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(54) **LIGHT EMITTING DIODE AND METHOD FOR PRODUCING IT**

(75) Inventor: **Hidemoto Uekusa**, Chiba (JP)

Correspondence Address:
BROWDY AND NEIMARK, P.L.L.C.
624 NINTH STREET, NW
SUITE 300
WASHINGTON, DC 20001-5303 (US)

(73) Assignee: **CITIZEN ELECTRONICS CO., LTD.**, Yamanashi (JP)

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(57) **ABSTRACT**

A light emitting diode is composed of a generally T-shaped body section **(36)** and a resin forming section **(37)** projected on a front surface of the body section **(36)**. The body section **(36)** has an upright portion **(32)** inserted into a hole **(51)** provided in a motherboard **(50)** and base portions (**31*a*** and **31*b***) which extend from the upright portion and which are mounted on a peripheral edge of the hole **(51)**. The resin forming section **(37)** includes a non-translucent frame **(40)** extending from a front surface of the upright portion **(32)** and an extension part **(41)** further projecting forwardly larger than the frame. The extension part **(41)** has a mounted portion **(42)** mounted on the peripheral edge of the hole **(51)** of the motherboard **(50)**. Mounted in the concave portion **(44)** provided in the frame **(40)** is a light emitting diode element **(34)**, which is sealed by a sealing body **(45)** of a translucent resin.

