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(54) **Electrodeless lamp**

Elektrodenlose Lampe

Lampe sans électrode

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- **PATENT ABSTRACTS OF JAPAN vol. 009, no. 270 (E-353) 26 October 1985 & JP-A-60 115 144 (HITACHI SEISAKUSHO KK) 21 June 1985**

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Description

Field of the Invention

[0001] The present invention relates generally to electrodeless lamps and, more particularly, to apparatus, i. e., a "virtual fixture", for reducing variations in performance of an electrodeless lamp when operating within or without an electrically conductive fixture.

Background of the Invention

[0002] Unfortunately, installation of an electrodeless lamp (e.g., an electrodeless fluorescent lamp) in a fixture with an electrically conductive outer shell results in significant variations in lamp performance, such as changes in lamp input power, output lumens, and ballast power loss. Changes in input power and output lumens are, to say the least, an inconvenience for the consumer, but changes in ballast power loss can significantly increase ballast temperature and shorten ballast life.

[0003] The changes in lamp performance upon installation in a fixture are caused by interaction between the electromagnetic fields produced by the excitation coil in the electrodeless fluorescent lamp and the conductive shell of the fixture. This interaction changes the impedance of the loaded drive coil as viewed from the ballast, and hence changes system performance.

[0004] A typical electrodeless fluorescent lamp ballast employs a resonant circuit. One approach to maintaining nominal performance of a resonant circuit is to use a feedback circuit in which an output variable is measured and fed back to a controller. In response to the feedback, the controller changes a control variable, such as input voltage or operating frequency, in such a manner that the circuit either runs with constant output power or operates at high efficiency. Disadvantageously, such feedback control schemes are too expensive to be practicable for the ballasts of electrodeless fluorescent lamps intended for use as incandescent lamp replacements.

[0005] Accordingly, it is desirable to provide apparatus for an electrodeless fluorescent lamp which allows the ballast to be adjusted for optimized performance outside of an electrically conductive fixture, while maintaining this performance even when the lamp is installed in a fixture that is electrically conductive.

Summary of the Invention

[0006] According to the present invention, there is provided an electrodeless discharge lamp in accordance with claim 1.

[0007] In a preferred embodiment of the invention, an electrodeless lamp (e.g., an electrodeless fluorescent lamp) comprises a dielectric housing shaped to conform to a portion of a lamp envelope, which housed portion is opposite to a portion through which light is emitted. The dielectric housing includes a continuous conductor, i.e., a shorted turn, situated between the dielectric housing and the lamp envelope which conforms to at least a portion of the dielectric housing. The configuration of the shorted turn, in terms of its location and amount of surface area occupied thereby, is optimized to minimize interaction between the excitation coil and any electrically conductive fixture and to avoid interfering with lamp starting and light output.

Brief Description of the Drawings

[0008] The features and advantages of the present invention will become apparent from the following detailed description of the invention when read with the accompanying drawings in which:

Figure 1 illustrates, in partial cross section, a typical electrodeless fluorescent lamp;

Figure 2a illustrates, in partial cross section, one embodiment of an electrodeless fluorescent lamp according to the present invention;

Figure 2b is a perspective view of the shorted turn of the electrodeless fluorescent lamp of Figure 2a;

Figure 3a illustrates, in partial cross section, one embodiment of an electrodeless fluorescent lamp according to the present invention; and

Figure 3b is a perspective view of the shorted turn of the electrodeless fluorescent lamp of Figure 3a.

Detailed Description of the Invention

[0009] Figure 1 illustrates a typical electrodeless fluorescent discharge lamp 10 having an envelope 12 containing an ionizable gaseous fill. (Although the present invention is illustrated with reference to an electrodeless fluorescent lamp, it is to be understood that the principles of the present invention apply equally to other types of electrodeless lamps which emit radiation having a wavelength in a range from approximately 100 nanometers (nm) to 1000 nm, e.g., high intensity metal halide discharge lamps.) A suitable fill, for example, for the electrodeless fluorescent lamp of Figure 1 comprises a mixture of a rare gas (e.g., krypton and/or argon) and mercury vapor and/or cadmium vapor. An excitation coil 14 is situated within, and removable from, a re-entrant cavity 16 within envelope 12. For purposes of illustration, coil 14 is shown schematically as being wound about a magnetic core 15, i.e., having a permeability greater than one, which is situated about an exhaust tube 20 that is used for filling the lamp. Alternatively, however, the coil may be wound about the exhaust tube itself, or may be spaced apart from the exhaust tube and wound about a core of insulating material, or may be

free standing, as desired. The interior surfaces of envelope 12 are coated in well-known manner with a suitable phosphor 18. Envelope 12 fits into one end of a base assembly 17 containing a radio frequency power supply (not shown) with a standard (e.g., Edison type) lamp base 19 at the other end.

