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Inventor(s)	Kumada; Kimio et al.

OPERATION DEVICE, KEYBOARD DEVICE, AND ELECTRONIC APPARATUS

Abstract

An operation device is a stick-type operation device configured to perform a tilt operation, and includes a support plate, a sensor substrate supported by a front surface of the support plate, a support columnar member provided to stand up from one surface of the sensor substrate, an operation member having light-transmitting property and attached to the support columnar member, a light source configured to irradiate the operation member with light, a first wire having a first end portion on which the light source is mounted and configured to pass through a back surface side of the support plate, a second wire having a first end portion connected to the sensor substrate and configured to pass through a front surface side of the support plate, and a control board to which a second end portion of the first wire and a second end portion of the second wire are each connected.

Inventors: **Kumada; Kimio (YOKOHAMA, JP), Kubota; Kazuyuki (YOKOHAMA, JP), Wada; Takahide (YOKOHAMA, JP)**

Applicant: **LENOVO (SINGAPORE) PTE. LTD.** (SINGAPORE, SG)

Family ID: **1000008321189**

Assignee: **LENOVO (SINGAPORE) PTE. LTD. (SINGAPORE, SG)**

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Background/Summary

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an operation device, a keyboard device, and an electronic apparatus.

Description of the Related Art

[0002] In an electronic apparatus such as a laptop PC, there is a configuration in which a stick-type operation device is provided in a keyboard device to improve convenience of an input operation (for example, refer to Japanese Patent No. 6719605). The operation device is disposed, for example, near the center of the keyboard device, so that the operation device has high operability.

SUMMARY OF THE INVENTION

[0003] In general, an operation device is used only for an input operation for operating a cursor or the like displayed on a display.

[0004] By the way, in the operation device, for example, an operation member operated by hand is colored red. Accordingly, the operation device can exhibit its own designability that can also be a keyboard device or an icon of an electronic apparatus. Therefore, it is considered that the operation device can be used not only for improvement of designability but also for further improvement of user experience and cooperation with various functions as long as the operation member can be caused to emit light.

[0005] However, the above-described operation device is often very small, and the surrounding space is also limited. Therefore, in a case where the operation device is equipped with a light emitting module, the handling of the wire is a problem.

[0006] The present invention has been made in consideration of the above-described problems of the related art, and an object of the present invention is to provide an operation device, a keyboard device, and an electronic apparatus capable of easily connecting a wire in a case where an operation member is caused to emit light.

[0007] An operation device according to a first aspect of the present invention is an operation device that is a stick-type operation device configured to perform a tilt operation, and the operation device includes: a support plate; a sensor substrate supported by a front surface of the support plate; a support columnar member provided to stand up from one surface of the sensor substrate; an operation member having light-transmitting property and attached to the support columnar member; a light source configured to irradiate the operation member with light; a first wire having a first end on which the light source is mounted and configured to pass through a back surface side of the support plate; a second wire having a first end portion connected to the sensor substrate and configured to pass through a front surface side of the support plate; and a control board to which a second end portion of the first wire and a second end portion of the second wire are each connected.

[0008] A keyboard device according to a second aspect of the present invention includes: a plate-like member; a plurality of key tops supported on an upper surface side of the plate-like member; a stick-type operation device supported by the plate-like member, having an operation member disposed at a position where a periphery of the operation member is surrounded by the key tops, and configured to perform a tilt operation on the operation member, in which the operation device includes a support plate, a sensor substrate supported by a front surface of the support plate, a

support columnar member provided to stand up from one surface of the sensor substrate, an operation member having light-transmitting property and attached to the support columnar member, a light source configured to irradiate the operation member with light, a first wire having a first end portion on which the light source is mounted and configured to extend from a back surface side of the support plate to a lower surface side of the plate-like member, a second wire having a first end portion connected to the sensor substrate and configured to extend from a front surface side of the support plate to the lower surface side of the plate-like member, and a control board to which a second end portion of the first wire and a second end portion of the second wire are each connected.

