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(54) **ILLUMINATION UNIT WITH SERPENTINE-SHAPED COLD CATHODE FLUORESCENT LAMP**

BELEUCHTUNGSEINHEIT MIT SERPENTINENFÖRMIGER KALTKATHODEN-FLUORESZENZLAMPE

LAMPE FLUORESCENTE POUR APPLICATIONS D'ECLAIRAGE

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Description

Field of the Invention

[0001] The present invention relates generally to a fluorescent lamp and more particularly, to a fluorescent lamp for lighting.

BACKGROUND OF THE INVENTION

Description of the Prior Art:

[0002] The existing high power tubular fluorescent lamps (FL), e.g., T12, T10, T8, T5 and T4 FL etc. are the hot cathode FL. It has been used for lighting beginning around 1940, and is widely used in the world now. It has the advantages of high efficiency, low cost and able to generate different color light. However, it has a short operating lifetime, and very short ON/OFF switching lifetime. It is also, difficult to control and change the color of light emitted by the hot cathode FL or to change its color temperature.

[0003] The cold cathode fluorescent lamp ("CCFL") has long operating lifetime, very long ON/OFF switching lifetime and high efficiency. It is widely used for LCD backlight, and some claims that the lifetime of CCFLs can be up to 60,000 hours. Cold cathode fluorescent lamp, or CCFL has been used to provide backlight for LCD display for some time. There are basically two types of CCFL backlight: (1) Edge type CCFL backlight;(2) Front type CCFL backlight; The Edge type has been the mainstream design for smaller size LCD backlights, while the Front type has emerged to be the mainstream design for the larger size LCD TV Displays.

[0004] There are three kinds of Front type CCFL backlight. A first type uses a tubular, U shape or serpentine shape CCFL in a housing, such as shown in US Patent 6,793,370 and US Patent Pub. 2006/0023470. A second type uses a flat container containing electrodes and discharge gas to provide a flat light source. A third type uses dividers between two plates to create a serpentine shaped passage with electrodes at the two ends of the passage between the two plates in a vacuum environment to create a flat lighting source, such as shown in US patent 6,765,633. All these three types of devices are used as LCD backlight. There are no controller or suitable outside connector used in conjunction with these designs to enable them to be used as general lighting devices.

[0005] The Edge type CCFL backlight needs relatively big reflector housing to provide uniform output through the whole surface, which is very important for backlight, but not for general lighting. While the other types of CCFL backlight have flat shapes, but their efficacy is relatively low due to short air discharge passage or too much heat generated during discharging. The third Front type CCFL backlight depends on using low melting point glass as building material, which can easily result in costly vacuum leaks so that it is difficult to maintain high vacuum for high CCFL efficacy.

[0006] US2004/0130252 discloses several embodiments of illumination devices, each comprising a single layer of a M-shaped cold cathode fluorescent lamp, each of which is located and supported within a light transmitting container by means of a punched base plate to which it is fixed e.g. by a ceramic adhesive. The spherical front face of the light transmitting container is transparent or diffusing.

[0007] The illumination devices also comprise electrical connector configurations for connecting the illumination devices mechanically and electrically to conventional electrical sockets. The cold cathode fluorescent lamps, the light transmitting containers, the base plate and the electrical connector configuration are mechanically interconnected.

[0008] FR 837795 discloses a tubular discharge device, which can be used instead of a conventional incandescent lamp. In one embodiment, the device comprises a conventional screw base that is connected to a housing. The latter contains e.g. a voltage transformer necessary to operate a discharge tube having cold cathodes. The shape of the discharge tube, which is fixed to the housing is defined to be curved.

[0009] The invention provides a CCFL device as defined in Claim 1.

[0010] A particularly useful and practical CCFL lighting device is provided by employing a serpentine shaped CCFL, a driver driving the CCFL, a connector that allows the device to connect to and receive power form conventional power sockets, and a fixture that connects them into a single device. Such device can be used for general lighting purposes and replaces incandescent and other fluorescent lamps in current use without having to change electrical sockets. A connector is used having a configuration adapted to be electrically and mechanically connected to a conventional electrical socket. The at least one fixture mechanically connecting said at least one CCFL, the driver and the connector to form a unitary mechanical structure. One layer of CCFL means either a complete CCFL or a portion thereof that has a shape that fits into a plate-shaped space.

[0011] When the driver is at an elevated temperature, the operation of the driver will be adversely affected. For example, the elevated temperature may adversely affect the magnetic field in a transformer in the driver and damage electronic components in the driver such as transistors and capacitors. By introducing a thermal insulator such as an air gap between the driver and the CCFL, heat transfer from the CCFL to the driver is inhibited, thereby preserving the integrity of the driver and its components, thereby avoiding shortening the useful life of the driver.

[0012] The driver may be separated from the CCFL by at least an air gap. As noted above, the air gap will preserve the integrity of the driver and its components, thereby avoiding shortening the useful life of the driver. A connector is used having a configuration adapted to be elec-

trically and mechanically connected to a conventional electrical socket. The at least one fixture mechanically connects the CCFL, the driver and the connector to form a unitary mechanical structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The accompanying drawings, which are included to provide further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiments of the invention and together with the description serve to explain the principle of the invention.

[0014] Fig. 1A is a schematic view of a flat fluorescent lamp.

[0015] Fig. 1B is a cross sectional view of the fluorescent lamp of Fig. 1A along the line C-C in Fig. 1A.

[0016] Fig. 2A is a schematic view of a fluorescent lamp.

[0017] Fig. 2B is a cross sectional view along the line E-E in Fig. 2A.

[0018] Fig. 3 is a schematic view of a flat fluorescent lamp.

[0019] Fig. 4 is a schematic view of a flat fluorescent lamp.

[0020] Fig. 5 is a schematic view of a fluorescent lamp.

[0021] Figs. 6 and 7 are schematic views of two more arrangements of CCFL.

[0022] Fig. 8A is a schematic view of the shape of a serpentine shaped CCFL.

[0023] Fig. 8B is a side view of the CCFL of Fig. 8A.

[0024] Fig. 9A is a top view of a serpentine shaped CCFL in a single layer.

[0025] Fig. 9B is a side view of the fluorescent of Fig. 9A.

[0026] Fig. 10A is a top view of a CCFL fluorescent lamp having a serpentine shaped CCFL in two layers to illustrate a first embodiment of the invention.

[0027] Fig.10B is a side view of the fluorescent lamp of Fig. 10A.

[0028] Fig. 11A is a top view of a CCFL fluorescent lamp with a serpentine shaped CCFL in three layers to illustrate another embodiment of the invention.

[0029] Fig. 11B is a side view of the fluorescent lamp of Fig. 11A.

[0030] For simplicity in description, identical components are labeled by the same numerals in this application.

[0031] The examples of Figures 1 to 9 are outside the scope of the invention but are retained as background.

[0032] One example provides a high efficacy, high light output, long lifetime, thin profile with good mechanical strength, dimmable and color adjustable flat light source that can be widely used in general lighting applications. It is based on the recognition that by providing a flat housing design, such that heat can be dissipated easily through air circulation of the CCFL in this housing, or thermal conduction through the CCFL supporting material of this housing, so that CCFL can be operated in this housing at a desirable temperature range of ~70C and heat generated by the CCFL cannot affect its controlling electronics, which is also housed in the vicinity of the CCFL.

