends of the outer leads **40** serve as pin terminals for the lamp **10.** One of the outer leads desirably includes a fuse wire **41.**

As shown in FIG. **4,** the mount **18** comprises a unitary structure that can be conveniently handled and inserted into the envelope **12.** The width of the mount **18** is slightly larger than the major inner diameter of the envelope **12** so that the mount will be compressed slightly when inserted and frictionally engage the envelope walls. Of course, when the mount is so compressed the upper bridge member **22** will be axially displaced slightly and increase the distance between the hooked ends of the auxiliary support wires **32** and **34.** These hooked ends are, accordingly, initially only loosely coupled with the bights or loops of the filament **28** and snugly grip such loops when the mount is inserted, as shown in FIGS. **1** and **3.** After the mount **18** is properly positioned within the envelope **12,** the frictional interaction between the envelope walls and compressed support wires **24** hold the mount in such position while the press seal **16** is being formed. After the envelope **12** has been exhausted it is filled with nitrogen (or argon, or a mixture of argon and nitrogen), dosed with a predetermined amount of a halogen gas (or halogen gas-forming compound), and the exhaust tube **14'** is tipped off and fused to the end of the spud wire **36.** The base **42** is then positioned in the proper spatial relationship with respect to the filament **28** and cemented to the press seal **16** in the usual fashion.

The lamp **10** preferably contains bromine and an inert fill gas such as argon or nitrogen, in which case the minimum bulb wall temperature required to sustain the gettering cycle is 200°C. The size of the planar filament **28** relative to the envelope **12** can thus be less than that heretofore specified, or a large bulb wall-to-filament spacing can be used.

The bridge members **20** and **22** are desirably fabricated from quartz or Vycor glass and, when the lamp **10** contains a halogen atmosphere, the metal portions of the mount **18** are fabricated from tungsten or other material that will not chemically react with the fill gas.

As shown in FIGS. **5** and **6,** an alternative lamp embodiment **10a** that contains an internal proximity reflector **30** can be readily fabricated in accordance with the invention by attaching the reflector to the lower bridge member **20***a* by a pair of support wires **32.** The reflector **30** is preferably fabricated from tungsten or similar refractory metal and has a concave surface that is disposed toward and circumscribes a planar face of the biplane filament **28***a.* It is positioned in parallel

heat-receptive proximity to the filament 28*a* so that it will reflect heat back onto the filament and reflect the light back toward the front wall of the envelop 12*a*.

It will be appreciated from the foregoing that the objects of the invention have been achieved in that a simple and inexpensive structure has been provided for mounting relatively large planar filaments in compact lamps and accurately orienting and resiliently suspending such filaments within the lamp envelopes. The use of partly flattened or oval shaped envelopes also facilitates making the press seal since the mouth of the envelope is much narrower than in the case of conventional cylindrical bulb. The filament is also located much closer to the optical system of the projector and thus permits the more effective use of the light generated by the filament.

While several embodiments have been disclosed, it will be appreciated that various modifications can be made without departing from the spirit and scope of the invention. For example, the same advantages can be obtained by utilizing the mount structure of this invention to position and resiliently support an arc tube in the outer envelope of a highpressure mercury discharge lamp. In addition, the body portion of the envelope need not be flattened or of oval cross-section over its entire length. Alternatively, channellike grooves or ribs can be formed along the sides of a conventional cylindrical envelope to obtain the same automatic positioning and resilient retention of the filament mount structure as is obtained with an oval bulb.

We claim as our invention:

1. In a single-ended electric incandescent lamp adapted for operation at a predetermined wattage, the combination comprising:

a light-transmitting envelope having an hermetic seal at one end and a body portion that contains halogen gas,

a planar filament sealed within said envelope body portion and comprising a plurality of interconnected coiled sections that are fabricated from a refractory material which coacts with said halogen gas when the lamp is energized and establishes a gettering cycle that returns vaporized refractory material to said filament,

said halogen gas being of a type which requires that the inner walls of said envelope attain a predetermined temperature during the operation of the lamp in order to sustain said gettering cycle, and

