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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Double-enveloped incandescent lamp.**

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(73) Proprietor: **GTE Products Corporation**
100 West 10th Street
Wilmington, DE 19801 (US)

(72) Inventor: **Gagnon, Peter R.**
65 1/2 Searle Street
Georgetown Massachusetts (US)

(74) Representative: **Lemke, Jörg-Michael, Dipl.-Ing.**
Oberländerstrasse 16a
D-8900 Augsburg (DE)

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Description

This invention relates to double-enveloped tungsten-halogen incandescent lamps comprising an outer envelope, a light-source capsule, a stem on which said capsule is mounted within said outer envelope, said stem having a flare which is hermetically sealed to said outer envelope, and a mesh surrounding said light-source capsule.

There is a small probability that a double-enveloped tungsten halogen incandescent lamp will burst during operation of the lamp, hereinafter called a "containment failure" of the lamp. When a lamp containment failure occurs, the sequence of events internal to the lamp is as follows. The capsule bursts causing fragments of glass or shards to be propelled against the outer envelope; these shards shatter the outer envelope of the lamp. The result is that the lamp bursts.

One type of containment failure which may occur in a lamp having a single-ended light-source capsule is as follows. The capsule ruptures near or in the press seal. The remainder or upper body of the capsule remains intact. Because of the release of substantial pressure from within the capsule, the capsule body (still referred to herein as a shard) is propelled away from the press seal toward the outer envelope. The outer envelope is shattered by the impact of the propelled capsule body.

The causes of these infrequent lamp failures are varied and unpredictable. Although occurrence of the failure is rare, nevertheless it could present a safety hazard to a person in the immediate vicinity of a lamp. Where such failures can be anticipated, lamp manufacturers notify users by means of warnings on packages and other descriptive materials and by suggested precautions in specifications. This hazard may be avoided by operating the lamp in a fixture designed to contain such a failure. The requirement that the lamp be operated in a protective fixture is frequently employed in commercial usage. However, this procedural safeguard is less acceptable for consumer usage. For reasons of safety, economy, and convenience in both commercial and consumer usage, it may be desirable to incorporate a reliable containment device as part of the lamp itself.

In U.S. Patent No. 4,281,274, is used July 28, 1981, by Bechard et al, there is disclosed an enclosure of glass surrounding the arc tube within the outer envelope of an arc discharge lamp. The enclosure is suggested as being useful as a means to protect against a containment failure of the lamp. While such enclosure may be effective in containing some arc tube bursts, it has been found that in a substantial percentage of cases the enclosure itself is shattered by the burst and containment failure of the lamp follows. Thus, the glass enclosure device taught in the Bechard et al patent offers only limited protection against lamp-containment failures, and such protection is especially tenuous in lamps having light-source capsules in which operating pressures may be as high as 20 atmospheres.

From FR—A—852 426 an incandescent lamp is known which is surrounded by a mesh for containment of shards produced by a burst of the lamp. The mesh or net of this prior art protects the surroundings from glass splinters in the event of a burst of the bulb of the lamp. Therefore, the net must have a mesh or stitch or opening size fine enough to contain splinters of virtually any size. This reduces the luminous efficacy of the lamp.

From FR—A—849 331 a double-enveloped incandescent lamp as described in the opening paragraph is shown. The mesh of this lamp has the function of supporting the inner capsule but not of protecting the environment in case of a containment failure of the lamp. Said protective function is to be carried out by the outer envelope.

The object of the present invention is to provide a double-enveloped incandescent lamp of the type mentioned in the first paragraph above in which the operational safety characteristics of the lamp are improved without the luminous efficacy being impaired.

The object is accomplished in that said mesh absorbs energy by deformation thereof in case of a capsule burst and restricts shards of said capsule from shattering said outer envelope, the size of the openings in the mesh being such that those shards of said capsule with mass large enough to cause a rupture of said outer envelope are restrained from passing through said mesh and impacting said outer envelope, said mesh being formed from light-reflecting metal wire and causing a minimal reduction in the luminous efficacy of said lamp, means for mounting said mesh about said capsule and anchoring said mesh on said stem being further provided.