[0033] Figs. 1A and 1B are respectively a schematic and cross sectional views of a CCFL device 100 to illustrate one example. Fig. 1B is a cross sectional view of the fluorescent lamp of Fig. 1A along the line C-C in Fig. 1A. As shown in Figs. 1A and 1B, a serpentine shaped CCFL 101 is substantially planar and flat having the overall shape of a rectangular plate. The serpentine shape of CCFL 101 is formed by straight segments of CCFL arranged substantially parallel to one another, with adjacent ends of certain segments connected to form the serpentine shape as shown in Fig. 1A. CCFL 101 is attached to a support plate 2 by means of adhesive 3. The fixture 4 together with support plate 2 form a housing which is not a closed structure for the CCFL 101, but is open on one side, the side opposite to support plate 2. An electrical connector 5 is used to connect driver 7 to power sockets (not shown) for powering the CCFL device 100. Fixture 4 also encloses electrodes 6 of the CCFL 101, driver 7 and connector 5 on one side of the CCFL device 100. Wires 8 connect the driver 7 to electrodes 6 of the CCFL. Driver 7 converts input power such as at 100 to 230 volts and 50 or 60 hertz or DC power at several to few hundred volts to AC power suitable for CCFL operation, such as output AC power at about 5 to 3000 volts and 1 to 800 kilohertz. Preferably driver 7 includes at least a transformer and its supporting components (not shown) for converting a lower voltage to a higher voltage. In one example, driver 7 receives a control signal from a controller (not shown) not a part of device 100 for controlling the operation of device 100. Fixture 4 may comprise a transparent solid or hollow member or body, and is preferably made of a glass, plastic, ceramic or metallic material. Fixture 4 connects the CCFL 101, driver 7, and connector 5 to form a unitary structure, with optional support plate 2.

[0034] Preferably, most of the length of CCFL 101 is exposed to air at least on the side of CCFL 101 opposite to plate 2, so that the heat generated by the CCFL can be easily dissipated. For low power flat fluorescent lamps, since the heat generated by the CCFL is small, in order to maintain the CCFL at a suitable high temperature, the distance between adjacent segments of the CCFL 101, D, may be selected to be small and both sides of the CCFL may have support plates instead of having a single plate 2. In such event, preferably, the distance D is smaller than twice the outside diameter of the segments of CCFL 101. Support plate 2 preferably is transparent or transmits diffuse light. Alternatively, plate 2 may have a light reflective surface, or has lenses and/or prisms. Connector 5 is in a shape suitable for connection to conventional sockets for general lighting.

[0035] Fig. 2A and 2B illustrate yet another example. As shown in Figs. 2A and 2B, device 200 includes a frame

9 so that the CCFL 101 is suspended within frame 9, without a support plate next to the CCFL. In this manner, air currents may pass through the gaps between the segments of the CCFL 101 within frame 9 for carrying away heat generated by the CCFL. Frame 9 may form a unitary structure with fixture 4. Frame 9 is preferably made of glass, plastic, ceramic or metallic material. It can have one or two light outputting windows situated at opposite side. Arrows 11 illustrate two light outputting windows in Fig. 2B. Light outputting windows of frame 9 may have rectangular, circular, square, oval or other geometrical shapes. In other respects, device 200 resembles device 100 of Figs. 1A and 1B.

[0036] Fig. 3 is a schematic view of a CCFL device 300 to illustrate still another example. Different from devices 100 and 200, device 300 includes a CCFL 101 which is formed by two layers of CCFLs, having one whole CCFL or a portion thereof in each layer: idea and 101b. Each of the two CCFLs or CCFL portions may have a shape similar to that of CCFL 101 in devices 100 and 200. When 101a and 101b are portions connected to form a single CCFL 101, this increases the length of the CCFL that fits within the same area or footprint occupied by a single layer CCFL that is only half its length. In this case, CCFL 101 can achieve high power within smaller area size when compared to its single layer counterpart. CCFL 101 may be connected to frame 9 by means of a mechanical connector 3a such as a rivet or silicon type of adhesive means. For heat dissipation, at least one hole 17 is provided in reflector plate 15 that reflects light generated by CCFL 101 towards window along directions such as along arrow 14.

[0037] Alternatively, device 300 may include two different and separate CCFLs 101a and 101b, so that they may be separately controlled to emit different lighting. In one such CCFL device 300, such device comprises at least two CCFLs: at least one with high color temperature phosphor and at least one with low color temperature phosphor, or at least one with low color temperature phosphor and at least one with mixture of green-blue color phosphor. By using one or more drivers to control power supplied to the CCFLs to change the relative light intensities of the light emitted by these CCFL tubes with different phosphors, to obtain different color temperature lights, it is possible to design the device as an adjustable color temperature lamp and/or an adjustable color temperature and dimmable lamp. For example, where three CCFL tubes have red, green and blue phosphors respectively, one or more drivers may be used to control power supplied to the three CCFLs to change the relative light intensities of the light emitted by these CCFL tubes so that the device is a light color variable lamp and/or a light color variable and dimmable lamp.

[0038] Frame 9, which can be opened, or closed at both sides of the planar CCFL(s), CCFL(s) 101, its or their driver 7, reflector plate 15, housing 4, outside electrical connector 16 are connected to form an unitary mechanical structure for general lighting.

[0039] Fig. 4 illustrates another CCFL device 400 for another example. Device 400 differs from device 300 in that the CCFL 101 comprises three portions 101a, 101b and 101c, instead of just two, where each portion is similar to CCFL 101 in devices 100 and 200 and the three portions are connected to form a single CCFL. In this case, it is possible to increase the CCFL length within the original area size of device 100 by three times. Thus a even higher power CCFL lamp than the previous examples can be made.

[0040] Alternatively, device 400 may include three different and separate CCFLs 101a, 101b and 101c, so that they may be separately controlled. In one such CCFL device 400, such device comprises at least two CCFLs with phosphor of different color temperatures, or at least one CCFL with phosphor of low color temperature and one CCFL with phosphor mixture of green-blue phosphors. By using one or more drivers to adjust power supplied to the CCFLs to change the relative light intensities of the light emitted by the CCFLs with different color temperature, one can obtain different color temperatures, thus, it is possible to design the device as an adjustable color temperature lamp and/or an adjustable color temperature and dimmable lamp.

[0041] In addition to using the above CCFL device arrangements 300 and 400 with multiple CCFLs that are separately controlled for general lighting applications, it is also possible to design a CCFL device that generates multicolor (e.g. colors based on the mixture of colors generated by the red, blue and green phosphors) lighting for various applications. For this purpose, two or more CCFLs may be used each having red, green or blue basic color phosphor. A driver circuit converts input electric power to an AC output in the range of about 5 to 400 volts and at a frequency in the range of about 1kc-800kc. At least one high voltage transformer responds to said AC output to cause suitable voltage(s) to be supplied to each of the two or more CCFLs to cause the CCFLs to supply light. In one example, a plurality of CCFL lamp units each having two or more CCFLs are used, each unit equipped with its high voltage transformer(s) that supplies a suitable voltage to the CCFL(s) of such unit. Hence, one or more driver circuits applying AC outputs to the two or more CCFL lamp units may apply AC outputs that are different from one another, so that the two or more CCFL units are individually controlled to emit light of the same or different intensities and produce a mixture light of various colors.