a mount structure suspending said multi-coil planar filament at a predetermined location within said envelope body portion and comprising (a) a pair of rigid lead-in conductors that are embedded in said hermetic seal and extend into the body portion of said envelope, (b) a transverse bridge member of insulating material that is joined to said pair of lead-in conductors and holds them in spaced apart relationship on opposite sides of said planar filament, and (c) at least one support wire that is anchored in said bridge member and is coupled to a medial part of said planar filament,

each of said lead-in conductors consisting of a wire that extends from the hermetic seal directly to and is fastened to a coiled section of the planar filament that constitutes one end of said filament so that said pair of lead-in conductors, conjoined bridge member, support wire and planar filament comprise an integral assembly,

the ratio of the width of said planar filament to the maximum cross-sectional dimension of the body portion of said envelope being at least 1:3 so that the inner walls of said envelope are thereby heated to the aforesaid temperature required to sustain the gettering cycle when the lamp is operated at said predetermined wattage, and

said lead-in conductors and support wire being composed of a metal which does not chemically react with said halogen gas.

2. The incandescent lamp of claim **1** wherein said halogen gas consists essentially of bromine.

3. The incandescent lamp of claim **1** wherein each of said lead-in conductors consists of a single piece of wire and the body portion of said envelope is elongated and of substantially uniform cross section.

4. The incandescent lamp of claim **1** wherein;

said multi-coil planar filament is so located that a planar face of the filament is disposed toward a side wall of said envelope body portion, and

the maximum spacing between at least one of the planar faces of said filament and the oppositely-disposed side wall of the envelope is less than the width of said filament.

5. The incandescent lamp of claim **1** where said lead-in wires extend into and through the associated coiled sections of said planar filament.

6. The incandescent lamp of claim **1** wherein;

the body portion of said envelope is terminated by a hollow sealed-off tip, and

said mount structure includes an upstanding member that extends into the sealed-off tip of said envelope.

7. The incandescent lamp of claim **1** wherein;

said envelope is composed of a material selected from the group consisting of quartz and Vycor glass, and

said planar filament, lead-in conductors and support wire are composed of tungsten.

8. The incandescent lamp of claim **1** wherein said mount structure includes a reflector that is disposed in operative relationship with said planar multi-coil filament and is composed of a refractory metal which does not chemically react with said halogen gas.

9. A single-ended electric incandescent projection lamp comprising;

a light-transmitting envelope having a press seal at one end and an elongated body portion,

a planar filament sealed within said envelope body portion and comprising a plurality of interconnected helical coiled sections that are arranged in spaced side-by-side relationship with their axes disposed in substantially parallel relationship with the longitudinal axis of said envelope body portion,

a unitary mount structure holding said multi-coil planar filament at a predetermined location within said envelope body portion with a planar face of the filament disposed toward a side wall of said envelope body portion, and

a pair of rigid lead-in conductors embedded in said press seal and electrically connected to the coiled sections that comprise the ends of said planar filament so that said conductors thereby constitute mechanical support and direct electrical-connector means for said filament,

said mount structure including a pair of elongated support members that (a) extend along opposite sides of and beyond said planar filament, (b) have

their innermost ends joined by a transverse bridge member of insulating material, and (c) have resilient laterally-protruding intermediate portions that are adapted in response to heat generated by said filament to accommodate variations in the length of the filament coiled sections produced by the thermal expansion and contraction thereof when the filament is energized and deenergized.

10. The incandescent projection lamp of claim **9** wherein:

said planar filament is fabricated from tungsten wire, and

said envelope contains a halogen gas.

11. The incandescent projection lamp of claim **9** wherein;

the elongated body portion of said envelope is of substantially uniform cross section throughout approximately its entire length,

said planar filament is symmetrically disposed about and aligned with the longitudinal axis of said envelope, and

the maximum spacing between at least one of the planar faces of said filament and the oppositely-disposed inner wall of the envelope is less than the width of said filament.

12. An electric lamp comprising;

a light-transmitting envelope having a sealed end portion and a body portion with arcuate side walls that define a pair of laterally-opposed inner wall surfaces of concave configuration,

a light source positioned at a predetermined location within said envelope,

a pair of rigid lead-in conductors extending through the sealed end portion of said envelope and electrically connected to said light source, and

means resiliently suspending said light source in such position within the envelope comprising a mount structure that includes a pair of resilient stabilizing members that have laterally-protruding intermediate portions which are seated against and compressibly retained between the concave inner wall surfaces of said envelope,

said stabilizing members being fastened to said lead-in conductors and supporting one end of said light source, and

the other end of said light source being joined to and supported by said rigid lead-in conductors.

