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(54) Low pressure gas discharge lamp.

(57) The present invention provides a low pressure gas discharge lamp comprising a light-emitting bulb (1) having a pinch seal portion (2) formed in said end portion of said bulb, an exhaust tube (11) airtightly inserted into and arranged at said pinch seal portion, a lead wire (8) airtightly inserted into and arranged at said pinch seal portion, a pair of electrodes (4), (5) generating discharge therebetween, one of which is positioned in the bulb and jointed to the one lead wire, wherein the bulb and the one lead wire are located side by side so that a central axis of the bulb is positioned between the tube and the one lead wire.

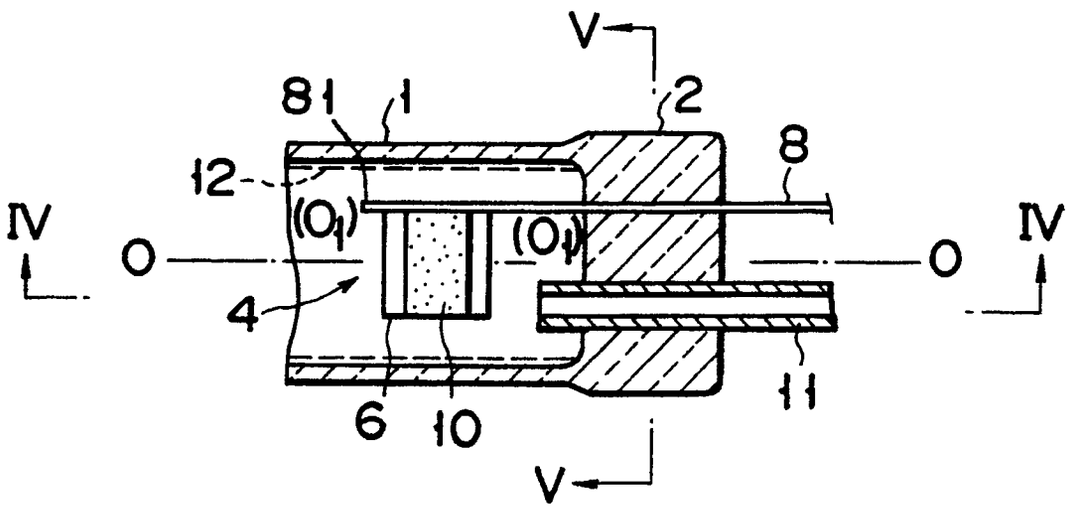

FIG. 2

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LOW PRESSURE GAS DISCHARGE LAMP

The present invention relates to a low pressure gas discharge lamp and more particularly to a sealing structure of a low pressure gas discharge lamp wherein an electrode and an exhaust tube are attached to a pinch seal portion formed in an end portion of a light-emitting bulb.

Recently, there has been used a low pressure gas discharge lamp such as a cold cathode fluorescent lamp serving as a scanner light source in electric equipments such as a facsimile machine or a copy machine or a backlight used in a liquid crystal display. Also, an extremely thin cold cathode fluorescent lamp has been used in a needle of a measuring instrument meter.

Such a cold cathode fluorescent lamp seals a cold cathode formed of a nickel plate to the end portion of light-emitting bulb formed of glass, and forms a fluorescent phosphor film in an inner surface of the light-emitting bulb. Also, mercury and rare gas are sealed in the light-emitting bulb.

Additionally, a cold cathode fluorescent lamp of rare gas discharge type without using mercury has been also well-known.

In such a cold cathode fluorescent lamp, since heat damage, which is generated in the electrode, is less than the case in a hot cathode fluorescent lamp, the life of the lamp can be prolonged. Also, since the size of the electrode can be reduced and the amount of heat, which is generated in the electrode is small, the diameter of a bulb can be reduced.

Therefore, there has been developed a fluorescent lamp whose outer diameter of the bulb is 6 mm or less, and such a fluorescent lamp having a small diameter has been used in the needle of the meter.

However, in such a fluorescent lamp having a small diameter, if flare stem, which is generally used in a conventional hot cathode fluorescent lamp, or bead stem is used to seal an opening end of the bulb is sealed, such flare or bead stem is unfavorable to the use of the thin bulb since the outer diameter of flare is larger. Also, in a case where the end portion of the bulb is sealed by the flare stem or the bead stem, since the distance between the sealed end portion and the top end of the electrode becomes large, that is, the height of the electrode becomes higher, an effective light-emitting length to the full length of the lamp is shortened.