[0042] Frame 9, which can be opened or closed with or without face plates at both sides of the planar CCFL 101, connects the CCFL 101, its driver 7 and its housing 4, its outside electrical connector 18 to form an unitary mechanical structure for general lighting.

[0043] Fig. 5 illustrates another CCFL device 500. Device 500 differs from device 300 in that in the CCFL device 500, driver 7 and fixture 4 are located at the side of reflective plate 15 opposite to that of CCFL(s) 101a and 101b. Cable 19 connects driver 7 to an external power

outlet.

[0044] Figs. 6 and 7 illustrate different arrangements for the CCFL. As shown in Fig. 6, the CCFL 600 may have two portions in two layers separated by a plate 2, to which the two portions are attached by means of silicon type of adhesive 3. Alternatively, there may be two different CCFLs attached to the two sides of plate 2. As shown in Fig. 7, the CCFL 700 may have three portions in three layers separated by plates 2a and 2b, to which the three portions are attached by means of silicon types of adhesive 3. Alternatively, there may be three different CCFLs attached to the two sides of plates 2a and 2b. The plates 2a, 2b can be in the form of a planar structures, with at least one hole for air circulation, or be replaced by an array of transparent rods or strips 2b with spaces 20 in between as shown in Fig. 7 to allow more space for air circulation to dissipate heat. Frame 9 of device 600 can be a closed frame, or with one or both light outputting windows open to air.

[0045] Figs. 8A and 8B illustrate a shape of serpentine CCFL 801 for another example. As shown in Fig. 8A, CCFL 801 is substantially flat and planar, having an overall circular, oblong or elliptical plate like shape. Its two electrodes are bent backwards to maintain an overall circular shape of the CCFL.

[0046] Figs. 9A and 9B illustrate a shape of serpentine CCFL 901 for another example. As shown in Fig. 9A, CCFL 901 is substantially flat and planar, having an overall partially oblong or partially elliptical plate like shape.

[0047] Figs. 10A and 10B are respectively the top and side views of a CCFL device 1000 illustrating a first embodiment of the invention. CCFL device 1000 contains a CCFL 101, which preferably has two portions each having a serpentine shape, and has overall planar flat shapes that resemble plate-like layer structures. The serpentine shape of CCFL 101 comprises straight segments arranged substantially parallel to one another, with adjacent ends of certain segments connected to form the serpentine shape. As shown in Figs. 10B, CCFL 101 is substantially two circular discs stacked on top of each other in overall shape. CCFL lamp 1000 includes two chambers: a first chamber enclosed within an upper housing 32 and second chamber enclosed within a lower housing 33, where the two housings are connected by connectors 34. The chamber defined by housing 32 contains the CCFL 101. The second housing 33 defines a chamber which contains the driver 7.

[0048] The CCFL 101 is attached to a reflector plate 23 on and attached to the upper housing 32 by means of silicon type of adhesive 3. The CCFL 101 is electrically connected to driver 7 by wires 8. Light emitted by the CCFL 101 is transmitted through a light transmitting or transparent plate 24 in window 13. Plate 24 may comprise a transparent, diffused or patterned material. The electrical connector 5 is the conventional connector for the GX53 type of lamp. The connectors 34 are of such dimension that the two chambers in upper and lower housings 32 and 33 are spaced apart by a thermal insulator such as an air gap 25 to reduce heat transfer from the CCFL to the driver 7. Wire 8 passes through holes in the upper and lower housings 32 and 33 to connect the CCFL 101 to driver 7.

[0049] One of the problems encountered in designing a high power fluorescent lamp for replacement of the current high power lamps is that the fluorescent lamp generates an abundance of heat, especially when it is enclosed in a closed chamber. A driver is required to supply the appropriate voltage and currents to the fluorescent lamp causing it to generate light. If the driver that converts low frequency low voltage power to high frequency high voltage power for powering CCFLs is placed in the vicinity of the lamp, the heat generated by the CCFLs may cause the driver components to be at an elevated temperature, which may adversely affect the operation of the driver and shorten the useful life of its components.

[0050] When the driver is at an elevated temperature, the operation of the driver will be adversely affected. For example, the elevated temperature may adversely affect the magnetic field in a transformer in the driver and damage electronic components in the driver such as transistors and capacitors. By introducing a thermal insulator such as an air gap 25 in Fig. 10B between the driver 7 and the CCFL 101, heat transfer from the CCFL to the driver is inhibited, thereby preserving the integrity of the driver and its components and thereby avoiding shortening the useful life of the driver.

[0051] The CCFL 101 in CCFL chamber 32 shown here preferably has two layers, which can be arranged in directions substantially parallel, perpendicular or transverse to each other. The two layers of CCFL can comprise two different and separate CCFLs having same phosphor or phosphor of different color temperatures. By controlling these two CCFLs through driver 7 can produce high power CCFL or high power CCFL with adjustable color temperature capability as described above in reference to Figs.3 and 4.

[0052] The CCFL lamp 1100 of Figs. 11A and 11B contains a CCFL 101 having three portions in three different layers which can have three different configurations: (1) When connected together as a single CCFL with same phosphor, it can make very high power CCFL lamp, but requires high driving voltage; (2) When arranged as three separated CCFLs with same phosphor, it can be connected in parallel and driven by a single controller with substantially lower driving voltage than (1); (3) When arranged as three separated CCFLs with different phosphors, like red, green, and blue phosphors, it can display multiple colors including the most commonly used cold and warm white light for general lighting. The CCFL 101 is housed within a chamber defined by annular reflector 23, and cover 24, which together form a chamber that encloses CCFL 101. Fixture 4 has a top cover so that it together with connector 5 forms a chamber that encloses driver 7. Fixture 4 is mechanically connected to connector 5. The two housing structures 4 and 23 are connected

together by means of connectors 34, so that an air gap 25 is maintained between the two chambers. This air gap will have the same effect as that described above in reference to Figs. 10B in drastically reducing the amount of heat that is transferred from the CCFL to the driver 7. Wire 8 passes through holes in the two housings 4 and 23 to connect the CCFL 101 to driver 7. Optionally, connectors 34 may have holes therein for wires 8 to pass.

[0053] While the invention has been described above by reference to figures 10 and 11, it will be understood that changes and modifications may be made without departing from the scope of the invention, which is to be defined only by the appended claims.

Claims

1. A cold cathode fluorescent lamp device (1000, 1100), comprising:

two layers of CCFL, cold cathode fluorescent lamp (101, 101 a, 101 b, 101 c), the device having either one CCFL which has a portion at each layer, or else a CCFL at each layer, each layer of CCFL having a serpentine shape, said layers being circular dics stacked on top of each other in overall shape;
a driver (7) arranged to supply AC power to the cold cathode fluorescent lamp or lamps to generate light;
a first connector (5) having a configuration adapted to be electrically and mechanically connected to a conventional electrical socket to support and power the device;
a first housing (23, 32) supporting the CCFL;
a second housing (4, 33) supporting the driver (7);
and further connectors (34) connecting the first and second housings so as to form with the first connector (16, 18, 5) a unitary mechanical structure.

2. The device of claim 1, wherein the first and second housings form respective chambers that are spaced apart by an air gap (25).

3. The device of claim 1 or 2, wherein the CCFL is attached to a reflector plate (23) on and attached to the first housing (32) by means of a silicon type of adhesive (3).