The mesh used with the invention has the ability to absorb energy upon deformation thereof by a capsule burst. Such ability can be achieved, in a preferred embodiment of the invention, by using a knitted mesh as shown in the drawings. It is easily understood that knitting is capable of absorbing energy upon impact of e.g. a shard because a knitted mesh can "give in" at that spot radially outwardly for some distance by stretching without exceeding the strength of a filament, more specifically, the kinetic energy of a shard is turned over into energy of deformation of the mesh, such deformation spreading from the point of impact of the shard.

It is emphasized that the mesh is not necessarily knitted; the expert knows different types of forming a mesh serving the purpose.

Further, the invention provides for mesh-mounting means for mounting said mesh about said capsule and anchoring said mesh on said stem so that, of course, the electrical circuit will not be effected. The mesh insulating means may include frictional force exerted by the mesh on the capsule. It will be apparent that such frictional forces enhance the forces necessary for a defor-

mation of the mesh and, hence, such frictional forces are serving the object of containing the capsule upon a burst.

With the invention the surroundings are protected as long as the outer envelope remains intact. The containment mesh, located within the outer envelope, need not restrain all shards from passing through the mesh; it need restrain only those shards having a mass large enough to rupture the outer envelope upon a capsule burst. Thus, the containment mesh and the outer envelope cooperate to protect the surroundings. As a result of this cooperation, the stitch or opening size of the mesh of the instant invention may be relatively large, so that the lamp luminous efficacy is not impaired.

Advantageous developments of the invention are subject of the subclaims.

As used herein, the terms "light-source capsule" or "capsule" denote a tungsten halogen incandescent light-generating capsule of a double-enveloped tungsten halogen lamp. This type of lamp, with single-ended and double-ended capsules, has been suggested in the prior art. U.S. Patents No. 3,194,625, by Danko, issued July 13, 1965; No. 3,448,321, by Shanks, issued June 3, 1969; and No. 3,515,930, by Walsh et al, issued June 2, 1970, provide examples of tungsten halogen lamps of both the single-ended and double-ended capsule varieties.

The terms "efficacy" or "luminous efficacy" used herein are a measure, expressed in lumens per watt, of the total luminous flux emitted by a light source over all wavelengths divided by the power input of the source.

For a general reference on the tungsten halogen incandescent lamp, see IES Lighting Handbook, 1981 Reference Volume, Section 8,

Lamps with light-source capsule containment devices constructed in accordance with the foregoing description will exhibit substantially improved operating safety characteristics when compared to lamps of the prior art.

The invention and advantageous developments are illustrated by means of embodiments shown in the accompanying drawings.

Fig. 1 is an elevational view of a tungsten halogen lamp employing an embodiment of the invention, with some parts broken away for clarity;

Fig. 2 is an elevational view of a single-ended light-source capsule illustrating an alternate embodiment of the invention, with parts broken away for clarity;

Fig. 3 is an elevational view of a single-ended light-source capsule illustrating another embodiment of the invention, with certain parts omitted for clarity;

Fig. 4 is an elevational view of a double-ended light-source capsule employing an embodiment of the invention, with certain parts omitted for clarity;

Fig. 5 is an enlarged, partial, pictorial view of an embodiment of a knitted containment mesh; and

Fig. 9 is an enlarged partial, pictorial, view of an embodiment of a rigid containment mesh or screen.

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following disclosure and appended claims taken in conjunction with the above-described drawings.

Referring to the drawings with greater particularity, Fig. 1 shows a double-enveloped tungsten halogen incandescent lamp 10 having a light-source capsule containment device 12. Lamp 10 comprises outer envelope 14, light-source capsule 16, stem 18, containment mesh 20, and mesh mounting means 22. Capsule 16 is mounted on stem 18 by means of stiff lead-in wires 23 which protrude from stem 18. In this embodiment, mesh 20 comprises knitted metal wire which forms a cylindrical sleeve which is closed at mesh top 26. Mesh 20 encloses capsule 16 laterally and about capsule-top 24. Mesh 20 may be formed into such a closed cylindrical sleeve by means of being knitted, self-welded, clamped, etc. More than one method may be used in the construction of containment mesh 20, such as knitting the mesh into a cylindrical sleeve and closing mesh-top 26 by welding or clamping. Mounting means 22 for containment mesh 20 comprises anchoring pins 29. Mesh 20, in sleeve form, is mounted by slipping the open end of the sleeve over capsule 16 and a portion of stem 18 such that anchoring pins 29 fit through respective stitches or openings of mesh 20. Anchoring pins 29 should be inserted into openings of mesh 20 which are sufficiently distant from the edge of the fabric so that the fabric will not tear in the event a force is exerted on mesh 20 in the direction of arrow 30. The distance between mesh-top 26 and outer envelope 14, as shown by distance d in the drawing, is greater than the maximum stretch of mesh 20 in the direction of arrow 30. The flare of stem 18, not shown in the drawing, is hermetically sealed to outer envelope 14.