[0010] Lamp 10 is illustrated as being of a reflective type; that is, light emitted within envelope 12 is reflected by a reflector, illustrated as comprising a reflective coating 34 on a portion of the interior or exterior surface of the envelope, such that light is emitted through an opposing portion 36 of the envelope. An exemplary reflective coating is comprised of titania. A dielectric housing, 32 e.g., comprised of plastic, is illustrated as being situated around the reflective portion of envelope 12.

[0011] In operation, current flows in coil 14 as a result of excitation by a radio frequency power supply (not shown). As a result, a radio frequency magnetic field is established within envelope 12, in turn creating an electric field which ionizes and excites the gaseous fill contained therein, resulting in an ultraviolet-producing discharge 23. Phosphor 18 absorbs the ultraviolet radiation and emits visible radiation as a consequence thereof, which visible radiation is reflected by reflective coating 34 through light-emitting portion 36 of lamp 10.

[0012] Disadvantageously, if the lamp of Figure 1 were installed in an electrically conductive fixture of well-known type for supporting lamps and directing the light emitted therefrom, the magnetic field of excitation coil 14 would induce currents in the conductive walls of the fixture. (A fixture 25 is illustrated schematically in Figure 1.) These currents would create another magnetic field that would induce an additional current in excitation coil 14, thereby changing its operation relative to operation outside the conductive fixture.

[0013] In accordance with the present invention, an electrodeless fluorescent lamp comprises a shorted turn for minimizing interaction with any metallic lamp fixture of well-known type (not shown) for supporting lamps and directing the light emitted therefrom.

[0014] Figures 2a and 2b illustrate an electrodeless fluorescent lamp 30 according to the present invention including a continuous conductor, or shorted turn, 40 which conforms to at least a portion of housing 32 and is situated between housing 32 and lamp envelope 12. The shorted turn may be attached to housing 32 in any suitable manner; for example, it may be glued, snap fit, or injection molded to the housing. Alternatively, the shorted turn may be attached to envelope 12 or may be incorporated into the housing.

[0015] Advantageously, shorted turn 40 is an ever-present conductive wall that functions to carry current in the same manner as an electrically conductive fixture would if the lamp were installed in one; thus, the shorted turn acts as a "virtual fixture". Hence, the lamp can be adjusted for optimized operation when not installed in an electrically conductive fixture, such that performance of the lamp will not change substantially when installed therein.

[0016] Shorted turn 40 is comprised of any suitable metal, e.g., copper, or combination of metals. The configuration of the shorted turn, in terms of its location and amount of surface area occupied thereby, is optimized to minimize interaction with any electrically conductive fixture and to avoid interfering with lamp starting and light output. In one embodiment, the thickness of the metal comprising the shorted turn is at least the skin depth at the operating frequency of the lamp to ensure that substantially all the magnetic field generated by excitation coil 14 at the location of the shorted turn induces currents to flow therein. The resistance around the shorted turn should be sufficiently low to minimize losses therein.

[0017] Dielectric housing 32 functions not only to support shorted turn 40, but also functions to protect a lamp user from potential electric shocks in case of contact with the shorted turn.

[0018] The width of the shorted turn is represented by *w* in Figures 2a and 2b. In Figures 2a and 2b, the shorted turn substantially covers the underside of the dielectric housing such that *w* is substantially the width of dielectric housing 32. The wider the shorted turn, and the farther it extends above and below the central portion, i.e., equator E, of the envelope, the better it is able to function as a virtual fixture. However, if the width is too great, then the shorted turn would interfere with stray electric fields used to start the lamp. Moreover, making the shorted turn extend beyond the reflective coating would interfere with light output. Therefore, the shorted turn should not extend beyond the portion of the envelope covered by the reflector.

[0019] Figures 3a and 3b illustrate an alternative embodiment of an electrodeless fluorescent lamp 30' according the present invention wherein a shorted turn 40' is significantly narrower ($w'<w$) than that of Figures 2a and 2b.

[0020] For any particular lamp configuration, the configuration of the shorted turn is optimized in terms of the location and amount of surface area occupied to minimize interaction with any metallic fixture and to avoid interfering with lamp starting and light output.

[0021] Advantageously, a shorted turn for an electrodeless lamp significantly reduces variations in lamp performance between operating in a conductive fixture and operating without a fixture.