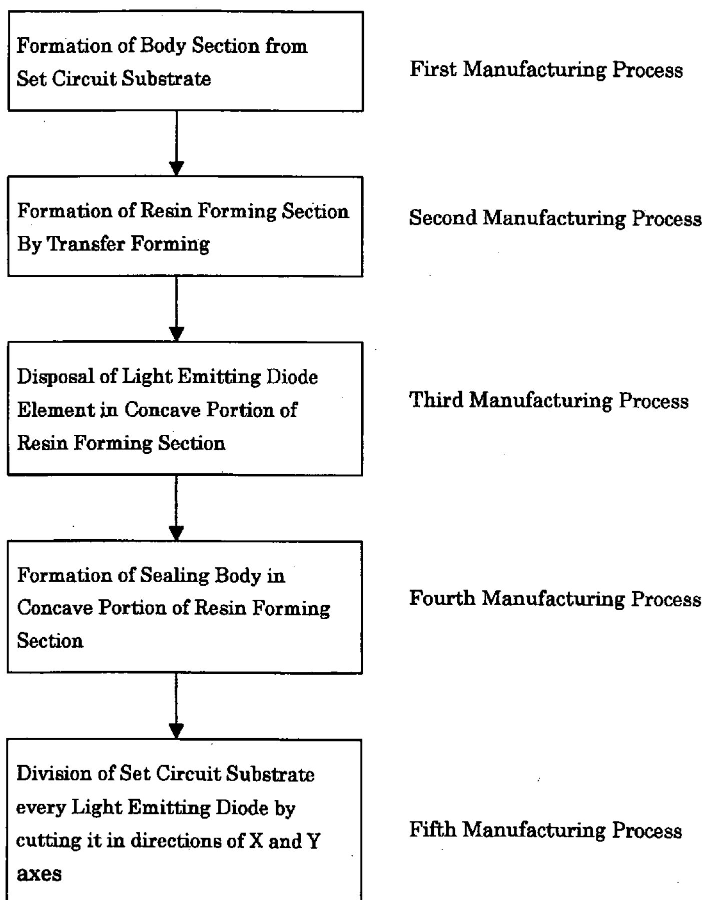


Fig. 1

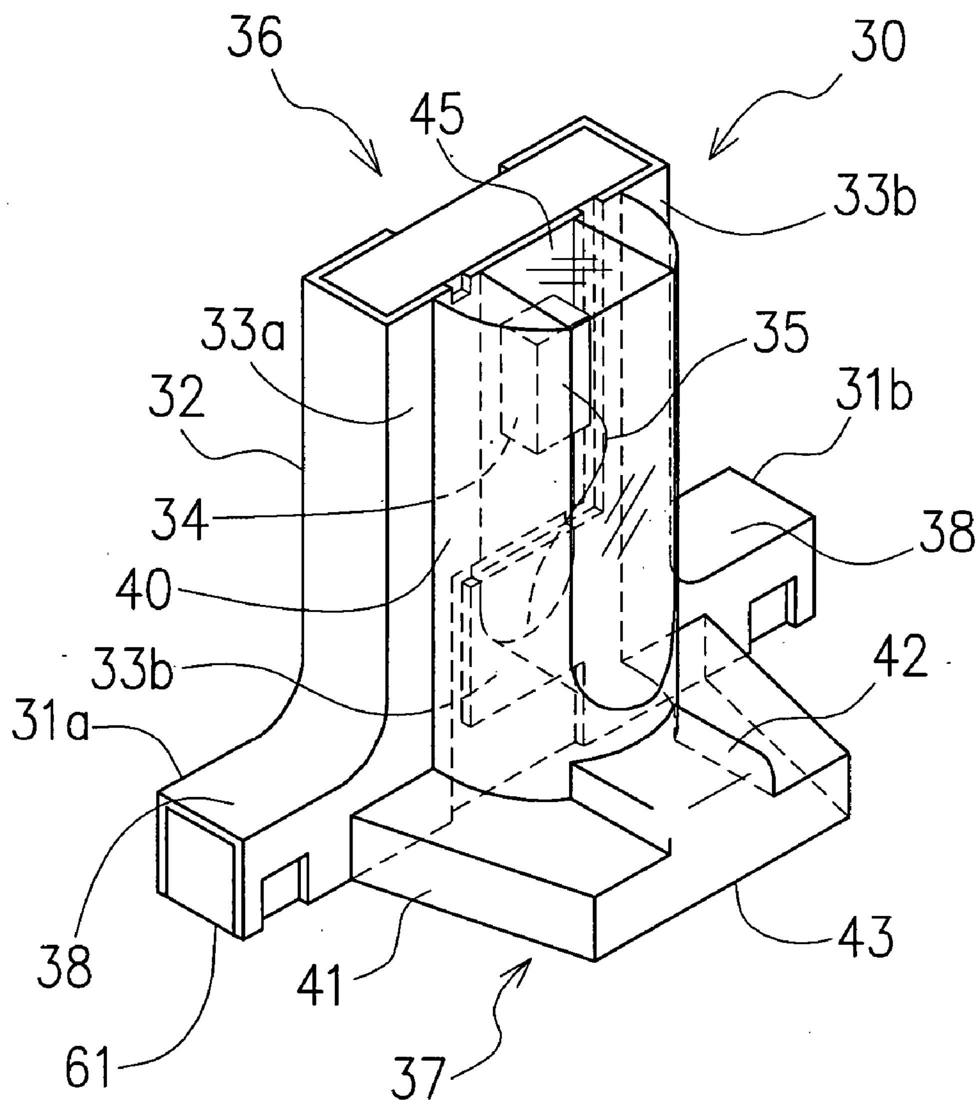


Fig. 2

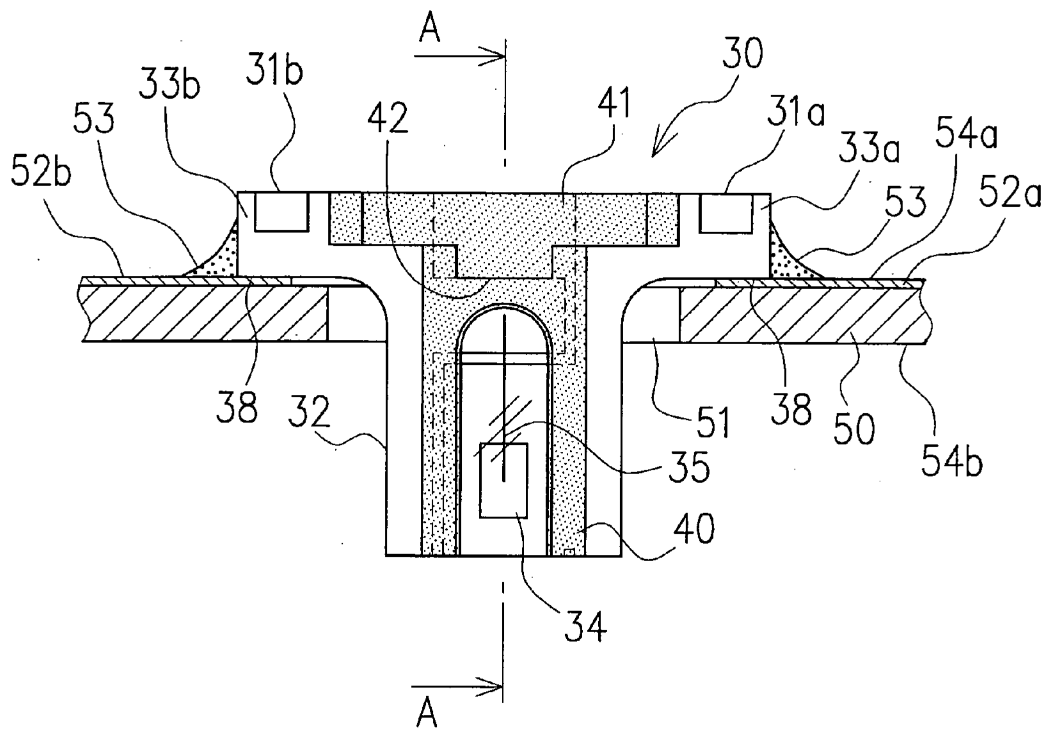


Fig. 3