In the event capsule 16 bursts, mesh 20 will absorb and contain a substantial portion of the energy emanating from such burst. In particular, mesh 20 will restrict shards of capsule 16 from shattering outer envelope 14. If capsule 16 fractures such that a substantial portion of capsule 16 is propelled in the direction of arrow 30, mesh 20 will contain capsule 16 and prevent it from shattering outer envelope 14 because mesh 20 is anchored to stem 18 and distance d exceeds the maximum possible extension of mesh 20. Thus, the protection against a containment failure of a tungsten halogen lamp has been significantly improved.

In some embodiments, containment mesh 20 is knitted. In other embodiments, containment mesh 20 may be rigid. In some embodiments, the knitted mesh may be preferred because of its superior energy-containing capability; in other embodiments, the rigid mesh may be preferred because of its tractability.

It is desirable that the mesh be as light-trans-

missive as possible so that there will be a minimal effect on the efficacy of the lamp. A certain percentage of light will be reflected by the mesh on the light's first pass through the capsule. A portion of the reflected light will be unobstructed by the mesh on the reflected light's subsequent pass or passes through the capsule. Thus, the net reduction in luminous efficacy is less than would be expected by estimating the percentage of the area of the capsule covered by the mesh. In all observed cases, efficacy was reduced by less than 7% due to the presence of the mesh. This efficacy loss can be reduced to less than 6% by electropolishing the mesh. Because of the partial diffusion caused by the mesh, there is reduced glare from the lamp.

The mesh size, i.e., the number of stitches or openings per inch, is selected such that the mesh will contain shards with mass large enough to be likely to cause a rupture of the outer envelope in the even of a burst of the light-source capsule. The selection of mesh size is dependent on many factors, such as the type of lamp, the properties of the light-source capsule, the atmosphere within the capsule, the type of mesh, the diameter and tensile strength of the strand or strands in the mesh, etc.

In embodiments where a wire mesh is employed, there is the possibility of an electrical short circuit caused by contact of the wire mesh with both lead-in wires. Where this possibility is a concern, one or both lead-in wires can be insulated by means of a dielectric sleeve or coating; also, one or both lead-in wires may contain a fuse as an additional precaution.

In the embodiment shown in Fig. 1, containment mesh 20 is mounted to stem 18 by means of anchoring pins 29. In some embodiments, a single anchoring pin or clamp may suffice. Another feasible mounting means would to warp a strap tightly around mesh 20 and stem 18. Still another mounting means may be to weld or clamp the mesh to one or both lead-in wires 23 provided one or both lead-in wires 23 have been properly insulated against the possibility of an electrical short circuit.

The selection of construction material for the containment mesh is heavily influenced by the environment within the outer envelope during operation of the lamp and immediately following a burst of the light-source capsule. During lamp operation, the temperature about the mesh may be in excess of 200°C. Stainless-steel wire with a high chromium content is a preferred material for the construction of the mesh and mounting strap or straps because of its superior high-temperature properties, relatively low coefficient of thermal expansion, good resistance to oxidation and corrosion, and high tensile strength.

Several example lamps of the type shown in Fig. 1 were constructed. Mesh sizes ranges from 7 to 20 stitches or openings per inch. Each containment mesh was knitted into a cylindrical sleeve from a single strand of stainless-steel wire having a diameter of 0.127 mm (0.005 inches). Closure of the top of the mesh was accomplished by welding a strap of nickel across the mesh top. The light-source capsules were sealed into A 21 bulbs such that the distance between the top of the mesh and the outer envelope was approximately one-half inch. Internal capsule pressures were approximately 7—10 atmospheres when the lamp was cold; operating capsule pressures were in the 15—20 atmospheres range.