For the above reason, in the cold cathode fluorescent lamp whose bulb diameter is small, there is used means wherein the end portion of the bulb is closed by a pinch seal structure.

If the bulb end portion is pinch-sealed, the diameter of the bulb can be reduced and the height of the electrode can be lowered, and no special stem is required, so that the manufacture of the lamp can be easily made.

In such a cold cathode fluorescent lamp, it is necessary to attach a cold cathode to the pinch seal portion and insert an exhaust tube for exhausting air in the bulb.

The cold cathode comprises a lead wire formed of a dumet wire and an electrode head formed of nickel connected to the top end of the lead wire. The lead wire is airtightly inserted into the pinch seal portion.

Therefore, the lead wire is airtightly inserted into the pinch seal portion in a state that the lead wire and the exhaust tube are arranged in the pinch seal portion along the width direction of the seal portion.

However, in conventional, two lead wires are connected to one cold cathode. In the structure wherein the cold cathode is mounted, since the exhaust tube must be inserted into the pinch seal portion in addition to two lead wires, the number of parts is increased. Particularly, in the lamp whose bulb diameter is small, since the width of the pinch seal portion is narrowed, it is impossible to surely have a space for arranging these three parts in the the pinch seal portion, so that difficulty of sealing occurs. Due to this, defective sealing occurs and leakage may be generated.

An object of the present invention is to provide a low pressure gas discharge lamp wherein the number of parts is small, assembly work is easily performed, sealing can be surely performed and the generation of leakage can be prevented.

The present invention provides a low pressure gas discharge lamp comprising a light-emitting bulb having a pinch seal portion formed in an bulb end portion, an exhaust tube airtightly inserted into and arranged at said pinch seal portion, one lead wire airtightly inserted into and arranged at said pinch seal portion, a pair of electrodes generating discharge therebetween, one of which is positioned in said bulb and jointed to said one lead wire, wherein said tube and said one lead wire are located side by side so that a central axis of said bulb is positioned between said tube and said one lead wire.

According to the present invention, since the number of lead wires to be connected to the electrode is one, the number of parts is small. Also, since the lead wire and the exhaust tube can be arranged in parallel with each other to be separated at the central axis of the bulb along the width direction of the pinch seal portion, the lead wire

and the exhaust tube can be surely sealed to the pinch seal portion even if the space of the pinch seal portion is small, and the generation of leakage can be prevented.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a side view of a cold cathode fluorescent lamp according to a first embodiment of the present invention;

Fig. 2 is a cross sectional view showing an enlarged II portion of Fig. 1;

Fig. 3 is a cross sectional view showing an enlarged III portion of Fig. 1;

Fig. 4 is a cross sectional view taken along line IV-IV of Fig. 2;

Fig. 5 is a cross sectional view taken along line V-V of Fig. 2;

Fig. 6 is a cross sectional view showing an end portion of a cold cathode fluorescent lamp according to a second embodiment of the present invention;

Fig. 7 is a cross sectional view showing an end portion of a cold cathode fluorescent lamp according to a third embodiment of the present invention;

Fig. 8 is a cross sectional view taken along the line VIII-VIII;

Fig. 9 is a side view of a cold cathode fluorescent lamp according to a fourth embodiment of the present invention; and

Fig. 10 is a side view of a cold cathode fluorescent lamp according to a fifth embodiment of the present invention.

A first embodiment of the present invention will be explained with reference to Figs. 1 to 5.

Fig. 1 is a side view showing the whole structure of a cold cathode fluorescent lamp of an A.C. lighting type or a high frequency lighting type. Figs. 2 and 3 are cross sectional views showing an end portion of the lamp, respectively. Figs. 4 and 5 are cross sectional views taken along lines IV-IV and V-V of Fig. 2.

In the drawings, reference numeral 1 is a light-emitting bulb of a cold cathode fluorescent lamp. The light-emitting bulb is formed of a straight-typed glass tube having an outer diameter of 6 mm or less, for example, 5.6 mm, a thickness of 0. 4 mm, a full length of about 80 mm. The bulb 1 has a bulb central axis O-O and both end portions, which are along the bulb central axis O-O, are sealed by pinch seal portions 2 and 3. The pinch seal portions 2 and 3 are formed in such a manner that the bulb end portions are heated and softened and pressed from the side surfaces.

An electrode, for example, cold cathodes 4 and 5 are sealed in the pinch seal portions 2 and 3, respectively.