[0022] While the preferred embodiments of the present invention have been shown and described herein, it will be obvious that such embodiments are provided by way of example only. Numerous variations, changes and substitutions will occur to those of skill in the art without departing from the invention herein. Accordingly, it is intended that the invention be limited only by the scope of the appended claims.

Claims

1. An electrodeless discharge lamp (30, 30'), comprising:

   a light-transmissive envelope (12) containing an ionizable, gaseous fill for sustaining an arc discharge (23) when subjected to an alternating magnetic field and for emitting light, said envelope (12) having a central portion and further having a lamp base (17) at one end thereof, said base being adapted for installation into a lamp fixture (25) comprising an electrically conductive material; and

   an excitation coil (14) situated proximate said envelope for providing said alternating magnetic field when excited by an alternating current energy source;

   characterised by

   a shorted metal turn (40, 40') comprising a continuous conductor situated between said envelope (12) and said fixture (25), said shorted metal turn covering a portion of said envelope, and said shorted metal turn minimizing electromagnetic interaction between said excitation coil and said fixture.

2. The lamp of claim 1, further comprising a dielectric housing (32) situated about a portion of said envelope, said dielectric housing having an underside facing said envelope, said shorted metal turn (40, 40') being held in position between said envelope and said fixture.

3. The lamp of claim 1, wherein said shorted metal turn (40, 40') covers a portion of said envelope toward the central portion thereof.

4. The lamp of claim 1 , comprising an electrodeless fluorescent lamp, said arc discharge emitting ultraviolet radiation when subjected to said alternating magnetic field, said envelope having an interior phosphor coating (18) for emitting visible radiation when excited by said ultraviolet radiation, said envelope further having a re-entrant cavity (16) formed therein, said excitation coil being contained within said re-entrant cavity, said lamp further comprising a dielectric housing (32) situated about a portion of said envelope.

5. The lamp of claim 4, further comprising a reflector (34) situated about a reflector portion of said envelope for reflecting light through a light-emitting portion (36) of said envelope situated opposite said reflector portion.

6. The lamp of claim 5, wherein said reflector (34) comprises a reflective coating on said envelope.

7. The lamp of claim 5, wherein said dielectric housing (32) covers said reflector portion of said envelope, and said shorted metal turn covers (40,40') the underside of said dielectric housing.

8. The lamp of claim 5, wherein said dielectric housing (32) covers said reflector portion of said envelope, and said shorted metal turn (40, 40') covers a portion of said reflector portion of said envelope toward the central portion thereof.

9. The lamp of claim 2 or 4, wherein said shorted metal turn (40, 40') is attached to said dielectric housing (32).

10. The lamp of claim 2 or 4, wherein said shorted metal turn (40, 40') is attached to said envelope (12).

11. The lamp of claim 2 or 4, wherein said shorted metal turn (40, 40') is incorporated into said dielectric housing (32).

12. The lamp of claim 2 or 4, wherein said dielectric housing (32) has an extension over said envelope (12) beyond said shorted metal turn (40, 40').

13. The lamp of claim 2 or 4, wherein said dielectric housing (32) comprises plastic, and said shorted metal turn (40, 40') comprises copper.

Patentansprüche

1. Elektrodenlose Entladungslampe (30, 30') enthaltend:

   einen lichtdurchlässigen Mantel (12), der eine ionisierbare Gasfüllung zur Aufrechterhaltung einer Bogenentladung (23) enthält, wenn sie einem wechselnden Magnetfeld ausgesetzt ist, und zum Emittieren von Licht, wobei der Mantel (12) einen Mittelabschnitt und ferner einen Lampensockel (17) an seinem einen Ende aufweist, wobei der Sockekl für einen Einbau in eine Lampenfassung (25) geeignet ist, die elektrisch leitendes Material aufweist, und
   eine Anregungsspule (14), die in der Nähe des Mantels angeordnet ist, zum Liefern des wechselnden Magnetfeldes, wenn sie durch eine Wechselstrom-Energiequelle angeregt ist,

   gekennzeichnet durch eine kurzgeschlossene Metallwindung (40, 40'), die einen durchgehenden Leiter aufweist, der zwischen dem Mantel (12) und der Fassung (25) angeordnet ist, wobei die

kurzgeschlossene Metallwindung einen Abschnitt von dem Mantel abdeckt und die kurzgeschlossene Metallwindung eine elektromagnetische Wechselwirkung zwischen der Anregungsspule und der Fassung minimiert.