Fig. 2 shows an elevational view of light-source capsule 16, containment mesh 20, and mesh-mounting means 32. In this embodiment, mesh 20 is mounted directly on capsule 16 by means of strap 33 which is tightly wrapped around mesh 20 and press seal 28 of capsule 16. Alternate mounting means would be to clamp mesh 20 together below capsule-base 34 or to clamp mesh 20 to one or both lead-in wires 23. If either of the alternate mesh-mounting means are employed, one or both lead-in wires 23 should be insulated with a dielectric sleeve or coating in order to prevent a possible electrical short circuit caused by the wire mesh coming in contact with both lead-in wires 23.

In Fig. 3, mesh 20 is mounted directly on capsule 16 by means of elastic or frictional forces exerted against the body of capsule 16 by mesh 20 itself. With the frictional mounting means, mesh 20 may not be anchored sufficiently to insure against the possibility of a substantial portion of capsule 16 and mesh 20 being propelled in the direction of arrow 30 and impacting with the outer envelope of the lamp. If this collision should occur, collision-absorbing means 36 acts as a cushion and prevents the shattering of the outer envelope. In this embodiment, collision-absorbing means 36 is a slightly crumpled portion of mesh 20 positioned above capsule-top 24.

In Fig. 4, a double-ended light-source capsule 38 has containment mesh 20 secured thereto by mesh-mounting means 22. In this embodiment, containment mesh 20 is a knitted cylindrical sleeve 21, and mesh-mounting means 22 comprises straps 43 which are tightly wrapped around sleeve 21 and press seals 44 of capsule 38.

Fig. 5 is an enlarged, partial, pictorial view of an embodiment of a knitted containment mesh 20. The stitch is approximately square, as shown by approximately equal horizontal and vertical distances x on the diagram. This type of mesh may be knitted from a single strand 46 of wire or other sutable material.

Fig. 6 is an enlarged partial, pictorial view of an embodiment of a screen or rigid containment mesh 20 which may be preferred in certain embodiments of the invention. The stitch is approximately square, as shown by approximately equal horizontal and vertical distances y on the diagram. This type of mesh generally is constructed from a plurality of strands of wire or strands of other suitable material as shown by vertical strands 48 and horizontal strands 50 in the diagram.

When light-source capsules in lamps like those

described in Fig. 1 were purposely induced to burst, an additional benefit of the presence of the containment mesh was noted. The usual loud report, which may be quite startling if unanticipated, was absent. The capsules burst almost in total silence. It is believed that the absence of the loud report may be explained by the fact that the burst of the capsule was contained within the outer envelope. The atmosphere within the outer envelope was near vacuum, and the sound of the burst does not propagate through the vacuum.

Thus, there is provided a double-enveloped tungsten halogen incandescent lamp having a light-source capsule containment device which provides substantially improved operational safety characteristics.

Claims

1. A double-enveloped tungsten-halogen incandescent lamp (10) comprising an outer envelope (14), a light-source capsule (16), a stem (18) on which said capsule is mounted within said outer envelope, said stem having a flare which is hermetically sealed to said outer envelope, a mesh (20) surrounding said light-source capsule, said mesh (20) absorbing energy by deformation thereof in case of a capsule burst and restricting shards of said capsule from shattering said outer envelope (14), the size of the openings in the mesh being such that those shards of said capsule with mass large enough to cause a rupture of said outer envelope are restrained from passing through said mesh and impacting said outer envelope, said mesh being formed from light-reflecting metal wire and causing a minimal reduction in the luminous efficacy of said lamp, said lamp (10) further comprising means (22, 29) for mounting said mesh about said capsule and anchoring said mesh on said stem.

2. A lamp according to claim 1, wherein the mesh-insulating means (22) includes frictional forces exerted by the mesh (20) itself on the body of the capsule (16).

3. A lamp according to claim 1 or 2, wherein the capsule (16) is single-ended.

4. A lamp according to claim 1, wherein collision-absorbing means (36) mounted within the outer envelope (14) above the top (24) of the capsule (16) is provided.

5. A lamp according to claim 4, wherein the collision-absorbing means (36) is a slightly crumpled portion of the mesh (20).

6. A lamp according to claim 5, wherein the mesh-mounting means (22) includes pins (29) for anchoring the mesh on the stem (18).

7. A lamp according to claim 6, wherein the mesh (20) is knitted.

8. A lamp according to claim 1, 5 or 6, wherein at least one anchoring pin (29) is mounted on the stem (18) and the mesh (20) is fixed by means of the anchoring pin such that a portion of the anchoring pin is inserted through an opening of the mesh.