The cold cathodes 4 and 5 are formed in such a manner that electrodes heads 6 and 7 are connected to lead wires 8 and 9, respectively. The electrode heads 8 and 9 are formed of plate-like material made of metal such as nickel or mercury discharge material. Respective electrode heads 8 and 9 have width of 3.0 mm, length of 3.5 mm, thickness of 0. 5 mm, and getter 10, 10 is applied on the surface thereof.

The lead wires 8 and 9 are formed of a dumet wire of about 0.2 mm and sealed to the pinch seal portions 2 and 3 to be airtightly inserted thereinto along the direction of the bulb central axis O-O, respectively. In this case, the respective lead wires 8 and 9 are linearly shaped and connected to one end of respective electrode heads 6 and 7 in the width direction of the electrode heads 6 and 7 by a spot-welding. The top end portions 81 and 91 of the lead wires 8 and 9 are projected a discharge space of the bulb beyond the top ends of the electrode heads 6 and 7.

In a case where the lead wires 8 and 9 are inserted into the pinch seal portions 2 and 3, the electrode heads 6 and 7 are sealed to the pinch seal portions 2 and 3 at the position where the electrode central axis O1 - O1 coincides with the bulb central axis O - O or is close to the bulb central axis. Due to this, the lead wires 8 and 9 are sealed to the pinch seal portions 2 and 3 at the position which is deflected in one direction from the bulb central axis O - O.

In both ends of the pinch seal portions 2 and 3, the respective lead wires 8 and 9 are positioned to be deflected in the same direction from the bulb central axis O - O.

An exhaust tube 11 is airtightly inserted into only pinch seal portion 2. The exhaust tube 11 is formed of a glass tube having an outer diameter of about 2.4 mm. As contrast with the lead wire 8, which is inserted into the pinch seal 2 and sealed thereto, the exhaust tube 11 is sealed to the pinch seal portion 2 at the position which is deflected from the opposite side of the bulb central axis O - O. In other words, the exhaust tube 11 and the lead wire 8 are provided side by side at the position where the exhaust tube 11 and the lead wire 8 are separated along the width direction of the pinch seal portion relative to the bulb central line O - O in the pinch seal portion 2.

A fluorescent phosphor film 12 is formed in the inner surface of the bulb 1. Also, predetermined amount of mercury and argon (Ar) gas are sealed in the bulb 1.

In the above-structured the cold cathode fluorescent lamp, since the electrode heads 6 and 7 of the cold cathodes 4 and 5 are respectively connected to the lead wires 8 and 9 and mechani-

cally supported, the number of parts for supporting electrodes is reduced, and assembling time is shortened, and assembly work can be easily made.

The cold cathodes 4 and 5 are connected to the lead wires 8 and 9, respectively. However, since these lead wires 8 and 9 are respectively connected to the end portions of the electrode heads 6 and 7 in their width direction, the lead wires 8 and 9 are deflected one direction from the bulb central axis O - O and sealed to the pinch seal portions 2 and 3, thereby the central axis O_1 - O1 of the electrode heads 6 and 7 can be positioned on bulb central axis O - O.

In this case, since the respective lead wires 8 and 9 are connected to one side of the electrode heads 6 and 7, deflected one direction from the bulb central axis O - O, and sealed to the pinch seal portions 2 and 3, the lead wires can be linearly formed, and no special curving work is required. Due to this, time for forming the lead line can be shortened, and increase in the manufacturing cost can be prevented.

Moreover, since only one lead line 8 and the exhaust tube 11 may be inserted into the pinch seal portion 2, no large space is required in the pinch seal portion 2, thereby these parts can be provided side by side without difficulty. Even if the bulb diameter and the width of the pinch seal portion 2 are small, sealing can be surely performed and no leakage is generated.

In other words, since the bulb diameter can be reduced, the height of the electrode can be lowered, and no special stem is not required, the manufacture of the lamp can be easily made.

Additionally, since the respective lead wires 8 and 9 are deflected in the same direction from the bulb central axis O - O and sealed to the pinch seal portions 2 and 3, the electrode structure between both end portions becomes symmetric. Also, characteristic of luminous intensity distribution becomes symmetric along the bulb central axis O - O and scatter of luminous intensity distribution is reduced. Due to this, scatter of luminous intensity distribution, which is along the bulb central axis O - O, is reduced.