[0009] An electronic apparatus according to a first aspect of the present invention includes: a chassis on which a motherboard is mounted; and a keyboard device mounted to face a surface of the chassis, in which the keyboard device includes a plate-like member, a plurality of key tops supported on an upper surface side of the plate-like member, and a stick-type operation device supported by the plate-like member, having an operation member disposed at a position where a periphery of the operation member is surrounded by the key tops, and configured to perform a tilt operation on the operation member, and the operation device includes a support plate, a sensor substrate supported by a front surface of the support plate, a support columnar member provided to stand up from one surface of the sensor substrate, an operation member having light-transmitting property and attached to the support columnar member, a light source configured to irradiate the operation member with light, a first wire having a first end portion on which the light source is mounted and configured to extend from a back surface side of the support plate to a lower surface side of the plate-like member, a second wire a first end portion connected to the sensor substrate and configured to extend from a front surface side of the support plate to the lower surface side of the plate-like member, and a control board which is electrically connected to the motherboard, and to which a second end portion of the first wire and a second end portion of the second wire are each connected.

[0010] According to the above-described aspect of the present invention, it is possible to easily connect a wire in a case where the operation member is caused to emit light.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a top view of an electronic apparatus according to one embodiment.

[0012] FIG. **2** is an exploded perspective view of an operation device.

[0013] FIG. **3** is an exploded perspective view of a part of the operation device illustrated in FIG. **2** assembled.

[0014] FIG. **4** is a schematic side cross-sectional view of the operation device and a keyboard device in a peripheral portion of the operation device.

[0015] FIG. **5** is a schematic bottom view of the keyboard device.

[0016] FIG. **6** is a schematic side cross-sectional view illustrating a light emission operation of the operation device.

[0017] FIG. **7** is a schematic side cross-sectional view illustrating a light emission operation of an operation device according to a second configuration example.

[0018] FIG. **8** is a schematic side cross-sectional view illustrating a light emission operation of an operation device according to a third configuration example.

[0019] FIG. **9** is a schematic side cross-sectional view illustrating a light emission operation of an operation device according to a fourth configuration example.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Hereinafter, suitable embodiments of an operation device, a keyboard device, and an

electronic apparatus according to the present invention will be described in detail with reference to the accompanying drawings.

[0021] FIG. **1** is a top view of an electronic apparatus **10** according to one embodiment. As illustrated in FIG. **1**, the electronic apparatus **10** of the present embodiment is a clamshell-type laptop PC. The electronic apparatus **10** has a configuration in which a lid body **11** and a chassis **12** are connected to each other by a hinge **14** so as to be relatively rotatable.

[0022] The lid body **11** has a thin flat box-shaped chassis. The lid body **11** is provided with a display **16**. The display **16** is, for example, an organic EL display or a liquid crystal display.

[0023] The chassis **12** is a thin flat box body. The chassis **12** mounts a keyboard device **20** including an operation device **18** according to one embodiment. The keyboard device **20** is installed to face the upper surface (surface **12***a*) of the chassis **12**. Reference numeral **22** in FIG. **1** denotes a touch pad.

[0024] Hereinafter, the chassis **12** and each component mounted on the chassis **12** will be described with reference to a posture in which an operator operates the operation device **18** and the keyboard device **20**, in which a width direction (left and right) of the chassis **12** will be referred to as X1 and X2 directions, a depth direction (front and back) of the chassis **12** will be referred to as Y1 and Y2 directions, and a thickness direction (up and down) of the chassis **12** will be referred to as Z1 and Z2 directions. The X1 and X2 directions may be collectively referred to as an X direction, and the Y1 and Y2 directions and the Z1 and Z2 directions may be similarly referred to as a Y direction and a Z direction, respectively. Each of these directions is a direction determined for convenience of description, and may be changed depending on a usage state, an installation posture, or the like of the electronic apparatus **10**.

[0025] The chassis **12** is formed by overlapping a first cover material **24** and a second cover material **25** in the thickness direction and connecting the first cover material **24** and the second cover material **25** to be attachable and detachable to each other. The first cover material **24** forms, for example, an upper surface (surface **12***a*) and four circumferential side surfaces of the chassis **12**, and has a substantially bathtub shape. The first cover material **24** has a large opening **24***a* having a substantially rectangular shape. The keyboard device **20** faces the Z1 side through the opening **24***a*. The second cover material **25** forms, for example, a lower surface of the chassis **12** and has a substantially flat plate shape. The hinge **14** is installed in a recessed hinge disposition groove **12***b* formed in a rear edge portion of the chassis **12** and connects the chassis **12** and the lid body **11** to each other.