Patentansprüche

1. Wolfram-Halogen-Doppelmantel-Glühlampe mit einer äußeren Hülle (14), einer Kapsel (16) als Lichtquelle, einem Stiel (18), auf dem die Kapsel innerhalb der äußeren Hülle angeordnet ist und der eine konische Erweiterung besitzt, die an der äußeren Hülle hermetisch dichtend angesiegelt ist, mit einem die Lichtquelle bildenden Kapsel umgebenden Gitter (20), das im Falle einer Kapselsprengung Energie durch Deformation absorbiert und Splitter der Kapsel daran hindert, die äußere Hülle (14) zu zerschlagen, wobei die Größe der Öffnungen in dem Gitter derart ist, daß diejenigen Splitter der Kapsel, deren Masse groß genug ist, um einen Bruch der Hu8lle hervorzurufen, an einem Passieren des Gitters und einem Auftreffen auf die äußere Hülle gehindert werden, und wobei das Gitter aus das Licht reflektierendem Metalldicht gebildet ist und eine minimale Reduzierung der Leuchteffizienz der Lampe hervorruft, und wobei schließlich die Lampe (10) darüberhinaus Elemente (22, 29) für die Montage des Gitters un die Kapsel herum und zum Verankerns desselben am Stiel aufweist.

2. Lampe nach Anspruch 1, bei welcher die Mittel (22) zur Montage des Gitters Reibkräfte einschließen, die von dem Gitter (20) selber auf den Körper der Kapsel (16) ausgeübt werden.

3. Lampe nach Anspruch 1 oder 2, bei welcher die Kapsel (16) ein einziges Anschlußende aufweist.

4. Lampe nach Anspruch 1, bei welcher innerhalb der äußeren Hülle (14) oberhalb der Spitze (24) der Kapsel (16) ein stoßabsorbierendes Element (36) vorgesehen ist.

5. Lampe nach Anspruch 4, bei welcher das stoßabsorbierende Element (36) von einem leicht geknitterten Teil des Gitters (20) gebildet ist.

6. Lampe nach Anspruch 5, bei welcher die Elemente (22) zur Montage des Gitters Mittel (29) für das Verankern des Gitters am Stiel (18) umfassen.

7. Lampe nach Anspruch 6, bei welcher das Gitter (20) gestrickt ist.

8. Lampe nach Anspruch 1, 5 oder 6, bei welcher an den Stiel (18) zumindest ein Ankerstift (29) montiert ist und das Gitter (20) mittels des Ankerstifts derart fixiert ist, daß ein Teil des Ankerstifts durch eine Öffnung im Gitter hindurchragt.

Revendications

1. Lampe à incandescence au tungstène halogène à deux ampoules (10) comprenant une ampoule extérieure (14), une capsule-source de lumière (16), un pied (18) sur lequel la dite capsule est montée à l'intérieur de la dite ampoule extérieure, le dit pied présentant un évasement hermétiquement scelle à la dite ampoule extérieure, un filet (20) entourant la dite capsule-source de lumière, le dit filet (20) absorbant de l'énergie par sa déformation dans le cas où la capsule éclate et interdisant aux fragments de la dite capsule de

briser la dite ampoule extérieure (14), la taille des ouvertures du filet étant telle que ces fragments de la dite capsule de grand poids suffisant pour provoquer le bris de la dite ampoule extérieure ne peuvent pas traverser le dit filet et heurter la dite ampoule extérieure, le dit filet étant formé avec un fil métallique réfléchissant la lumière et provoquant une réduction minimale du rendement lumineux de la dite lampe, la dite lampe (10) comprenant, en outre, des moyens (22) pour monter le dit filet par rapport à la dite capsule et pour ancrer le dit filet au dit pied.

2. Lampe selon la revendication 1 caractérisée en ce que les moyens de montage du filet (22) incluent des forces de friction engendrées par le filet (20) lui-même sur le corps de la capsule (16).

3. Lampe selon la revendication 1 ou 2 caractérisée en ce que la capsule (16) ext à extrémité unique.

4. Lampe selon la revendication 1 caractérisée en ce qu'un moyen d'absoprtion des collisions (36) est disposé à l'intérieur de l'ampoule extérieur (14) au-dessus du sommet (24) de la capsule (16).