2. Lampe nach Anspruch 1, wobei ferner ein dielektrisches Gehäuse (32) vorgesehen ist, das um einen Abschnitt von dem Mantel herum angeordnet ist, wobei das dielektrische Gehäuse eine auf den Mantel gerichtete Unterseite aufweist und die kurzgeschlossene Metallwindung (40, 40') in einer Lage zwischen dem Mantel und der Fassung gehalten ist.

3. Lampe nach Anspruch 1, wobei die kurzgeschlossene Metallwindung (40, 40') einen Abschnitt von dem Mantel in Richtung auf seinen Mittelabschnitt überdeckt.

4. Lampe nach Anspruch 1, die eine elektrodenlose Leuchtstofflampe bildet, wobei die Bogenentladung ultraviolette Strahlung emittiert, wenn sie dem wechselnden Magnetfeld ausgesetzt ist, wobei der Mantel einen inneren Leuchtstoffüberzug (18) aufweist zum Emittieren von sichtbarer Strahlung, wenn er durch die ultraviolette Strahlung angeregt wird, wobei der Mantel ferner eine darin ausgebildete zurückspringende Kammer (16) aufweist, in der die Anregungsspule angeordnet ist, wobei die Lampe ferner ein dielektrisches Gehäuse (32) aufweist, das um einen Teil von dem Mantel herum angeordnet ist.

5. Lampe nach Anspruch 4, wobei ferner ein Reflektor (34) um einen Reflektorabschnitt von dem Mantel herum angeordnet ist zum Reflektieren von Licht durch einen Licht emittierenden Abschnitt (36) von dem Mantel, der gegenüber dem Reflektorabschnitt angeordnet ist.

6. Lampe nach Anspruch 5, wobei der Reflektor (34) einen reflektierenden Überzug auf dem Mantel aufweist.

7. Lampe nach Anspruch 5, wobei das dielektrische Gehäuse (32) den Reflektorabschnitt von dem Mantel überdeckt und die kurzgeschlossene Metallwindung (40, 40') die Unterseite von dem dielektrischen Gehäuse überdeckt.

8. Lampe nach Anspruch 5, wobei das dielektrische Gehäuse (32) den Reflektorabschnitt von dem Mantel überdeckt und die kurzgeschlossene Metallwindung (40, 40') einen Teil von dem Reflektorabschnitt des Mantels in Richtung auf seinen Mittelabschnitt überdeckt.

9. Lampe nach Anspruch 2 oder 4, wobei die kurzgeschlossene Metallwindung (40, 40') an dem dielektrischen Gehäuse (32) befestigt ist.

10. Lampe nach Anspruch 2 oder 4, wobei die kurzgeschlossene Metallwindung (40, 40') an dem Mantel (12) befestigt ist.

11. Lampe nach Anspruch 2 oder 4, wobei die kurzgeschlossene Metallwindung (40, 40') in das dielektrische Gehäuse (32) eingefügt ist.

12. Lampe nach Anspruch 2 oder 4, wobei das dielektrische Gehäuse (32) eine Erstreckung über dem Mantel (12) über die kurzgeschlossene Metallwindung (40, 40') hinaus hat.

13. Lampe nach Anspruch 2 oder 4, wobei das dielektrische Gehäuse (32) Kunststoff aufweist und die kurzgeschlossene Metallwindung (40, 40') Kupfer aufweist.

Revendications

1. Lampe (30, 30') à décharge sans électrode, comprenant :

une enveloppe (12) transmettant la lumière, contenant une charge gazeuse ionisable destinée à entretenir une décharge d'arc (23) sous l'action d'un champ magnétique alternatif et à émettre de la lumière, ladite enveloppe (12) comportant une partie centrale et comportant de plus un culot de lampe (17) à l'une de ses extrémités, ledit culot étant adapté pour une installation dans un support de lampe (25) comprenant un matériau conduisant l'électricité; et une bobine d'excitation (14) située à proximité de ladite enveloppe et destinée à fournir ledit champ magnétique alternatif lorsqu'elle est excitée par une source d'énergie à courant alternatif;

caractérisée par

un élément métallique formant spire en court-circuit (40, 40') comprenant un conducteur continu situé entre ladite enveloppe (12) et ledit support (25), ledit élément métallique formant spire en court-circuit couvrant une partie de ladite enveloppe, et ledit élément métallique formant spire en court-circuit minimisant l'interaction électromagnétique entre ladite bobine d'excitation et ledit support.

2. Lampe selon la revendication 1, comprenant de plus un logement diélectrique (32) situé autour d'une partie de ladite enveloppe, ledit logement dié-

lectrique comportant une face inférieure faisant face à ladite enveloppe, ledit élément métallique formant spire en court-circuit (40, 40') étant maintenu en position entre ladite enveloppe et ledit support.