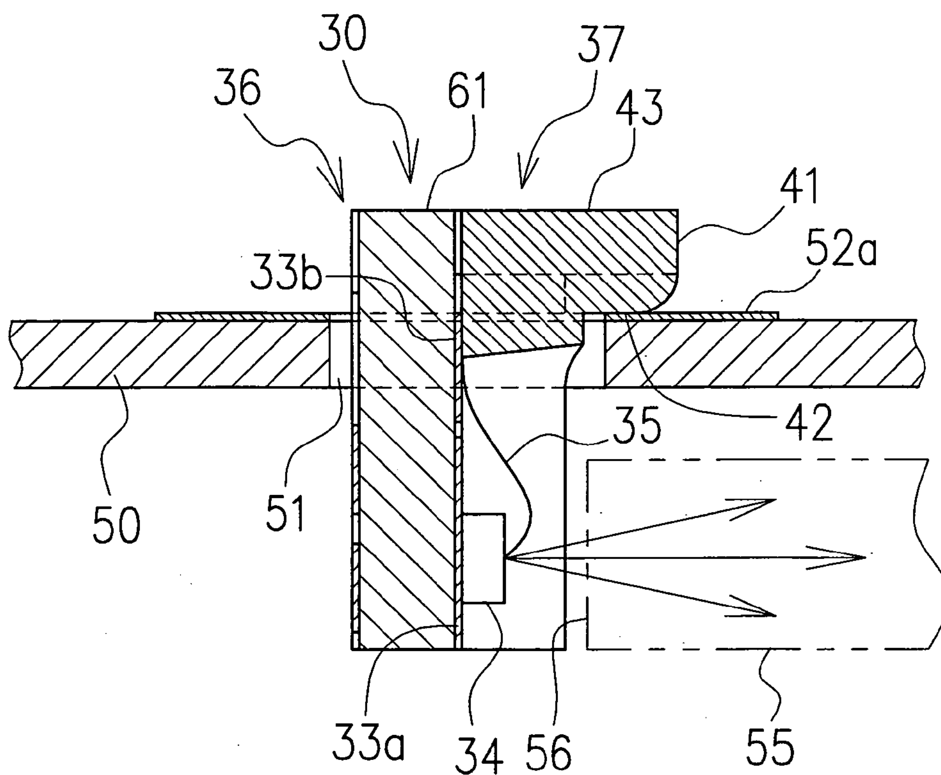


Fig. 4

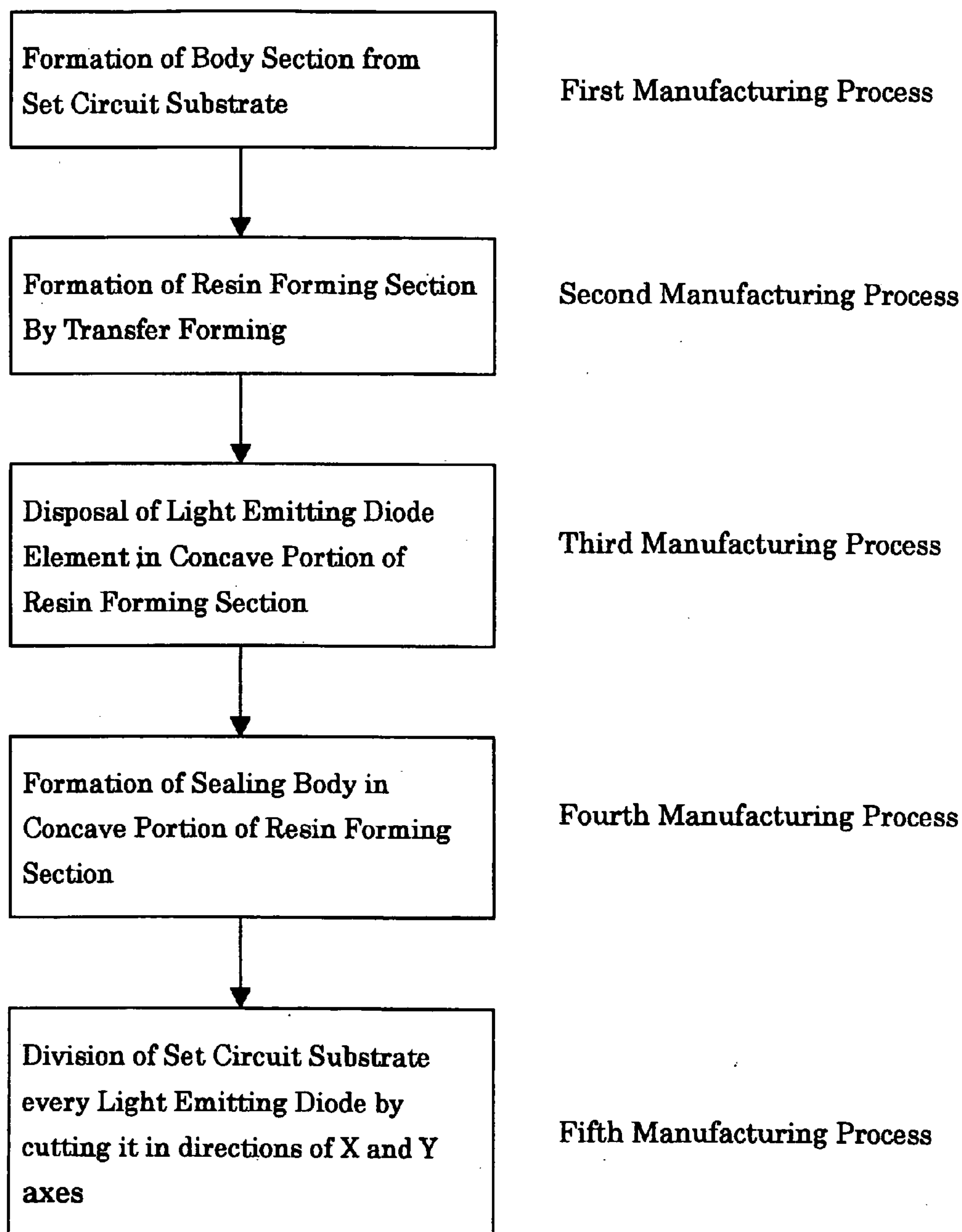


Fig. 5

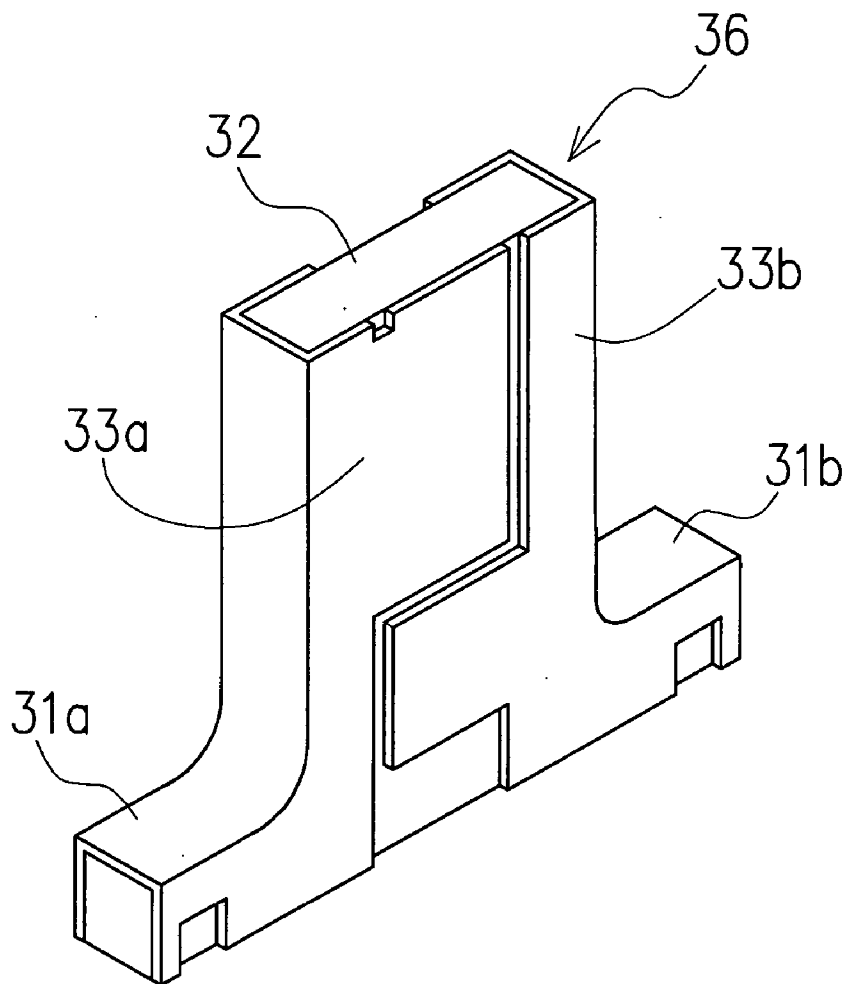


Fig. 6