5. Lampe selon la revendication 4 caractérisée en ce que le dit moyen (36) d'absorption des collisions est une partie légèrement écrasée du filet (20).

6. Lampe selon la revendication 5 caractérisée en ce que les dits moyens de montage du filet (22) incluent des ergots pour ancrer le filet sur le pied (18).

7. Lampe selon la revendication 6 caractérisée en ce que le filet (20) est tricoté.

8. Lampe selon la revendication 1, 5 ou 6 caractérisée en ce qu'au moins un ergot d'ancrage (29) est monté sur le pied (18) et que le filet (20) est fixé au moyen de l'ergot d'ancrage de manière qu'une partie de celui-ci soit insérée dans une ouverture du filet.

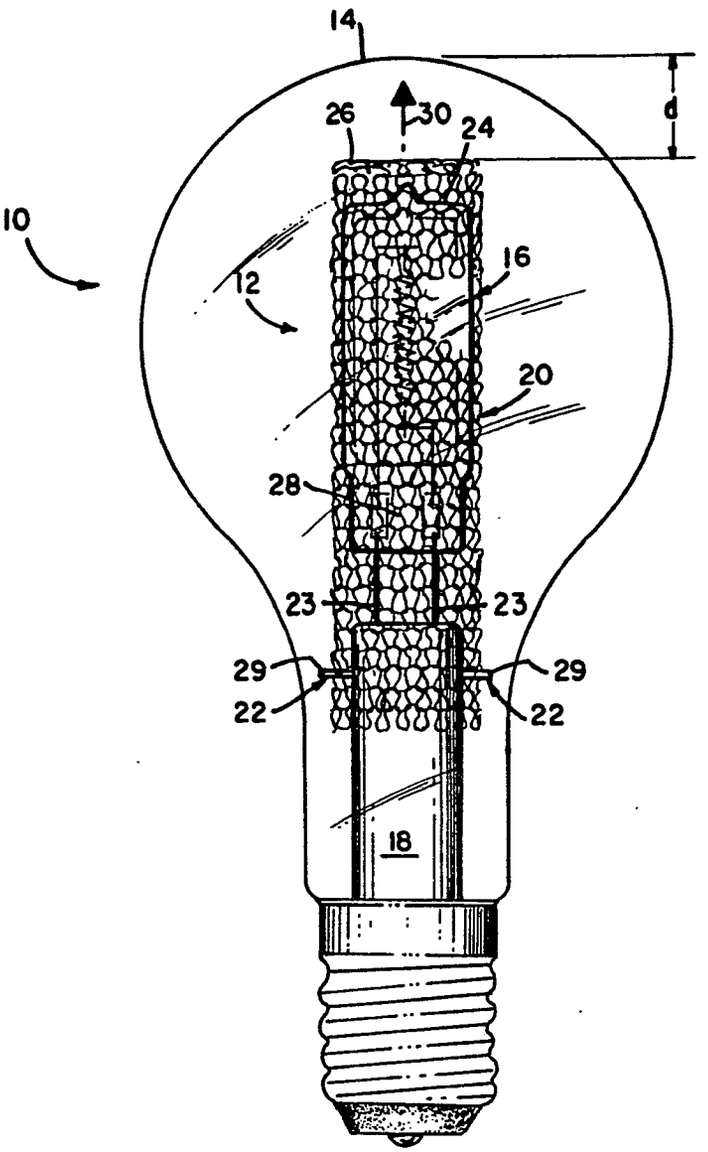

FIG. 1

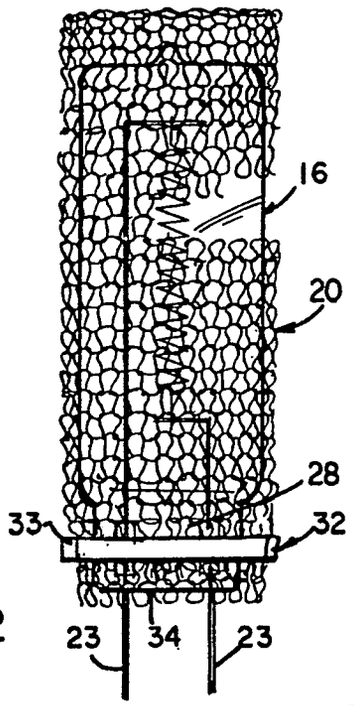

FIG.2

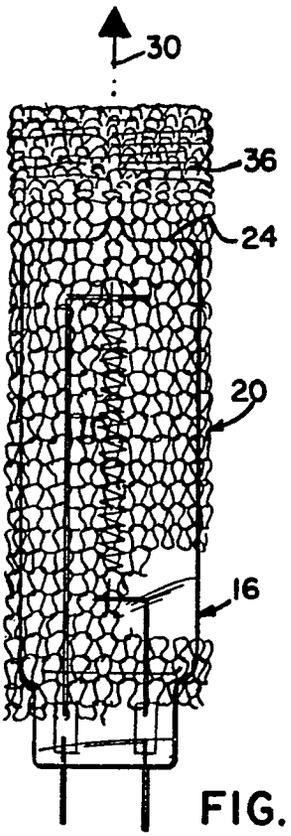

FIG.3

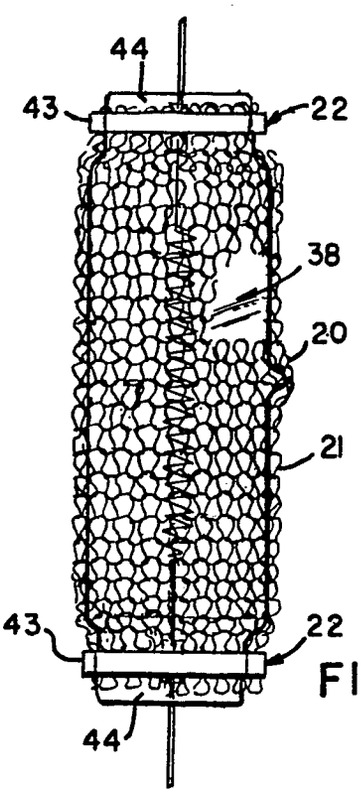

FIG.4

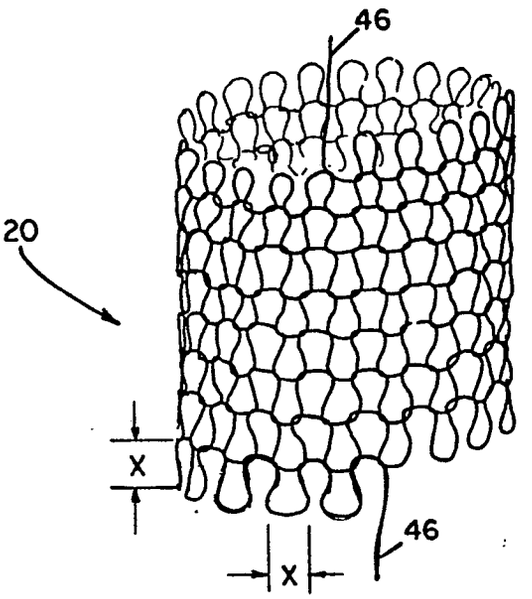

FIG.5

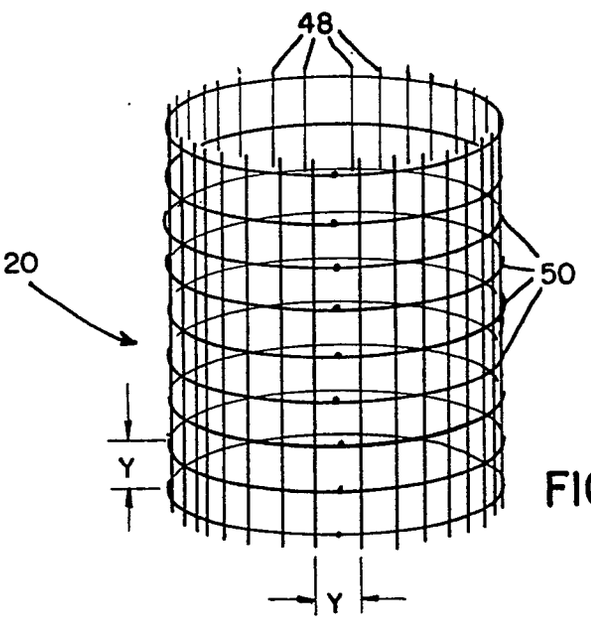

FIG.6