[0026] FIG. **2** is an exploded perspective view of the operation device **18**. FIG. **3** is an exploded perspective view of a part of the operation device **18** illustrated in FIG. **2** assembled. FIG. **4** is a schematic side cross-sectional view of the operation device **18** and a keyboard device **20** in a peripheral portion of the operation device.

[0027] As illustrated in FIGS. **2** to **4**, the operation device **18** can include a support plate **28**, a sensor substrate **30**, a support columnar member **32**, an operation member **34**, a light source **36**, and two wires **38** and **39**.

[0028] As illustrated in FIG. **1**, the operation device **18** is attached to the vicinity of the center of the keyboard device **20**. The operation device **18** is a pointing device also called a pointing stick or a track point (registered trademark). That is, the operation device **18** is a stick-type input device that can perform a tilt operation on the operation member **34** by hand. The operation device **18** can operate a cursor (mouse pointer) displayed on the display **16** instead of the mouse. The operation device **18** can perform the same operation as a mouse in cooperation with, for example, a plurality of function buttons assigned to the touch pad **22**. These function buttons correspond to, for example, left and right buttons or a center button of a mouse.

[0029] As illustrated in FIGS. **2** to **4**, the support plate **28** is a member that serves as a base of the operation device **18**. The support plate **28** is also a bracket for attaching the operation device **18** to the keyboard device **20**. The support plate **28** can be formed of a metal plate formed of a thin steel

plate, a stainless steel plate, an aluminum plate, or the like. The support plate **28** can have, for example, a substantially triangular shape that is tapered toward the Y2 side in a plan view. The support plate **28** may have a rectangular shape or the like. A plate thickness of the support plate **28** is, for example, 0.5 mm.

[0030] A through-hole **28***a* and a plurality of support holes **28***b* are provided at a position slightly toward the Y1 side of the center of the support plate **28**. The through-hole **28***a* penetrates the support plate **28** in a plate thickness direction. The through-hole **28***a* has an inner diameter into which the light source **36** can be inserted. For example, four support holes **28***b* are provided to surround the periphery of the through-hole **28***a*. The support holes **28***b* are used to fix the sensor substrate **30** to the support plate **28**.

[0031] A pair of attachment holes **28***c* and **28***c* and an engagement portion **28***d* are provided around corner portions of the support plate **28**. The attachment hole **28***c* and the engagement portion **28***d* are used for attaching the operation device **18** to the keyboard device **20**. Each attachment hole **28***c* is a screw hole into which a screw **53** (see FIG. **5**) for fixing the support plate **28** to the keyboard device **20** is tightened. The engagement portion **28***d* is engaged with an engagement piece **54** formed on a plate-like member **50** of the keyboard device **20**, which will be described later.

[0032] The sensor substrate **30** is a printed circuit board assembly (PCBA) on which a sensor **30***a* that detects the tilt operation with respect to the operation member **34** is mounted. As illustrated in FIG. **2**, the sensor substrate **30** has a plurality of sensors **30***a*, a recessed portion **30***b*, a through-hole **30***c*, and a plurality of support holes **30***d*. In FIG. **4**, the recessed portion **30***b* and the like are not illustrated.

[0033] For example, four sensors **30***a* are provided to surround the recessed portion **30***b* located at the center of the sensor substrate **30**. The sensors **30***a* are respectively disposed in four directions along an XY direction as viewed from the center of the sensor substrate **30**. The sensor **30***a* may be any sensor as long as it can detect a tilt movement of the operation member **34**, and is, for example, a strain gauge type load sensor.

[0034] The recessed portion **30***b* is a recessed portion having a shallow counterbore shape formed at the center of a Z1-side surface (one surface **30***e*) of the sensor substrate **30**. A lower end portion of the support columnar member **32** is fitted into and fixed to the recessed portion **30***b* by adhesion. Therefore, an inner peripheral shape of the recessed portion **30***b* is a shape corresponding to an outer peripheral shape of the support columnar member **32**. The recessed portion **30***b* of the present embodiment has a rectangular shape.

[0035] The through-hole **30***c* is formed at the center of the sensor substrate **30** and penetrates the sensor substrate **30** in the plate thickness direction. That is, the through-hole **30***c* penetrates the bottom surface of the recessed portion **30***b*. The through-hole **30***c* is disposed coaxially with the through-hole **28***a* of the support plate **28** and communicates with the through-hole **28***a*. An inner diameter of the through-hole **30***c* can be formed to be smaller than an inner diameter of the through-hole **28***a* of the support plate **28** into which the light source **36** is inserted.