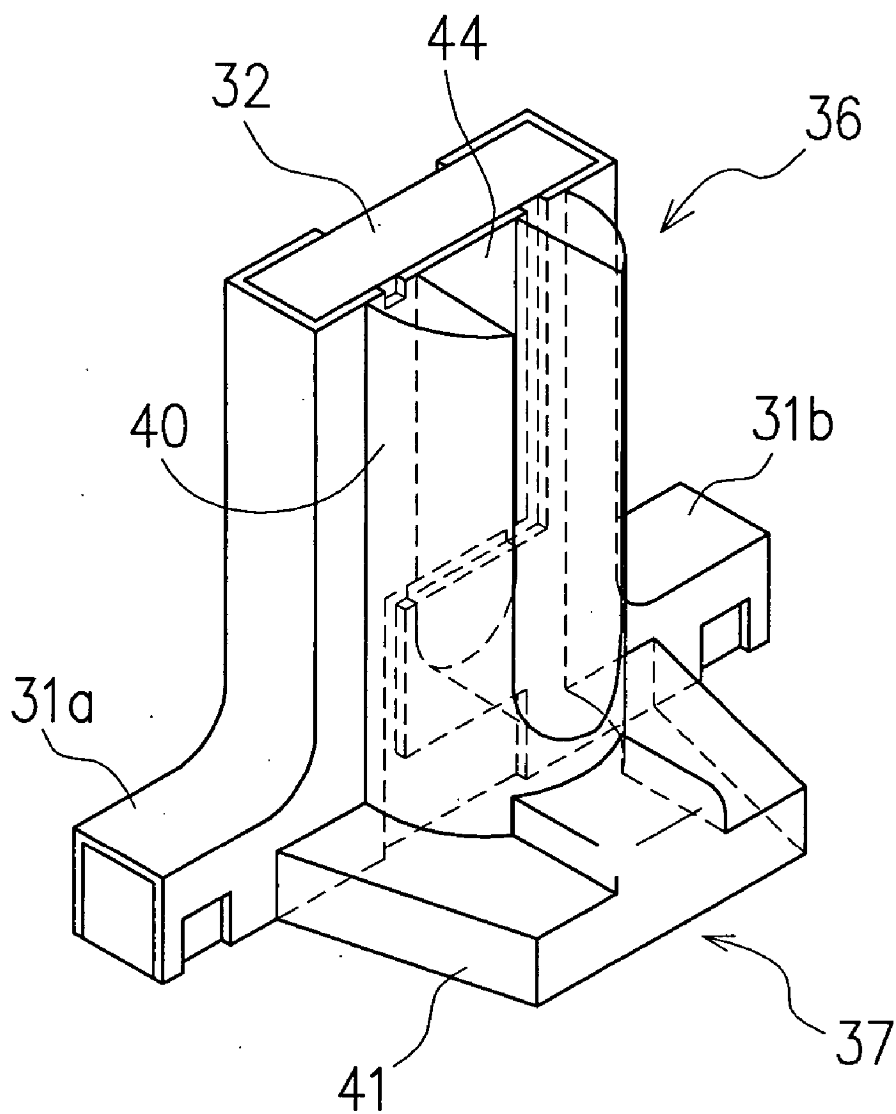


Fig. 7

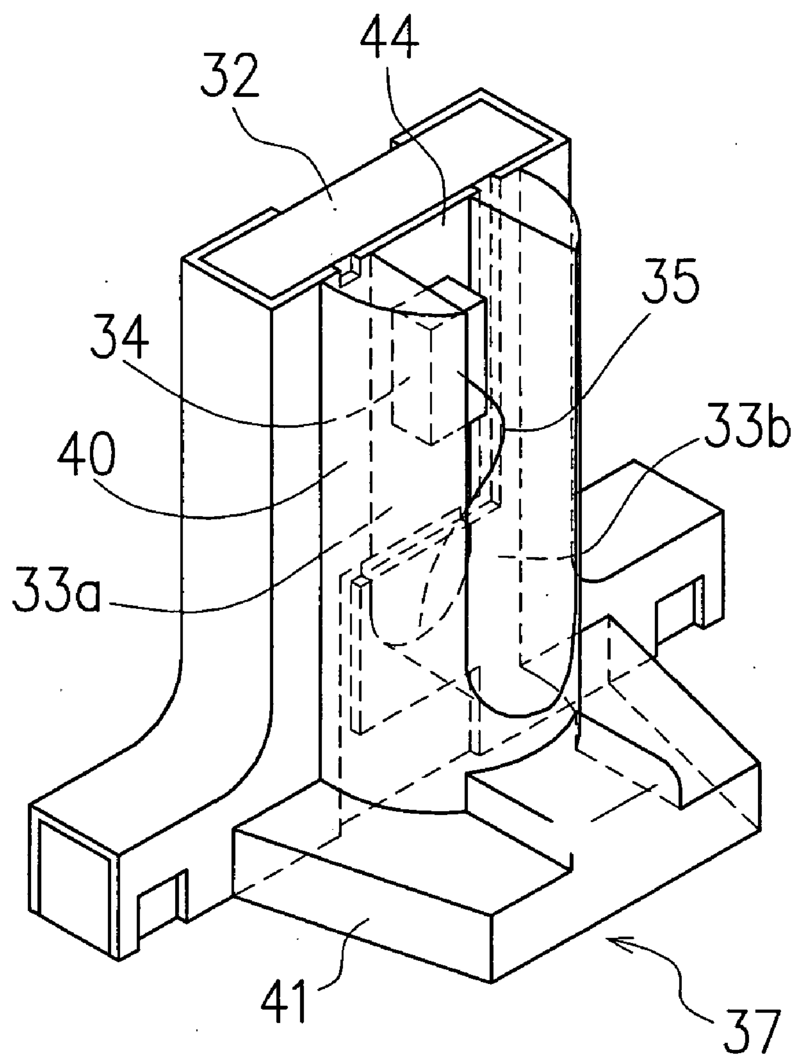


Fig. 8

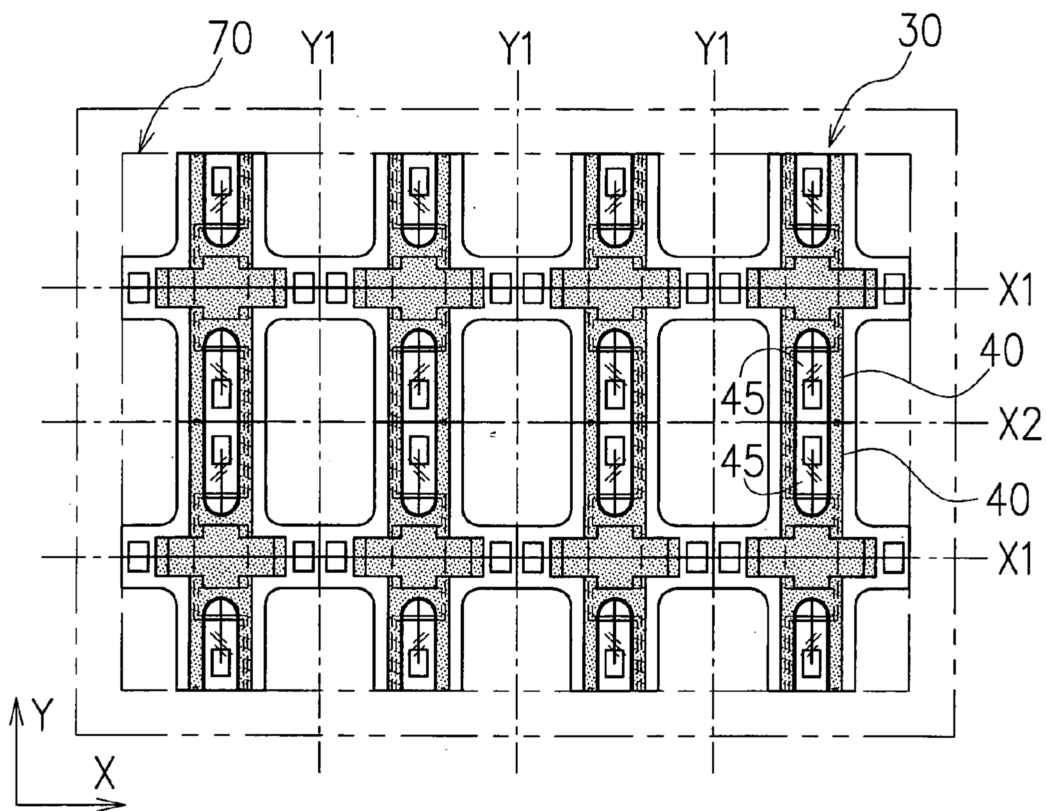


Fig. 9
(Prior Art)