3. Lampe selon la revendication 1, dans laquelle ledit élément métallique formant spire en court-circuit (40, 40') couvre une portion de ladite enveloppe vers la partie centrale de celle-ci.

4. Lampe selon la revendication 1, comprenant une lampe fluorescente sans électrode, ladite décharge d'arc émettant un rayonnement ultraviolet lorsqu'elle est soumise audit champ magnétique alternatif, ladite enveloppe comportant un revêtement interne luminophore (18) destiné à émettre un rayonnement visible lorsqu'il est excité par ledit rayonnement ultraviolet, ladite enveloppe comportant de plus à l'intérieur une cavité rentrante (16), ladite bobine d'excitation étant contenue à l'intérieur de ladite cavité rentrante, ladite lampe comprenant de plus un logement diélectrique (32) situé autour d'une partie de ladite enveloppe.

5. Lampe selon la revendication 4, comprenant de plus un réflecteur (34) situé autour d'une partie réflectrice de ladite enveloppe et servant à réfléchir la lumière à travers une partie (36) émettrice de lumière de ladite enveloppe située à l'opposé de ladite partie réflectrice.

6. Lampe selon la revendication 5, dans laquelle ledit réflecteur (34) comprend un revêtement réfléchissant sur ladite enveloppe.

7. Lampe selon la revendication 5, dans laquelle ledit logement diélectrique (32) couvre ladite partie réflectrice de ladite enveloppe, et ledit élément métallique formant spire en court-circuit (40, 40') couvre la face inférieure dudit logement diélectrique.

8. Lampe selon la revendication 5, dans laquelle ledit logement diélectrique (32) couvre ladite partie réflectrice de ladite enveloppe, et ledit élément métallique formant spire en court-circuit (40, 40') couvre une partie de ladite partie réflectrice de ladite enveloppe vers la partie centrale de celle-ci.

9. Lampe selon la revendication 2 ou 4, dans laquelle ledit élément métallique formant spire en court-circuit (40, 40') est fixé audit logement diélectrique (32).

10. Lampe selon la revendication 2 ou 4, dans laquelle ledit élément métallique formant spire en court-circuit (40, 40') est fixé à ladite enveloppe (12).

11. Lampe selon la revendication 2 ou 4, dans laquelle ledit élément métallique formant spire en court-circuit (40, 40') est incorporé audit logement diélectrique (32).

12. Lampe selon la revendication 2 ou 4, dans laquelle ledit logement diélectrique (32) s'étend sur ladite enveloppe (12) au-delà dudit élément métallique formant spire en court-circuit (40, 40').

13. Lampe selon la revendication 2 ou 4, dans laquelle ledit logement diélectrique (32) comprend une matière plastique, et ledit élément métallique formant spire en court-circuit (40, 40') comprend du cuivre.