4. The device of claim 1, 2 or 3, comprising one CCFL which has a portion at each layer.

5. The device of claim 1, 2 or 3, comprising a CCFL at each layer.

6. The device of claim 5, each CCFL comprising straight segments that are substantially parallel to one another with adjacent ends of certain segments connected to form the serpentine shape.

7. The device of claim 5, the CCFL being driven by the same driver (7).

8. The device of claim 5, the CCFLs comprising different phosphors for emitting light of different colors.

9. The device of any preceding claim, said serpentine shape of each CCFL or of each portion of said CCFL being formed by straight segments arranged substantially parallel to one another, with adjacent ends of certain segments connected together.

10. The device of claim 9, wherein each of the CCFLs or each portion of the one CCFL in two layers comprises straight segments, and the straight segments in the two layers are substantially parallel to one another.

11. The device of claim 9, wherein each of the CCFLs or each portion of the one CCFL in the two layers comprises straight segments, and the straight segments in one of the two layers are transverse to the straight segments in the other layer.

Patentansprüche

1. Kaltkathoden- Fluoreszenzlampenvorrichtung (1000, 1100), die Folgendes umfasst:

zwei Lagen von CCFL, Kaltkathoden-Fluoreszenzlampen (101, 101a, 101b, 101c), wobei die Vorrichtung entweder eine CCFL, die an jeder Lage einen Abschnitt hat, oder aber eine CCFL an jeder Lage hat, hat, wobei jede Lage von CCFL eine schlangenförmige Gestalt hat, wobei die Lagen kreisförmige Scheiben sind, die in einer Gesamtform übereinander gestapelt sind,
einen Treiber (7), der dafür angeordnet ist, der Kaltkathoden-Fluoreszenzlampe oder den -lampen Wechselstromenergie zuzuführen, um Licht zu erzeugen,
einen ersten Verbinder (5), der eine Konfiguration hat, die dafür eingerichtet ist, elektrisch und mechanisch mit einer herkömmlichen elektrischen Fassung verbunden zu werden, um die Vorrichtung zu tragen und zu speisen,
ein erstes Gehäuse (23, 32), das die CCFL trägt,
ein zweites Gehäuse (4, 33), das den Treiber (7) trägt,
und weitere Verbinder (34), um das erste und das zweite Gehäuse so zu verbinden, dass sie mit dem ersten Verbinder (16, 18, 5) eine einheitliche mechanische Struktur bilden.

2. Vorrichtung nach Anspruch 1, wobei das erste und das zweite Gehäuse jeweilige Kammern bilden, die durch einen Luftspalt (25) voneinander getrennt sind.

3. Vorrichtung nach Anspruch 1 oder 2, wobei die CCFL an einer Reflektorplatte (23), auf dem ersten Gehäuse (32) und mit Hilfe eines silikonartigen Klebstoffs an demselben befestigt, befestigt ist.

4. Vorrichtung nach Anspruch 1, 2 oder 3, die eine CCFL umfasst, die an jeder Lage einen Abschnitt hat.

5. Vorrichtung nach Anspruch 1, 2 oder 3, die eine CCFL an jeder Lage umfasst.

6. Vorrichtung nach Anspruch 5, wobei jede CCFL gerade Segmente umfasst, die im Wesentlichen parallel zueinander sind, wobei die benachbarten Enden bestimmter Segmente verbunden sind, um die sclilangenförmige Gestalt zu formen.

7. Vorrichtung nach Anspruch 5, wobei die CCFL durch den gleichen Treiber (7) angesteuert werden.

8. Vorrichtung nach Anspruch 5, wobei die CCFLs unterschiedliche Leuchtstoffe umfassen, um Licht mit unterschiedlichen Farben auszustrahlen.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die schlangenförmige Gestalt jeder CCFL oder jedes Abschnitts der CCFL geformt wird durch gerade Segmente, die im Wesentlichen parallel zueinander angeordnet sind, wobei die benachbarten Enden bestimmter Segmente miteinander verbunden sind.

10. Vorrichtung nach Anspruch 9, wobei jede der CCFLs oder jeder Abschnitt der einen CCFL in den zwei Lagen gerade Segmente umfasst und die geraden Segmente in den zwei Lagen im Wesentlichen parallel zueinander sind.

11. Vorrichtung nach Anspruch 9, wobei jede der CCFLs oder jeder Abschnitt der einen CCFL in den zwei Lagen gerade Segmente umfasst und die geraden Segmente in der einen der zwei Lagen quer zu den geraden Segmente in der anderen Lage sind.

Revendications

1. Dispositif de lampe fluorescente à cathode froide (1000, 1100), comprenant :

deux couches de CCFL, lampe fluorescente à cathode froide (101, 101a, 101b, 101c), le dispositif comportant une CCFL comportant une partie de chaque couche, ou une CCFL au niveau de chaque couche, chaque couche de CCFL ayant une forme en serpentin, lesdites couches étant constituées, dans leur forme globale, par des disques circulaires empilés les uns sur les autres ;
un dispositif de commande (7), destiné à alimenter la lampe ou les lampes fluorescentes à cathode froide en courant alternatif pour produire de la lumière ;
un premier connecteur (5), ayant une configuration adaptée pour être connecté électriquement et mécaniquement à une douille électrique conventionnelle pour supporter et alimenter le dispositif ;
un premier boîtier (23, 32) supportant les CCFL ;
un deuxième boîtier (4, 33), supportant le dispositif d'entraînement (7) ;
et des connecteurs additionnels (34), connectant les premier et deuxième boîtiers, de sorte à former avec le premier connecteur (16, 18, 5) une structure mécanique unitaire.

2. Dispositif selon la revendication 1. dans lequel les premier et deuxième boîtiers forment des chambres respectives espacées par une lame d'air (25).

3. Dispositif selon les revendications 1 ou 2, dans lequel la CCFL est fixée sur une plaque de déflexion (23) agencée sur le premier boîtier (32) et fixée sur celui-ci par un adhésif du type silicone (3).

4. Dispositif selon les revendications 1, 2 ou 3, comprenant une CCFL comportant une partie au niveau de chaque couche.

5. Dispositif selon les revendications 1, 2 ou 3, comprenant une CCFL au niveau de chaque couche.

6. Dispositif selon la revendication 5, comprenant des segments droits pratiquement parallèles les uns aux autres, les extrémités adjacentes de certains segments étant connectées pour établir une forme en serpentin.

7. Dispositif selon la revendication 5, la CCFL étant entraînée par le même dispositif de commande (7).

8. Dispositif selon la revendication 5, les CCFL comprenant des phosphores différents pour émettre de la lumière de couleurs différentes.

9. Dispositif selon l'une quelconque des revendications précédentes, ladite forme en serpentin de chaque CCFL ou de chaque partie de ladite CCFL étant formée par des segments doits agencés de manière pratiquement parallèle les uns aux autres, les extrémités adjacentes de certains segments étant con-

nectées les unes aux autres.

10. Dispositif selon la revendication 9, dans lequel chacune des CCFL ou chaque partie d'une CCFL dans deux couches comprend des segments droits, les segments droits dans les deux couches étant pratiquement parallèles les uns aux autres.

11. Dispositif selon la revendication 9, dans lequel chacune des CCFL ou chaque partie d'une CCFL dans les deux couches comprend des segments droits, les segments droits dans l'une des deux couches étant transversaux aux segments droits dans l'autre couche.