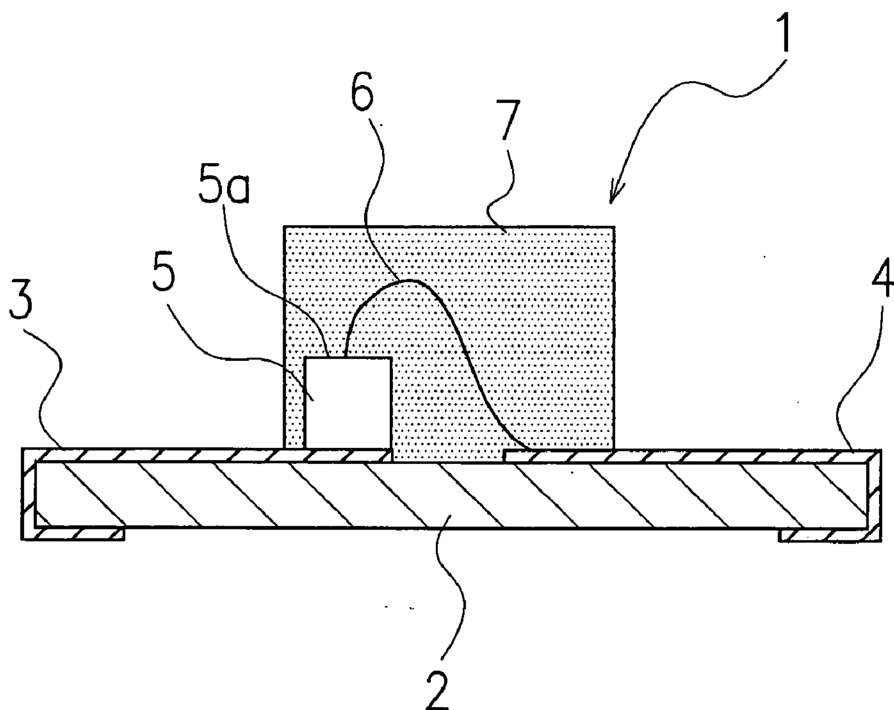


Fig. 10
(Prior Art)

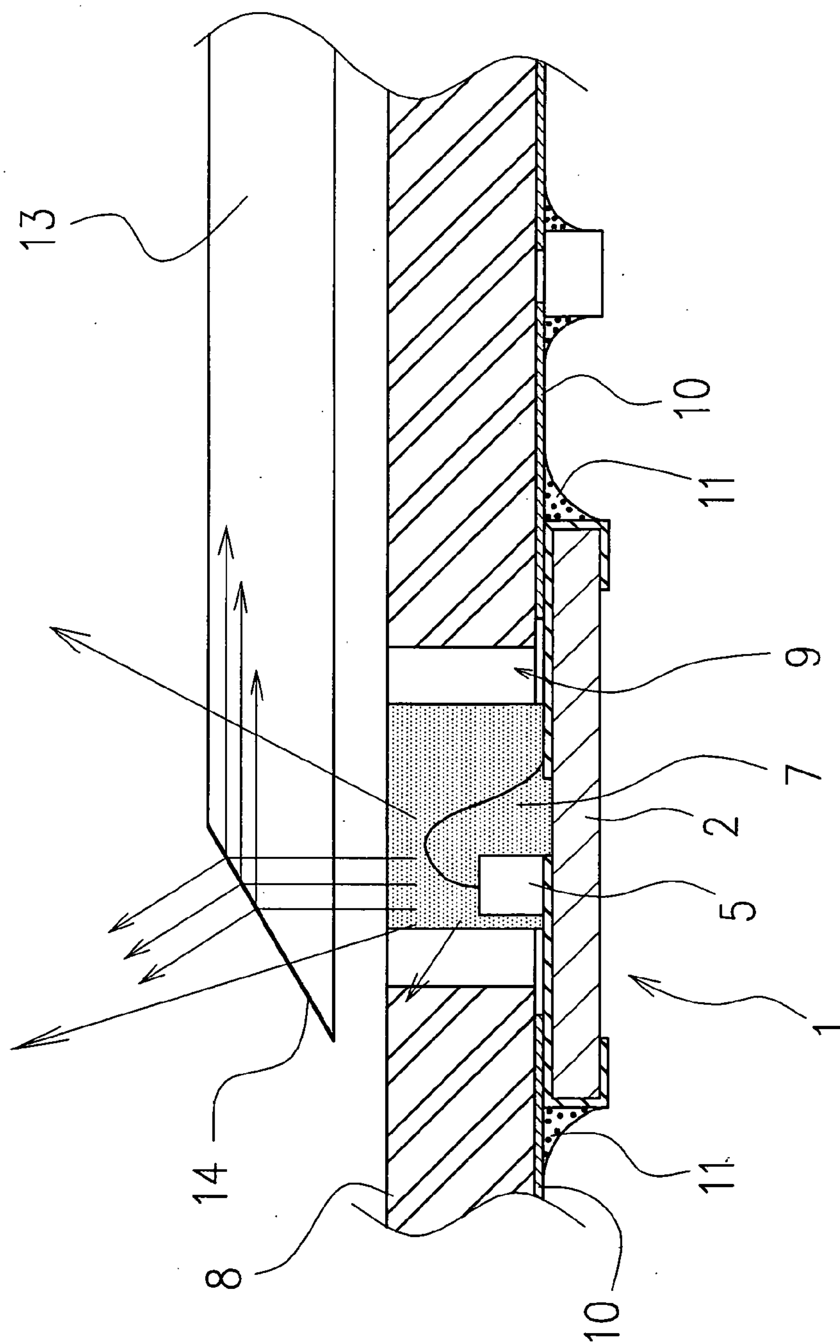
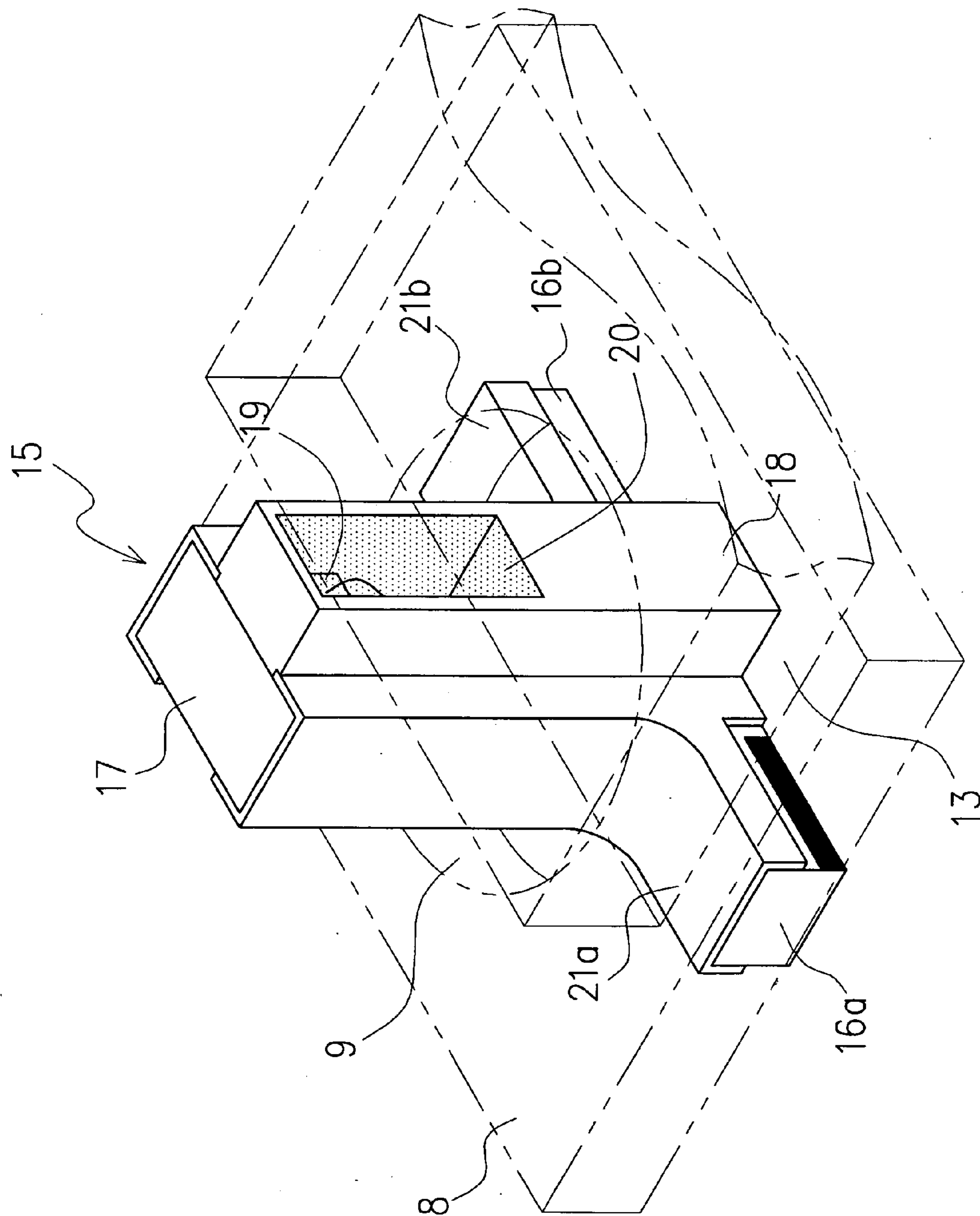