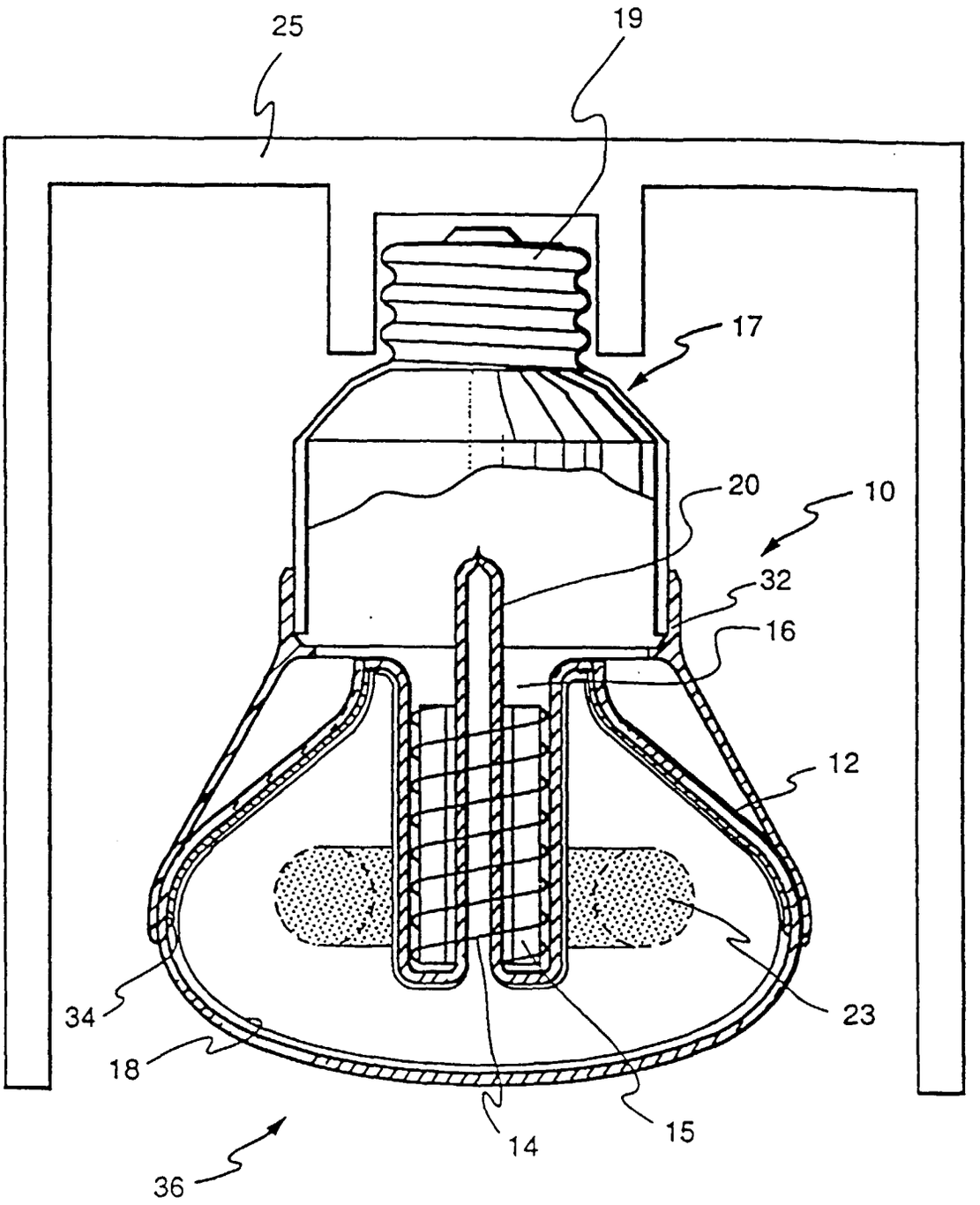

FIG. 1

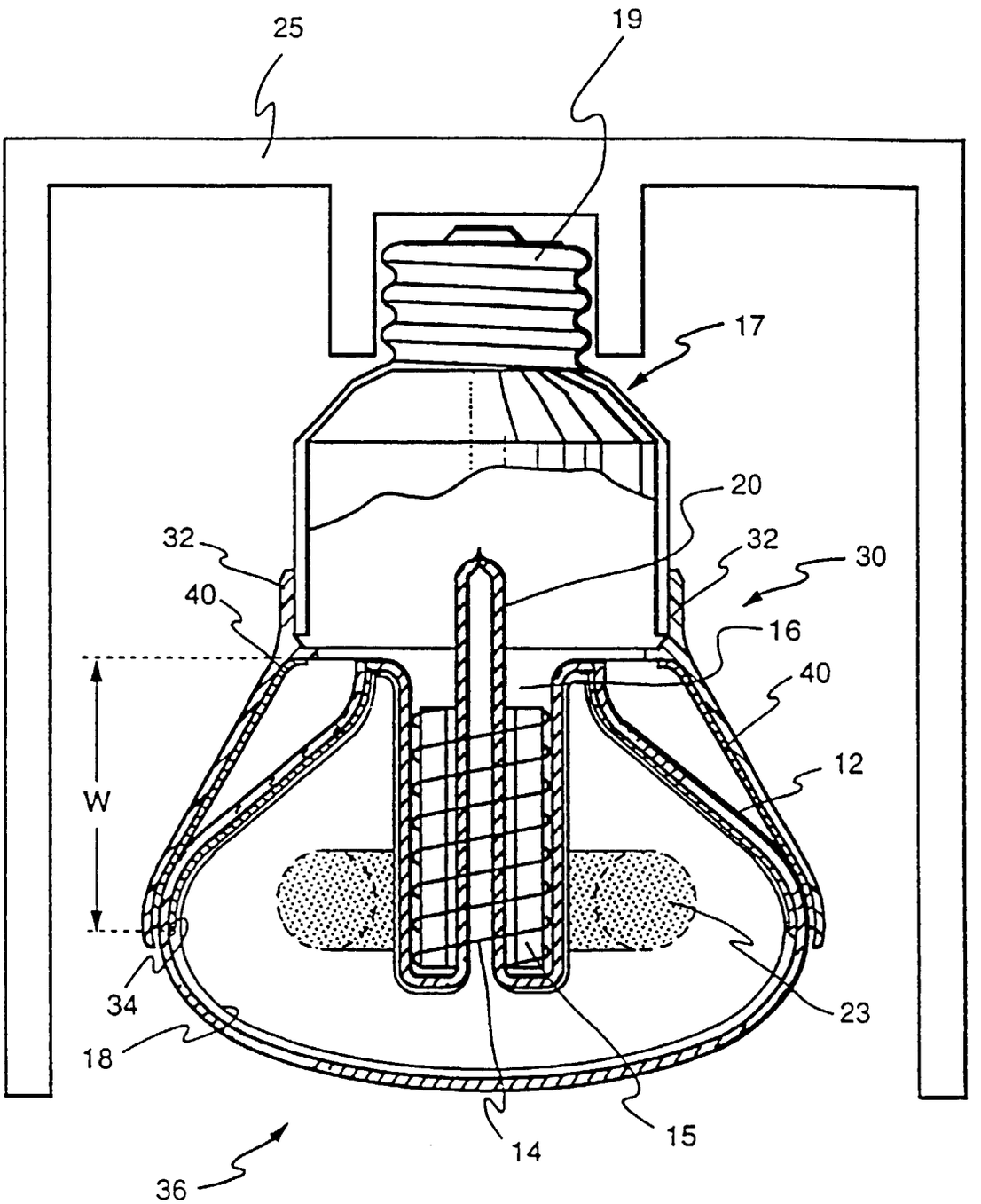