Fig. 1A

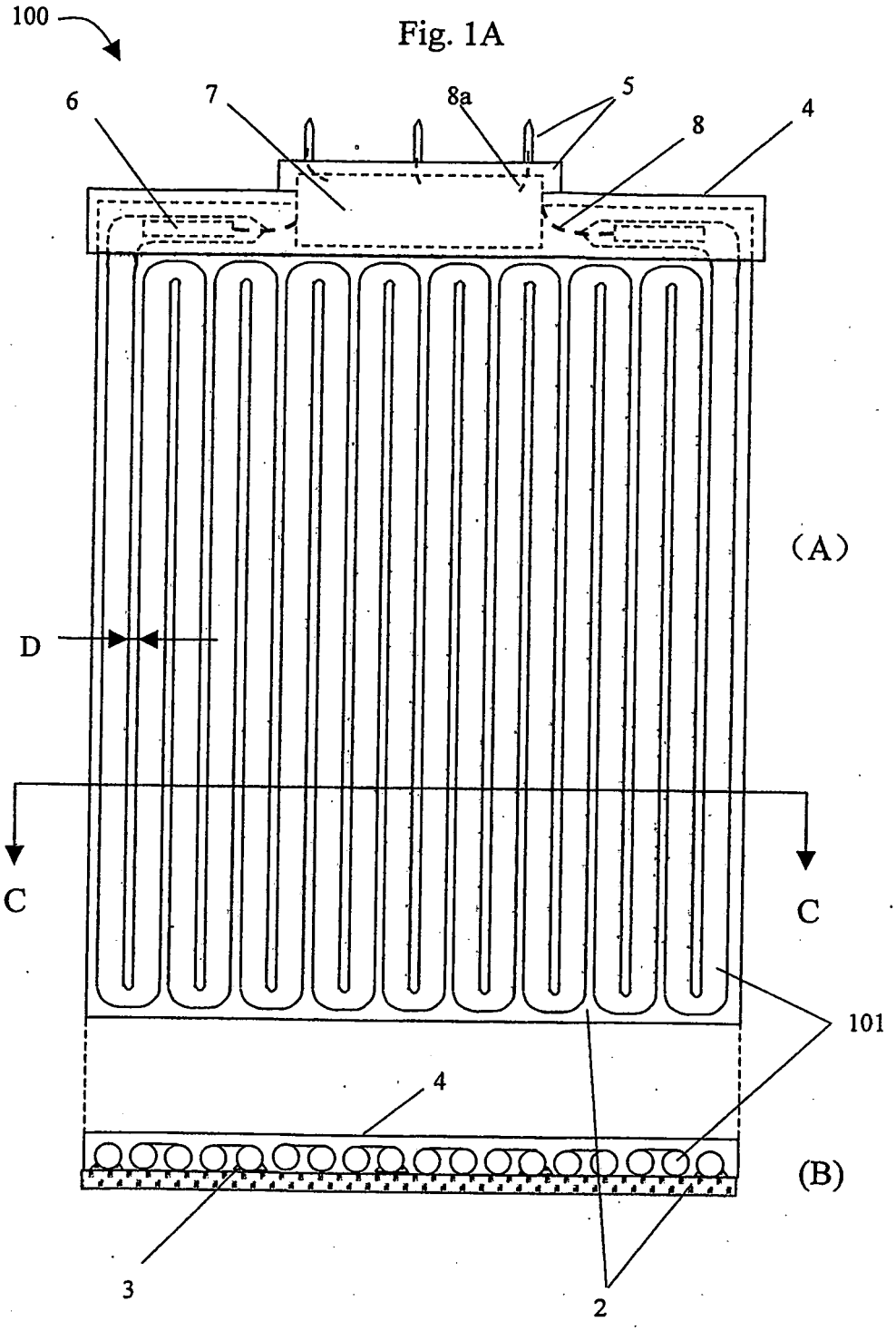


Fig. 1B

Fig. 2A

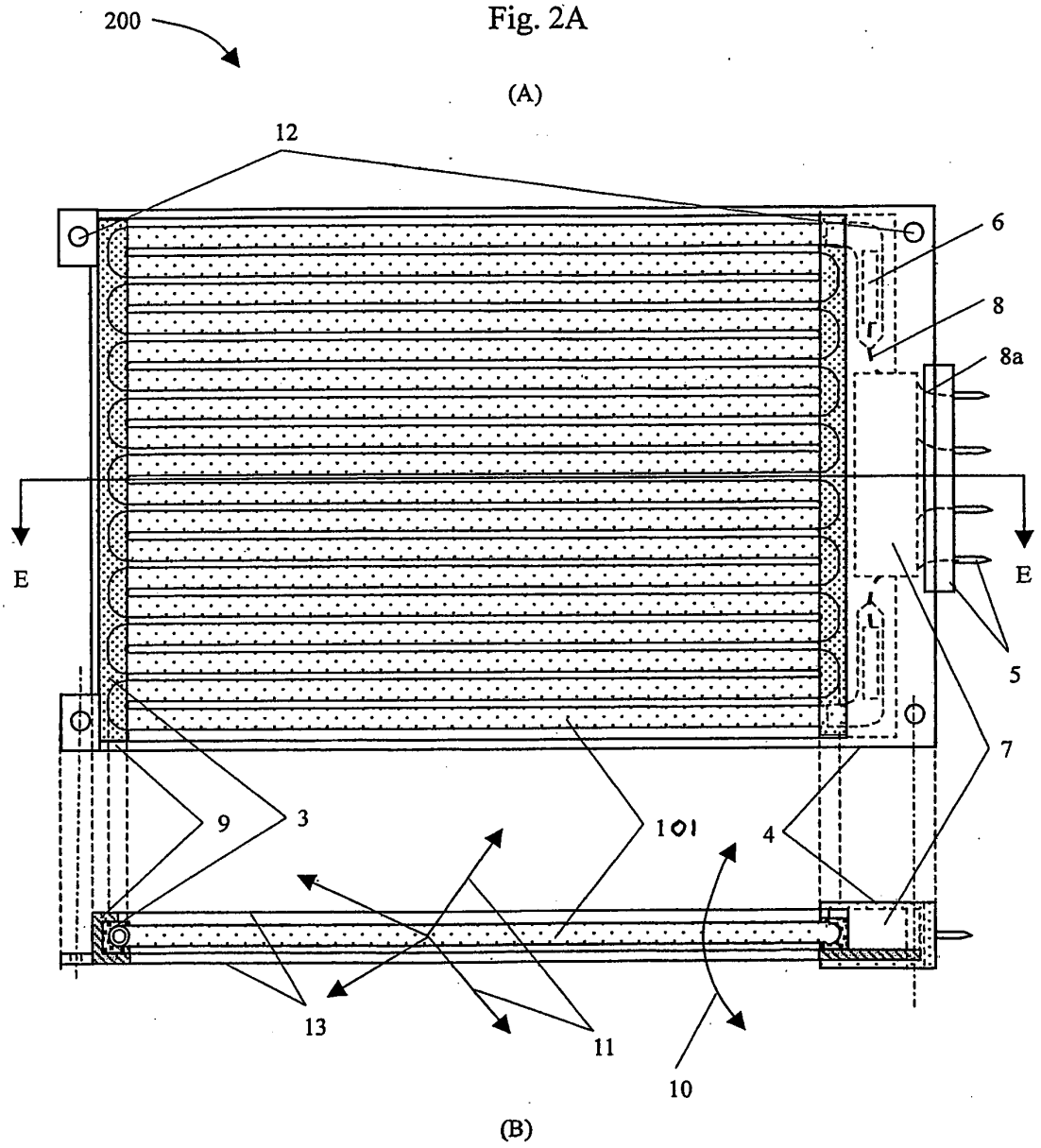


Fig. 2B

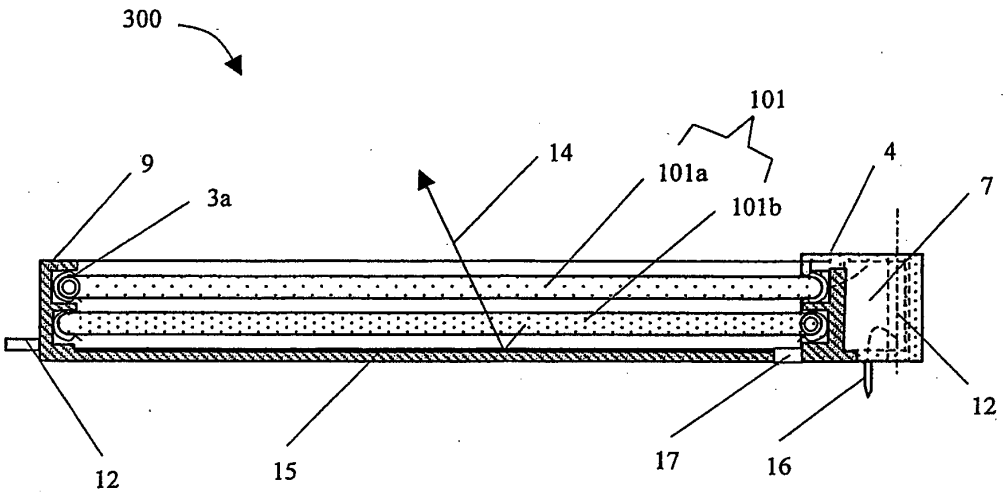

300
101
9
3a
14
101a
101b
4
7
12
12
15