Fig. 11
(Prior Art)



LIGHT EMITTING DIODE AND METHOD FOR PRODUCING IT

[0001] This is a division of copending parent application Ser. No. 10/706,284, filed Nov. 13, 2003.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a light emitting diode and a method for producing the same, particularly, to a light emitting diode suitable for side luminescence.

[0004] 2. Description of the Prior Art

[0005] Conventionally, a large number of light emitting diodes of surface or plane mounting type have been used for portable phones and the other small electrical instruments, one typical configuration thereof is known in general, as shown in **FIG. 9**, for example.

[0006] The light emitting diode **1** has a structure in which a pair of substrate electrodes **3** and **4** is patterned on an upper surface of a glass epoxy substrate **2**, a light emitting diode element **5** is fixed on one electrode **3** by means of a conductive adhesive (not shown) and an upper electrode **5***a* of the light emitting diode element **5** and the other electrode **4** are connected by a bonding wire **6**, and the light emitting diode element **5** is sealed by a sealing body **7** formed from a transparent epoxy resin.

[0007] The aforementioned light emitting diode **1** is generally mounted on a surface of a motherboard **8** (see **FIG. 10**) and is often formed to emit light upward.

[0008] In recent, the light emitting diode is often used as a light source of a backlight for illuminating a screen of a liquid crystal display of a portable phone, for example.

[0009] In this case, the light emitting diode **1** is inserted into a hole **9** provided in the motherboard **8**, from a side of a back surface of the motherboard and then the substrate electrodes **3** and **4** of the light emitting diode **1** are fixed on a print wiring **10** provided on the back surface of the motherboard **8** by a solder **11** to reflect perpendicularly light emitted upwardly from the light emitting diode **1** on a inclined end surface **14** of an optical wave-guide **13** which is disposed above of the motherboard **8** and to guide the reflected light into the optical wave-guide **13**.

[0010] However, in such a method as to use the reflected light, there is a possibility of generating a loss of light, and further it is necessary to carry out a micro-adjustment of an reflected angle of light illuminated from the light emitting diode element **5** and an angle of the inclined end surface **14**, because the optical wave-guide **13** is thinned.

[0011] Under the circumstances, the Applicant in the present application has proposed a light emitting diode of a generally T-character shape as shown in **FIG. 11**, as a light emitting diode of a side luminescence type to coincide an illuminated direction of light from the light emitting diode with an entered direction of light into the optical wave-guide (see Japanese Patent Laid-Open No. 2002-164583).

[0012] The light emitting diode **15** includes a upright section **17**, base sections **16***a* and **16***b* extending rightward and leftward from the upright section **17**, and a protrusion **18** projecting from a front surface of the upright section **17**. The protrusion **18** is formed with a concave portion in which a light emitting diode element **19** is disposed.

[0013] The light emitting diode element **19** is sealed by a sealing body **20** which is formed by a transparent resin filled into the concave portion.

[0014] The light emitting diode **15** structured as described above is mounted on the motherboard **8** in such a manner that the light emitting diode **15** is inserted into the hole **9** of the motherboard **8** from the back surface of the motherboard **8** and then upper surfaces of the base sections **16***a* and **16***b* are disposed upon the motherboard at two positions on a peripheral edge of the hole **9** in order to fix substrate electrodes **21***a* and **21***b* of the base sections **16***a* and **16***b* to a print wiring of the motherboard **8** by soldering and to conduct electrically them.

[0015] The light emitting diode having the structure as described above has advantageous effects that it is possible to illuminate an incident surface or side surface of the optical wave-guide **13** on the side of the surface of the motherboard **8** and to enter directly the light emitted horizontally from the light emitting diode element **19** in the side of the optical wave-guide **13**.

[0016] However, because the aforementioned T-shaped light emitting diode **15** has such a structure that the protrusion **18** is formed on the front surface of the upright section **17**, there is a problem that a center of gravity of the light emitting diode offsets forwardly and therefore an unbalance for inclining the light emitting diode generates when the base sections **16***a* and **16***b* are mounted on the peripheral edge of the hole **9** provided in the motherboard **8**.

SUMMARY OF THE INVENTION

[0017] It is, therefore, a first object of the present invention to provide a light emitting diode in which the light emitting diode can be supported with at least three points when it is mounted on a peripheral edge of a hole in a motherboard to carry out stability of a posture of the light emitting diode.

[0018] It is a second object of the present invention to provide a method for producing a light emitting diode by a simple process.