Moreover, since the exhaust tube 11 is attached to only pinch seal portion 2 and no exhaust tube 11 is attached to the pinch seal portion 3, the number of use of the exhaust tube is reduced and sealing is made easy. Moreover, the number of glass parts is reduced and the generation of cracks is lessened.

In the lead wires 8 and 9 of the above embodiment, the top end portions 81 and 91 are projected to the discharge space beyond the electrode heads 6 and 7. Due to this, since electric field is concentrated on the protruded end portions 81 and 91, discharge is easily started and the characteristic of start is improved.

A second embodiment of the present invention will be explained with reference to Fig. 6.

In the second embodiment, the different point from the first embodiment is that the end portion, which is introduced into the bulb 1 of a lead wire 80 is curved and the inner end portion is jointed to the electrode head 6 on the central axis O1 - O1 of the electrcde head 6.

According to the above-mentioned structure, the central axis O1 - O1 of the electrode head 6 can be easily conformed to the bulb central axis O - O.

A third embodiment will be explained with reference to Figs. 7 and 8.

The third embodiment is different from the first embodiment in that the structure of the electrode head is different. More specifically, in the first embodiment, the electrode head is formed of one plate. However, in the third embodiment, the electrode head is formed of a plurality of plates. For example, an electrode head 60 is formed of two plates 61 and 62 having mercury discharge structure. In this case, two plates 61 and 62 sandwich the lead wire 8 therebetween and push each other in an inclined manner, and are substantially angular-shaped seen from the side view. Additionally, getter 10 is applied to the inner surfaces of the plates 61 and 62.

In the above-mentioned structure, since the surface area of the electrode head 60 is large, discharge performance of the electron is good and the life of the electrode can be prolonged.

Also, unlike one plate of the first embodiment, the angular shape of the third embodiment, the shape of the electrode head is not limited. The shape of the electrode head may be cylindrical or columnar.

A fourth embodiment of the present invention will be explained with reference to Fig. 9.

In the fourth embodiment, the different point from the embodiment is that the electrode head 7 of the electrode 5, which is fixed to the pinch seal portion 3 having no exhaust tube 11, is held by a plurality of lead wires, for example, two lead wires 901 and 902. In this case, two lead wires 901 and 902 are respectively jointed to both end portions of the electrode head 7 in its width direction.

According to the above-mentioned structure, strength of holding the electrode 5 is improved.

A fifth embodiment will be explained with reference to Fig. 10.

The fifth embodiment shows a fluorescent lamp of d.c. lighting type. In this case, a hot cathode is used as a positive electrode, that is, a coil filament 40, and a cold cathode 30 is used as a negative electrode.

The structure of the cold cathode 30 may be

the same as that of Fig. 2 and the exhaust tube 11 is provided. Lead wires 41 and 42 are connected to both end portions of the coil filament 40 serving as a positive electrode and the lead wires 41 and 42 are airtightly inserted into the pinch seal portion 3.

In the above-mentioned structure, since the number of lead line 8 to be connected to the cold cathode is one, the number of parts can be reduced. Also, since the lead wire 8 and the exhaust tube 11 can be arranged in parallel with each other to be separated at the central line of the bulb along the width direction of the pinch seal portion, the lead wire and the exhaust tube can be surely sealed to the pinch seal portion even if the space of the pinch seal portion is small.

In the present invention, mercury is sealed in the bulb. However, noble gas discharge lamp in which xenon gas (Xe) in place of mercury is sealed may be used. In other words, any lamps may be used if a lamp has a cold cathode.

Moreover, the material of the cold cathode of the present invention may be aluminum, zirconium,tantalum, yttrium, or alloy of these materials, or boride, carbide, or nitride in place of nickel.

Furthermore, the shape of the lamp is not limited to the straight pipe, and an annular or U-shaped curved lamp may be used.

The sectional shape of the light-emitting bulb may be either a circle or an ellipse. Moreover, the other electrode may be an external electrode which is formed in the outer surface of the bulb.

As mentioned above, according to the present invention, since the number of lead wires to be connected to the electrode is one, the number of parts is small. Also, since the lead wire and the exhaust pipe can be arranged in parallel with each other to be separated at the central line of the bulb along the width direction of the pinch seal portion, the lead wire and the exhaust pipe can be surely sealed to the pinch seal portion even if the space of the pinch seal portion is small. Due to this, the generation of leakage can be prevented even if the lamp having a small diameter is used.