17
16

Fig. 3

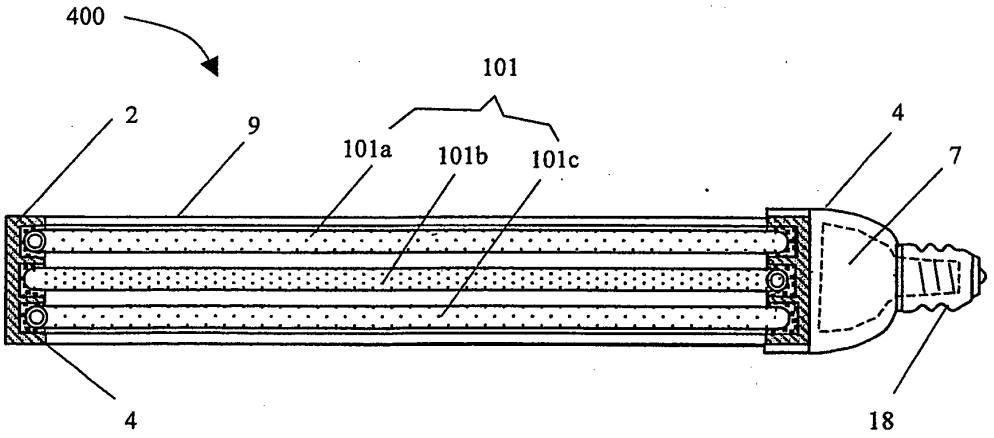

400
101
2
9
101a
101b
101c
4
7
4
18

Fig. 4

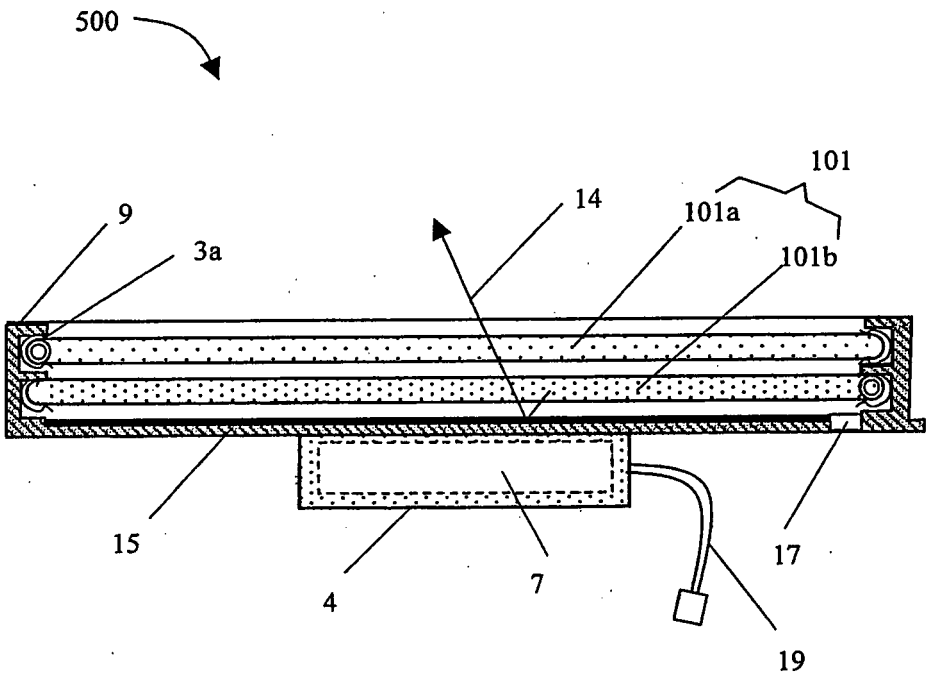


Fig. 5

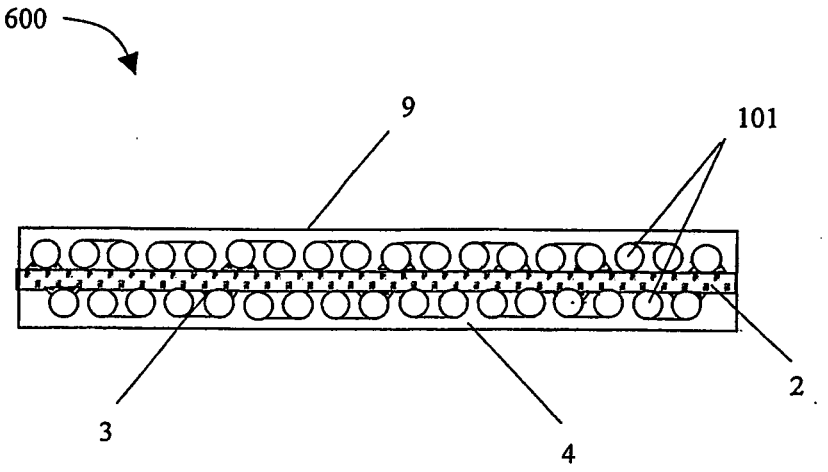


Fig. 6