[0019] To achieve the above first object, the light emitting diode according to the present invention comprises a generally T-shaped body section including base portions having mounted surfaces mounted on peripheral edges of a hole opened in a motherboard and an upright portion which rises from the base portions and which is inserted into the hole; a resin forming section including a non-translucent frame projecting from a front surface of the body section and an extension part which projects more forwardly than the frame from the body section and which has a mounted portion mounted on a peripheral edge of the hole of the motherboard; a light emitting diode element mounted in a concave portion provided in the frame; and a translucent resin body formed in the concave portion of the frame to seal the light emitting diode element.

[0020] In one embodiment, the resin forming section is formed integrally with the body section by a transfer forming.

[0021] The mounted portion of the extension part is set to position in the same level as the mounted surfaces of the base portions, and a suction portion is provided on a back surface of the mounted portion.

[0022] The frame is provided with two mutually perpendicular light emitting parts.

[0023] In an embodiment, the frame is formed from a non-translucent resin of white color system.

[0024] The body section is provided with a pair of substrate electrodes with which the light emitting diode is electrically connected.

[0025] To achieve the above second object, the method for manufacturing the light emitting diode according to the present invention comprises the steps of projecting and forming a resin forming section having a frame, on a front surface of a body section having a upright portion and base portions by a transfer forming, providing a concave portion in the frame of the resin forming section, disposing a light emitting diode element within the concave portion, and filling a translucent resin in the concave portion to seal the light emitting diode.

[0026] According to this method for manufacturing, the resin forming section can be easily formed through the transfer forming and the position of the light emitting diode element can be determined by means of the frame of the transfer forming.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] **FIG. 1** is a perspective view showing an outside shape of a completed light emitting diode according to the present invention.

[0028] **FIG. 2** is a front view showing a state that the light emitting diode is mounted on a motherboard.

[0029] **FIG. 3** is a sectional view taken along A-A line in **FIG. 2**.

[0030] **FIG. 4** is a block view showing processes for producing the light emitting diode.

[0031] **FIG. 5** is a perspective view showing a light emitting diode formed in a first manufacturing process.

[0032] **FIG. 6** is a perspective view showing a light emitting diode formed in a second manufacturing process.

[0033] **FIG. 7** is a perspective view showing a light emitting diode formed in a third manufacturing process.

[0034] **FIG. 8** is a top plane view showing a light emitting diode formed on a collective circuit board in a fourth manufacturing process.

[0035] **FIG. 9** is a sectional view showing of one example of a conventional light emitting diode.

[0036] **FIG. 10** is a sectional view showing a state that the conventional light emitting diode is mounted on a motherboard.

[0037] **FIG. 11** is a perspective view showing one example of a conventional T-shaped light emitting diode.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] Several embodiments of the present invention will be explained with reference to the accompanying drawings below.

[0039] A light emitting diode **30** according to an embodiment as shown in FIGS. **1** to **3** comprises a body section **36** formed into a generally T-character shape from a glass epoxy resin material and a resin forming section **37** extending integrally from, for example, a front surface of the body section through a transfer forming.

[0040] The body section **36** includes an upright portion **32** extending upwardly and base portions **31***a* and **31***b* extending rightward and leftward from opposite sides of the upright portion **32** at a lower end thereof. A pair of right and left substrate electrodes **33***a* and **33***b* is provided on surfaces of the base portions **31***a* and **31***b* and upright portion **32**, as shown in **FIG. 5**. The base portions **31***a* and **31***b* have at upper surfaces thereof (as viewed in **FIG. 1**) mounted surfaces **38** which are mounted on a peripheral edge of a hole provided in a motherboard as described below. A light emitting diode element **34** is fixed on one substrate electrode **33***a*, for example, in a front surface of the upright section **32**. For example, the light emitting diode element **34** has a three-dimensional rectangular shape. An end of a bonding wire **35** extending from the light emitting diode element **34** is connected with the other substrate electrode **33***b* by any means (see FIGS. **1** to **3**).

[0041] On the other hand, the resin forming section **37** is composed of a generally U-shaped frame **40** formed on the front surface of the upright section **32** and a plate-shaped extension part **41** which is formed integrally with the frame **40** at a lower end thereof and which extends forwardly larger than the frame from the base portions **31***a* and **31***b* at an approximate center part thereof.

[0042] The extension part **41** has a generally trapezoidal shape and is formed at the center of an upper surface thereof with a rectangular mounted portion **42** projecting from the extension part **41**. It should be noted that an upper surface of the mounted portion **42** is positioned to become the same level as the upper surfaces or mounted surfaces **38** of the base portions **31***a* and **31***b*. In this embodiment, a back surface **43** of the extension part **41** is formed into a large flat suction surface flush with back surfaces **61** of the base portions **31***a* and **31***b* to facilitate a suction transport in transferring the light emitting diode **30**.

[0043] On the other hand, the aforementioned frame **40** having a semi-circular cylindrical shape is formed with an elongate concave portion **44** disposed on a central portion of the frame for inserting the light emitting diode element **34**. An upper end of the concave portion **44** is opened and a bottom end of the concave portion **44** is formed into a curved shape.

[0044] It should be noted that the concave portion is formed so as to expose a portion of the one substrate electrode **33***a*. As a result, when the light emitting diode element **34** is inserted into the concave portion **44**, it can be mounted easily on the exposed substrate electrode **33***a*. The insertion of the light emitting diode element **34** into the concave portion **44** is carried out after the resin forming section **37** is formed through the transfer forming.

[0045] Thereafter, a sealing body **45** is formed in the concave portion **44** of the frame **40** by filling a liquid translucent material of epoxy system into the concave portion and hardening it. Because the frame **40** is, first, formed by the transfer forming and then the light emitting diode

element **34** is disposed in the concave portion **44**, it is possible to use the frame **40** to position the light emitting diode element **34** when arranging it into the concave portion **44**.

[**0046**] As shown in **FIG. 1**, when the light emitting diode element **34** is disposed in the concave portion **44**, both side and lower surfaces of the light emitting diode element **34** are shielded by means of the frame **40** and only front and upper surfaces of the light emitting diode element are not shielded by means of the frame **40**. Consequently, it is possible to emit intensively light from the front and upper surfaces of the light emitting diode element in forward and upward directions of the light emitting diode **30**.

[**0047**] In addition, it is desirable to use a non-transparent resin of white color system as the forming material of the resin forming section **37** having the frame **40** and extension part **41** because it can reflect effectively the light from the light emitting diode element **34**, thus obtaining a high efficiency of irradiation of light in the forward direction of the light emitting diode.

[**0048**] **FIGS. 2 and 3** illustrate a state of mounting the light emitting diode **30** structured as described above on a motherboard **50**. The motherboard **50** is provided with a circular hole **51** for mounting the light emitting diode **30** thereon. The upright portion **32** is, first, inserted in the hole **51** and the mounted surfaces **38** of the base portions **31***a* and **31***b* are, then, mounted on a peripheral edge of the hole **51** and at the same time, the mounted portion **42** is mounted on the peripheral edge of the hole **51** to support the light emitting diode with three points of the mounted surfaces **38** and mounted portion **42**.