FIG. 2a

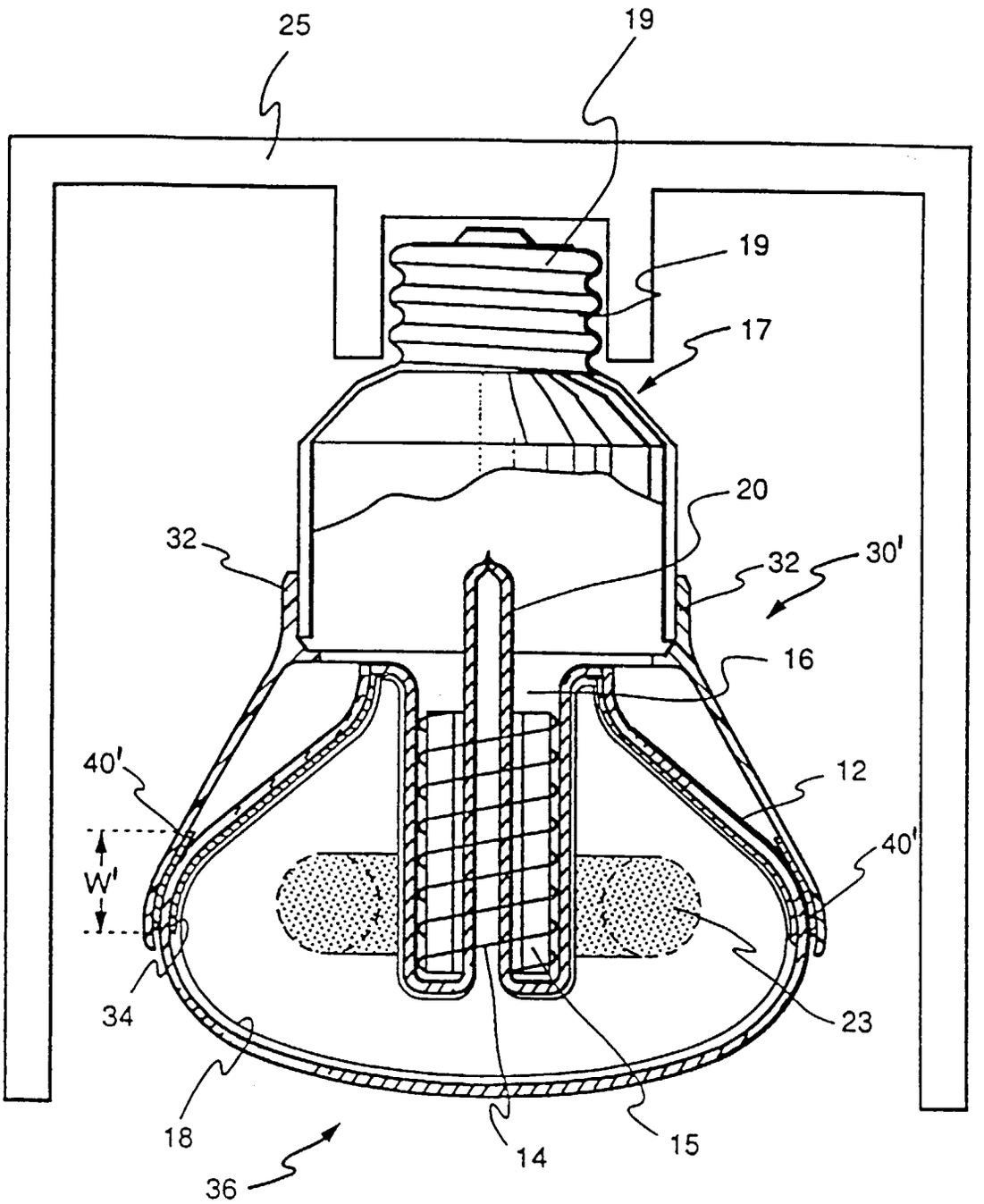

FIG. 3a