Claims

1. A low pressure gas discharge lamp characterized by comprising:

   a light-emitting bulb (1) having a pinch seal portion (2) formed in an end portion of said bulb;

   an exhaust tube (11) airtightly inserted into and arranged at said pinch seal portion;

   a lead wire (8) airtightly inserted into and arranged at said pinch seal portion; and

   a pair of electrodes (4), (5) generating discharge therebetween, one of which is positioned in said bulb and jointed to said one lead wire;

   wherein said tube and said one lead wire are located side by side so that a central axis of said bulb is positioned between said tube and said one lead wire.

2. The low pressure gas discharge lamp according to claim 1, characterized in that said electrode is a cold cathode.

3. The low pressure gas discharge lamp according to claim 2, characterized in that a top end (81) of said lead wire is projected to a discharge space of said bulb berond said cold cathode.

4. The low pressure gas discharge lamp according to claim 2, characterized in that said cold cathode includes a plurality of conductive plates (61), (62) secured to said lead wire at these end portions.

5. The low pressure gas discharge lamp according to claim 2, characterized in that said cold cathode is positioned so that central axis of said electrode is in accord with a central axis of said bulb.

6. A low pressure gas discharge lamp characterized by comprising:

   a light-emitting bulb (4) having pinch seal portions (2), (3) formed in both end portions of said bulb;

   an exhaust tube (11) airtightly inserted into and arranged at one of said pinch seal portions;

   lead wires airtightly inserted into and arranged at said pinch seal portions;

   a pair of electrodes (4), (5) generating discharge therebetween, which are positioned in said bulb and jointed to said lead wires;

   wherein said tube and one of said lead wires are located side by side so that a central axis of said bulb is positioned between said tube and one of said lead wires.

7. The low pressure gas discharge lamp according to claim 1, characterized in that other end portion of said bulb has a plurality of lead wires connected to other of said electrodes.

8. The low pressure gas discharge lamp according to claim 7, characterized in that said electrode, which is connected to a plurality of lead wires inserted into the other pinch seal portion, is a hot cathode.

9. The low pressure gas discharge lamp accord-

ing to claim 1, characterized in that outer diameter of said bulb is not more than 6 mm.