[**0049**] As a result, the light emitting diode **30** can be mounted correctly and firmly on the motherboard **50**. On that basis, the substrate electrodes **33***a* and **33***b* on the base portions **31***a* and **31***b* and circuit electrodes **52***a* and **52***b* print-wired on the motherboard **50** are fixed by means of a solder **53** to secure firmly the light emitting diode **30** on the motherboard **50**.

[**0050**] Note that the attachment the light emitting diode **30** on the motherboard **50** may, also, be carried out in such a state that they are upside down.

[**0051**] At this time, the upright portion **32** and frame **40** of the light emitting diode **30** extend passing through the hole **51** from a back surface **54***a* to a front surface **54***b* of the motherboard **50**. The front surface **54***b* of the light emitting diode element **34** disposed in the upright portion **32** is positioned to face a forward direction of the light emitting diode **30** or an optical wave-guide **55** which is shown by chained lines in **FIG. 3** and which is disposed in the front direction of the light emitting diode **30** (see **FIG. 3**).

[**0052**] Because the both side and lower surfaces of the light emitting diode element **34** are shielded by the frame **40**, the light from the light emitting diode element **34** is shielded so that diffusion of light to the both sideward and downward directions of the light emitting diode is blocked. Accordingly, when the principle of the light emitting diode is used as a light source of the optical wave-guide **55** in a backlight of a liquid crystal, the light emitted from the light emitting diode element **34** is directed toward a guiding end surface **56** and entered directly therein and then goes straightly in the optical wave-guide **55**, as shown in **FIG. 3**.

[**0053**] In this case, it is possible to illuminate more brightly the optical wave-guide **55**, because an amount of light of entering into the optical wave-guide **55** is increased by an operation of blocking light diffusion by the frame **40** surrounding the light emitting diode element **34**.

[**0054**] Subsequently, a method for manufacturing the light emitting diode **30** of the above structure will be explained with reference to FIGS. **4** to **8** below.

[**0055**] The body section **36** is, first, formed as shown in **FIG. 5**. As a means for forming the body section, for example, a method for producing simultaneously a large number of body sections **36** having the same shape from one collective circuit board **70** is often adopted, as shown in **FIG. 8**. Used for the collective circuit board **70** is an epoxy substrate on whose surface a thin copper plate is provided. The base portions **31***a* and **31***b* and the upright portion **32** are formed into a T-character shape on the epoxy substrate, and thereafter the pair of substrate electrodes **33***a* and **33***b*, a through hole (not shown) and so on are formed by means of etching and deposition (first manufacturing process).

[**0056**] Next, a die is disposed on the collective circuit board **70** on which the body section **36** is formed to form a resin forming section **37** through transfer forming (second manufacturing process). The resin forming section **37** is composed of a frame **40** projecting on a front surface of the upright portion **32** as shown in **FIG. 6** and an extension part **41** projecting on a front surface of the base portions **31***a* and **31***b*. In the process, a concave portion **44** is, also, formed in a front surface of the frame **40** to expose a portion of at least one substrate electrode **33***a* to mount the light emitting diode element **34**, as shown in **FIG. 6**.

[**0057**] In the next process, as shown in **FIG. 7**, the light emitting diode element **34** is disposed in the concave portion **44** to fix a bottom surface thereof on the one substrate electrode **33***a* by adhering and then an end or leading end of a bonding wire **35** extending from an upper surface of the light emitting diode element **34** is adhered to the other substrate electrode **33***b* to conduct electrically them (third manufacturing process).

[**0058**] Subsequently, as shown in **FIG. 1**, the sealing body **45** is formed by fill-up of a liquid achromatic transparent epoxy resin into the concave portion **44** of the frame **40** to seal the light emitting diode element **34** and bonding wire **35**. The filled epoxy resin is hardened through a hardening process (fourth manufacturing process).

[**0059**] **FIG. 8** illustrates a large number of light emitting diodes **30** arranged and formed on the collective circuit board through the aforementioned manufacturing processes. In the final, fifth manufacturing process, the collective circuit board is divided every a completed single light emitting diode **30** as shown in **FIG. 1**, by it being cut along cutting lines X1 and X2 in a direction of X axis and along a cutting line Y in a direction of Y axis. As shown in **FIG. 8**, because two light emitting diodes **30** in the direction of Y axis are formed on the collective circuit board to face with respect to each other, it is possible to form simultaneously the sealing bodies **45** of the two light emitting diodes **30** by filling the liquid transparent resin into the concave portion **44** of the frame **40** (shown in **FIG. 7**) once. As a result, when the frame is divided into two along the cutting line X2, the transparent resin is exposed at an upper end of each frame **40**.

[**0060**] In addition, although the above embodiment has been described with respect to the case of using the light emitting diode **30** as the light source of the optical waveguide **55** of the backlight in the liquid crystal, the light emitting diode **30** may be used for the other case, for example, as an indicator for a portable phone, PDA (Personal Digital Assistance) or the like.

[**0061**] As described above, according to the light emitting diode, because the light emitting diode can be supported with at least three points of the mounted surfaces in the base portions and mounted portion of the extension part on the peripheral edge of the hole provided in the motherboard, it is possible to accomplish stability of the light emitting diode at the time of mounting on the motherboard and a high level of performance of soldering.

[**0062**] According to the method for manufacturing the light emitting diode in the present invention, because the frame is formed on the front surface of the body section having the base portions and upright portion by the transfer forming, the light emitting diode element is disposed in the concave portion provided in the frame and then the light emitting diode element is sealed by filling the translucent resin in the concave portion, it is possible to simplify the manufacturing processes of the light emitting diode and to use the frame formed by the transfer forming in positioning the light emitting diode element in the frame.

[**0063**] Moreover, because it is possible to make a large number of light emitting diodes of the same shape from one collective circuit board in the manufacturing method, minimization of a manufacturing cost can be achieved.

What is claimed is:

1. A method for manufacturing a light emitting diode, comprising the steps of:

projecting and forming a resin forming section having a frame, on a front surface of a body section having an upright portion and base portions by a transfer forming;

providing a concave portion in the frame of the resin forming section;

disposing a light emitting diode element within the concave portion; and

filling a translucent resin in the concave portion to form a sealing body for sealing the light emitting diode.

2. A method for producing a light emitting diode, comprising the steps of:

forming a pair of electrodes on a body section having a upright portion and base portions;

projecting and forming a resin forming section having a frame and an extension part, on a surface of said body section by a transfer forming;

providing a concave portion in the frame of the resin forming section to expose a portion of one of the pair of electrodes;

disposing a light emitting diode element within the concave portion to conduct electrically with the one of the pair of electrodes; and

filling and hardening a translucent resin in the concave portion to form a sealing body for sealing the light emitting diode.

* * * * *