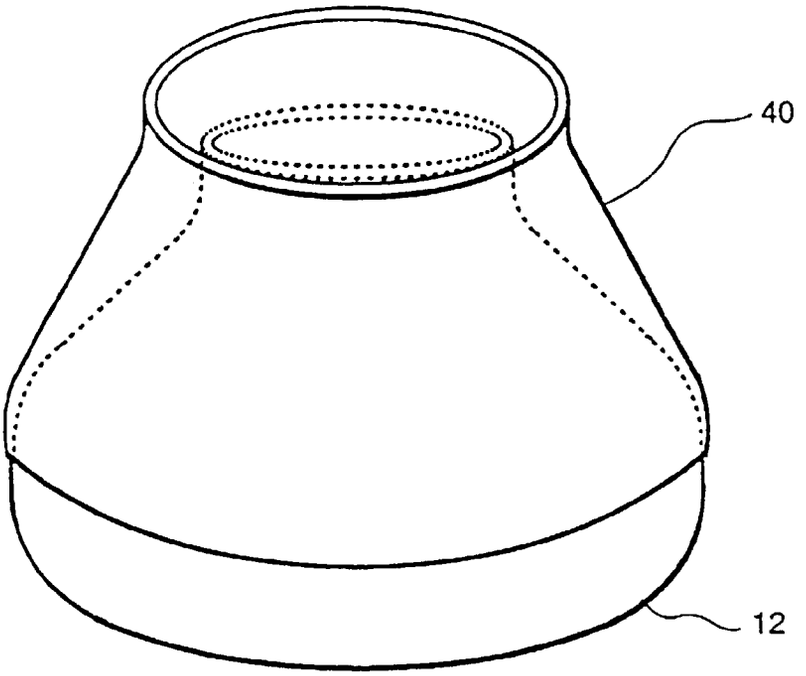

FIG. 2b

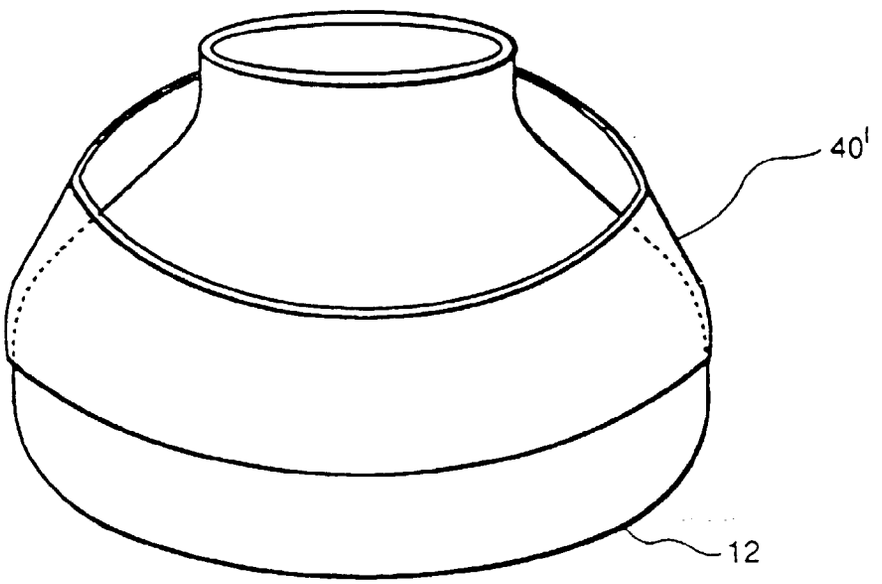

FIG. 3b