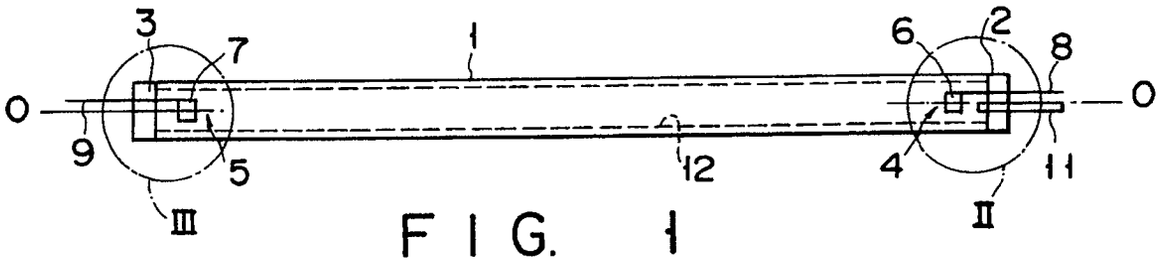

FIG. 1

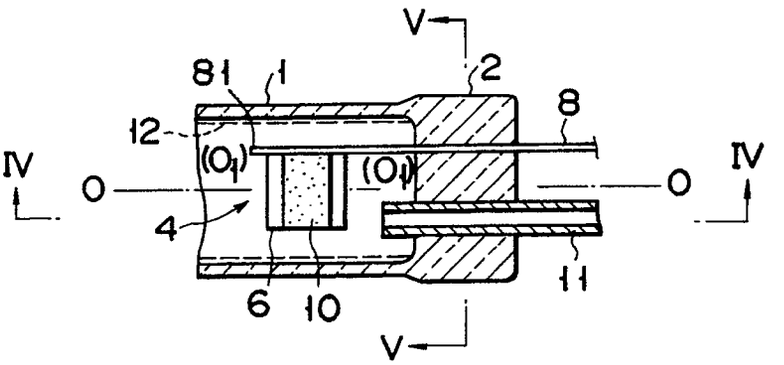

FIG. 2

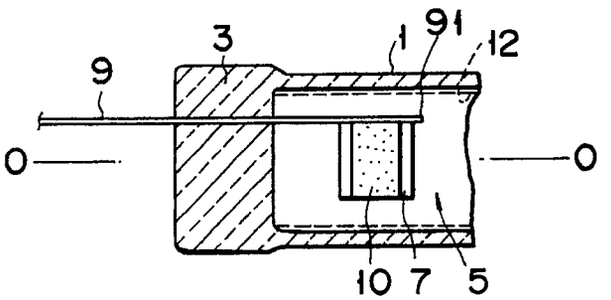

FIG. 3

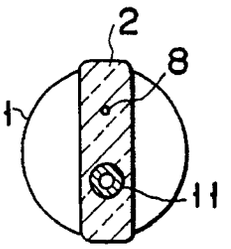

FIG. 5

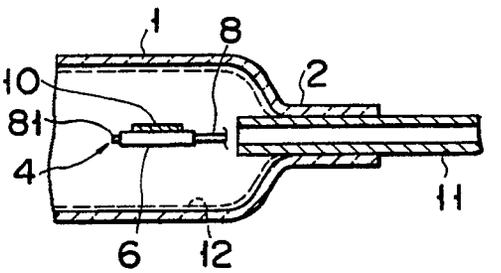

FIG. 4

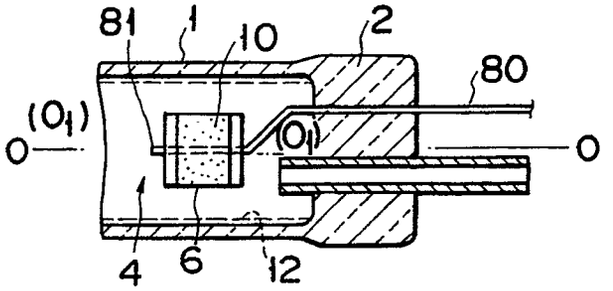

FIG. 6

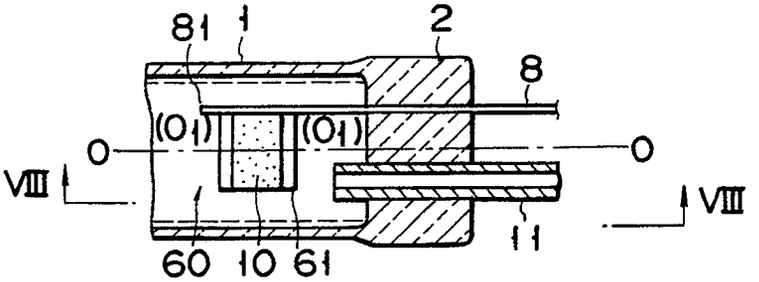

FIG. 7

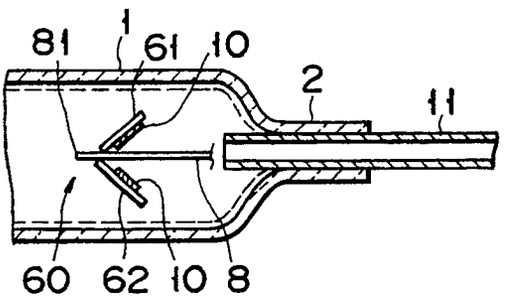

FIG. 8

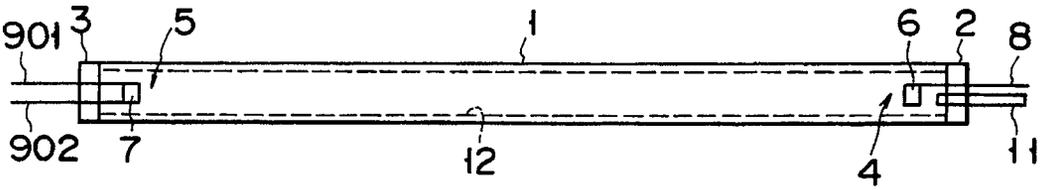

FIG. 9

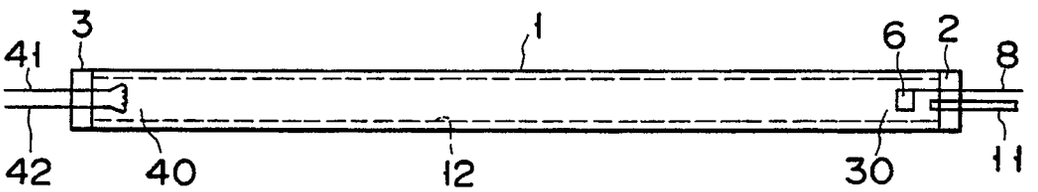

FIG. 10