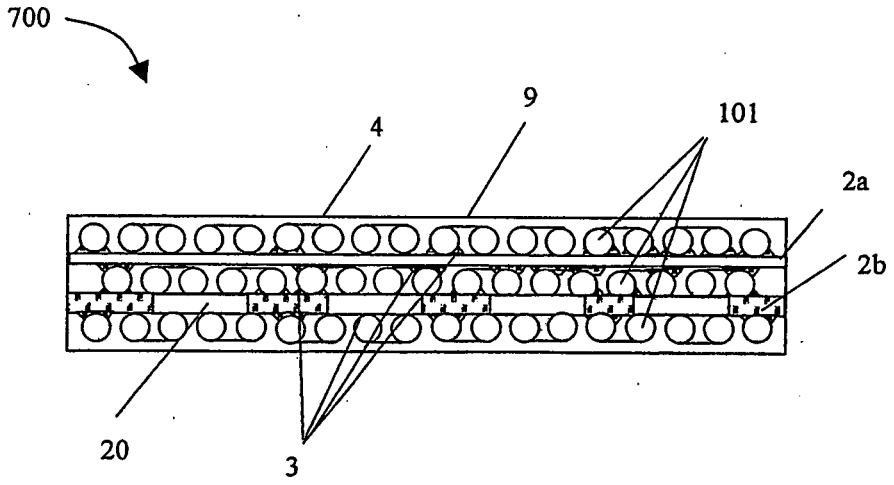


Fig. 7

Fig. 8A

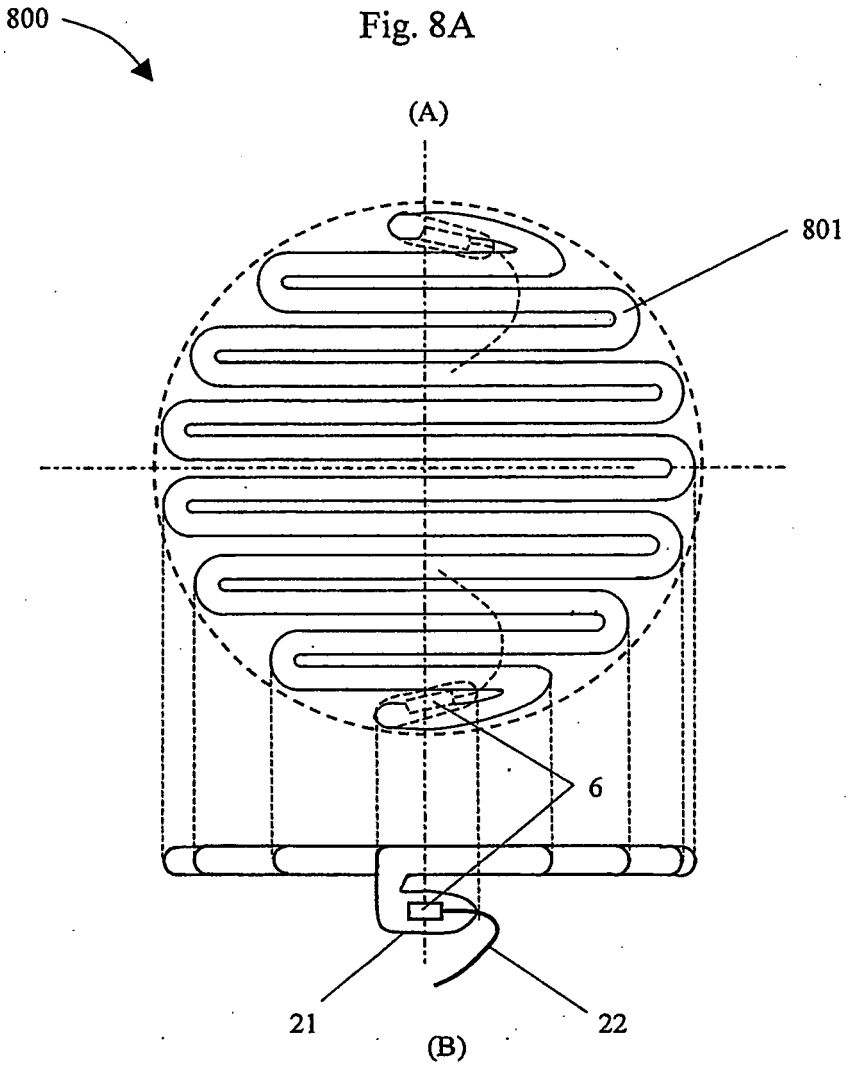


Fig. 8B

Fig. 9A

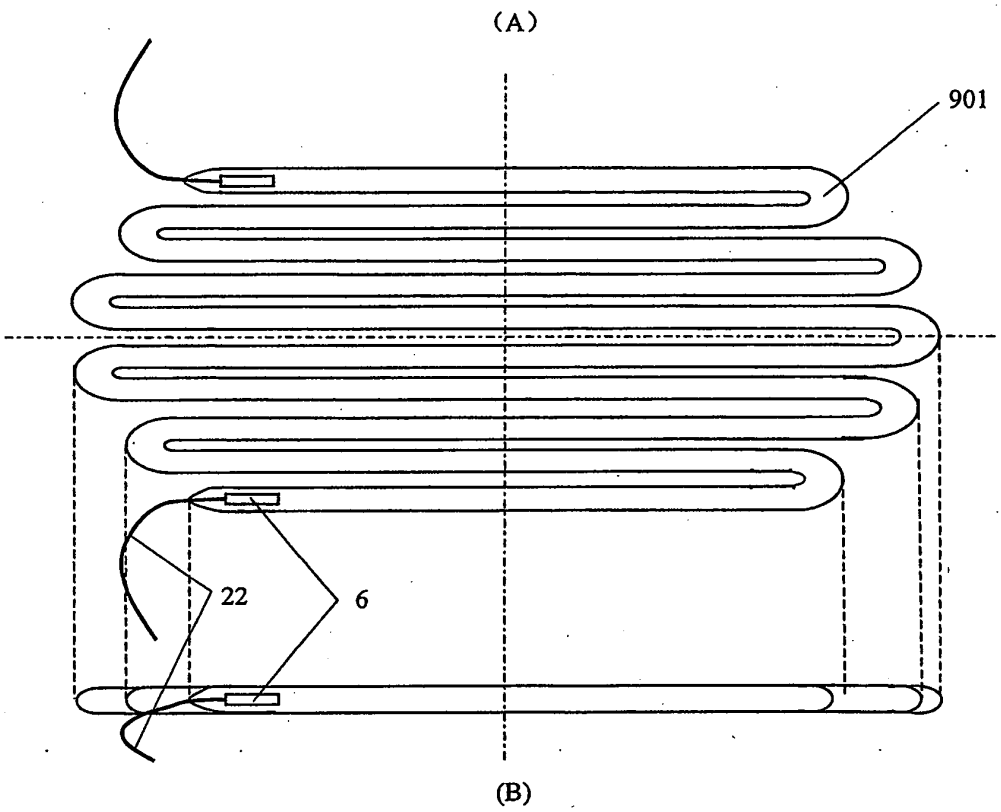
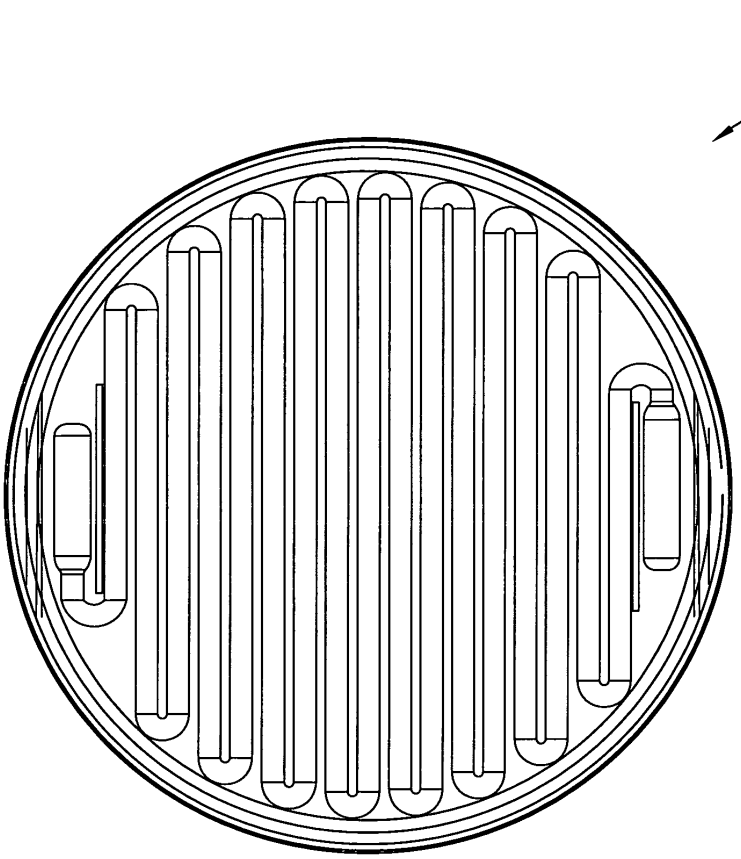