13. The electric lamp of claim **12** wherein the body portion of said envelope is elongated and of noncircular cross section.

14. The electric lamp of claim **12** wherein;

said light source comprises a coiled filament that thermally expands and contracts in the same general direction as the longitudinal axis of the envelope when the lamp is energized and deenergized, and

the said intermediate portions of said stabilizing members are in heat-receptive proximity to said filament and adapted to thermally expand and contract along with said filament and effect compensating changes in the length of said mount structure.

15. The electric lamp of claim **12** wherein;

the body portion of said envelope is of tubular configuration and has a pair of generally flat oppositelydisposed faces that are joined by rounded side walls, and

said stabilizing members are seated against and compressibly retained between the opposed rounded side walls of said envelope body portion.

16. The electric lamp of claim **15** wherein;

said light source comprises a filament having a plurality of joined substantially parallel spaced coils of tungsten wire arranged in the form of a planar grid that is (a) of biplane or monoplane configuration, (b) disposed toward the generally flat faces of said envelope body portion, and (c) oriented so that the coils extend in the same general direction as the envelope axis;

the sealed end portion of said envelope comprises a press seal; and,

said envelope contains a halogen atmosphere.

17. The electric lamp of claim **16** wherein;

said stabilizing members comprise resilient wires that are joined to the inner ends of the respective lead-in conductors and have their free ends joined by a first transverse bridge member of vitreous material,

a second transverse bridge member of vitreous material is anchored to and joins the inner ends of said leadin conductors, and

the intermediate portions of said planar-grid filament between the respective coils are attached to auxiliary support wires that are anchored in and depend from said first and second bridge members.

18. The electric lamp of claim **17** wherein;

said envelope body portion is of oval cross section,

said resilient stabilizing wires are of generally shallow V-shape and are arranged so that the apex of each wire is disposed toward and is in sliding point-contact with the curved side walls of the envelope body portion,

said planar-grid filament, auxiliary support wires, bridge members, stabilizing wires and lead-in conductors are substantially disposed in a common plane, and

the inner end of said mount structure is laterally stabilized by a spud wire that is anchored in said first bridge member and extends therefrom into a tipped-off remnant of a vitreous exhaust tube that protrudes from the proximate end of the body portion of said envelope.

19. In a single-ended electric incandescent lamp adapted for operation at a predetermined wattage, the combination comprising;

a light-transmitting envelope having an hermetic seal at one end and a body portion that contains a predetermined amount of bromine,

a planar filament sealed within said envelope body portion and comprising a plurality of interconnected coiled sections that are fabricated from a refractory metal which coacts with said bromine when the lamp is energized and establishes a gettering cycle that returns vaporized refractory metal to said filament, and

a mount structure holding said multi-coil planar filament at a predetermined location within said envelope body portion and comprising (a) a pair of rigid lead-in conductors that are embedded in said hermetic seal and extend into the body portion of said envelope, (b) a transverse bridge member of insulating material that is joined to said pair of lead-in conductors and holds them in spaced-apart relationship on opposite sides of said planar filament, and (c) at least one support wire that is anchored

in said bridge member and is coupled to a medial part of said planar filament,

each of said lead-in conductors consisting of a wire which is composed of a metal that does not chemically react with bromine and extends from the hermetic seal directly to and is fastened to a coiled section of the planar filament that constitutes one end of said filament so that said pair of lead-in conductors, conjoined bridge member, support wire and planar filament comprise an integral mount assembly,

the width of said planar filament and the maximum cross-sectional dimension of the body portion of said envelope being so correlated that the inner walls of said envelope are heated to a temperature of at least 200°C when the lamp is operated at said predetermined wattage and the gettering cycle is thereby sustained.

20. The incandescent lamp of claim **19** wherein said planar multi-coil filament is fabricated from tungsten wire and said envelope also contains an inert fill gas.

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