Fig. 9B

Fig 10A



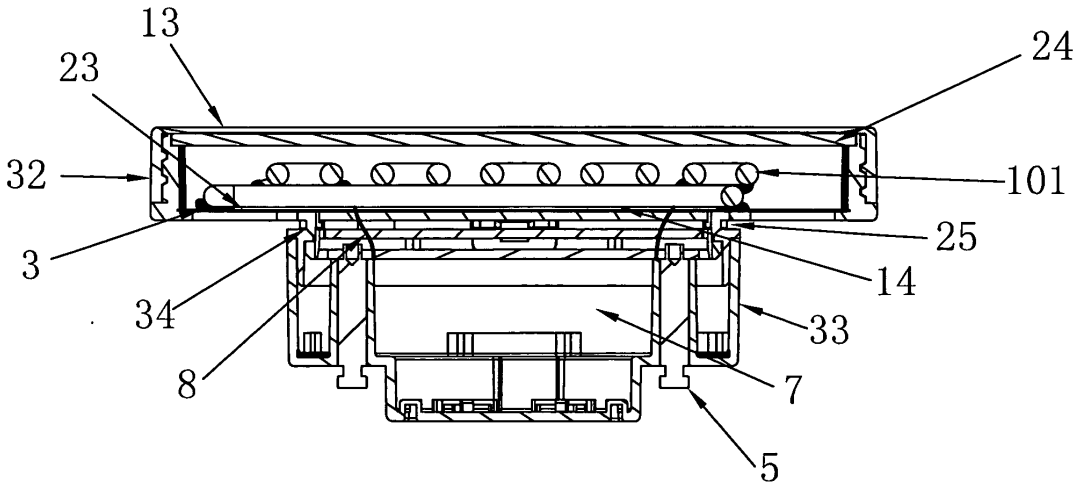
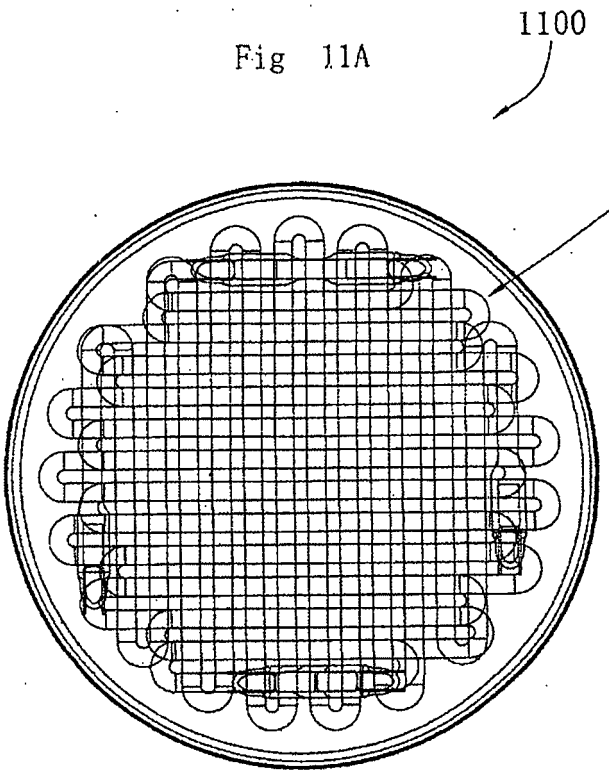


Fig 10B

Fig 11A



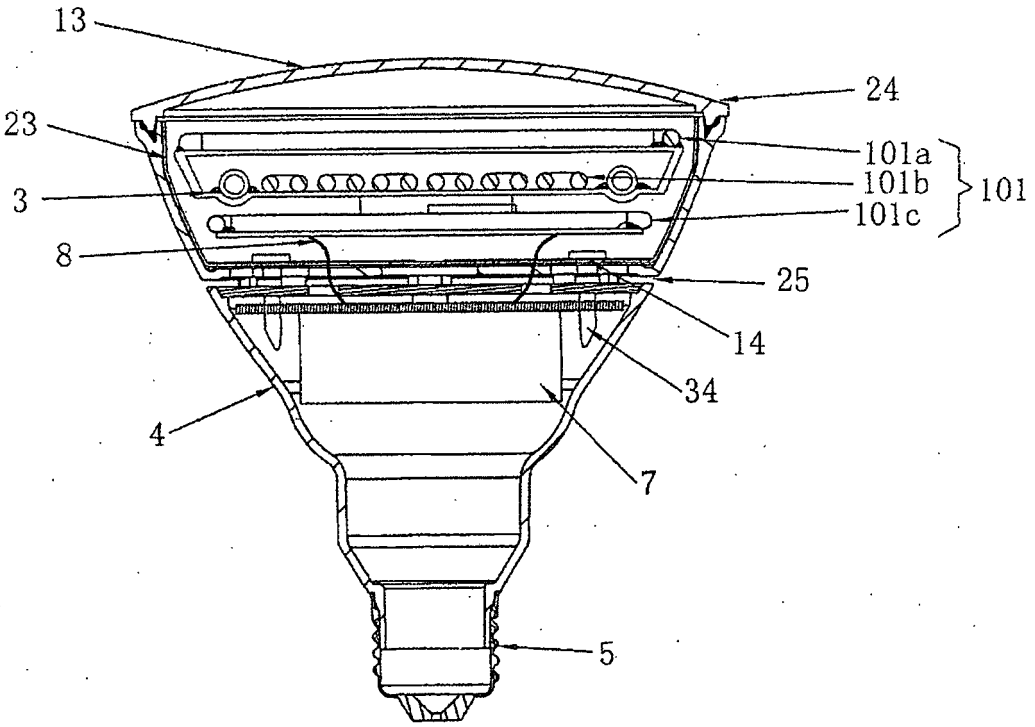


Fig 11B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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