[0036] For example, four support holes **30***d* are provided to surround the recessed portion **30***b* at the center of the sensor substrate **30**. Each support hole **30***d* penetrates the sensor substrate **30** in a plate thickness direction. Each support hole **30***d* is disposed between the adjacent sensors **30***a* and **30***a*. The support holes **30***d* are used to fix the sensor substrate **30** to the support plate **28**.

[0037] The sensor substrate **30** is supported by the support plate **28** with, for example, a ring-shaped metal washer **40** interposed therebetween. Four hole portions **40***a* corresponding to the respective support holes **30***d* are formed to penetrate the ring-shaped portion of the metal washer **40**. Each hole portion **40***a* is coaxially disposed with each support hole **30***d* and communicates with each support hole **30***d*. A shallow counterbore shape recessed portion is formed around the one surface **30***e* side of the support hole **30***d*.

[0038] The support columnar member **32** constitutes an operation lever of the operation device **18**. The support columnar member **32** has, for example, a prismatic shape (quadrangular prism shape)

having two upper and lower surfaces and four outer peripheral surfaces. The support columnar member **32** can also be formed of, for example, a polygonal prism or the like of which the outer periphery is formed of six surfaces. The support columnar member **32** can also be formed in a columnar shape.

[0039] The support columnar member **32** is provided to stand up from one surface **30***e* of the sensor substrate **30**. A lower end portion (Z2-side end portion) of the support columnar member **32** is fitted to the recessed portion **30***b* of the sensor substrate **30** and is fixed by adhesion. Accordingly, the support columnar member **32** stands up from the one surface **30***e* in the Z1 direction at a position where the through-hole **30***c* is blocked.

[0040] The support columnar member **32** is formed of a material (light-transmitting material) that can transmit light. The support columnar member **32** can be formed of, for example, transparent or translucent polycarbonate. The support columnar member **32** is fixed to the sensor substrate **30** using, for example, a heat curable adhesive. Therefore, the support columnar member **32** is preferably formed of, for example, a heat-resistant material having a heat resistance of about 180° C.

[0041] The operation member **34** is a member that is actually operated by the operator with a fingertip or the like. The operation member **34** is, for example, an umbrella-attached cylindrical member formed in a substantially dome shape or a substantially mushroom shape. A fitting hole **34***a* is open at the center of the lower surface (Z2-side surface) of the operation member **34**. The fitting hole **34***a* is a recessed hole that does not penetrate the operation member **34** in the Z direction. The support columnar member **32** is inserted into the fitting hole **34***a* from the upper end portion (Z1-side end portion) and fitted. The operation member **34** can also be fixed to the support columnar member **32** by adhesion or the like.

[0042] The upper surface (Z1-side surface) of the operation member **34** can be formed in a dome shape or an umbrella shape that is easy to operate with a fingertip. A plurality of protrusions **34***c* can also be arranged in a circular shape on the upper surface (operation surface **34***b*) of the operation member **34** as illustrated by two-dot chain lines in FIG. **4**. The protrusion **34***c* functions as a non-slip for a fingertip or the like and improves the operability with respect to the operation member **34**.

[0043] The operation member **34** is formed of, for example, a rubber material. The operation member **34** is colored, for example, red. The operation member **34** has the fitting hole **34***a* formed in the center, and a rubber cap that is formed to be thin as a whole. As a result, the operation member **34** has light-transmitting property in the thickness direction.

[0044] The light source **36** is, for example, an LED element. The light source **36** may emit white light or may emit light of a color (for example, red) matching the color of the operation member **34**.

[0045] In the configuration example illustrated in FIG. **4**, the light source **36** is installed in the through-hole **28***a* of the support plate **28**. In the light source **36**, for example, an upper surface (Z1-side surface) is a light irradiation surface **36***a*. The light irradiation surface **36***a* faces the Z1 direction (the support columnar member **32** side) in the through-hole **28***a*, and thus the light can be applied to the support columnar member **32** through the through-hole **28***a* and the through-hole **30***c*. Although details will be described later, light incident on the support columnar member **32** is guided and diffused in the support columnar member **32**, and the operation member **34** emits light.

[0046] The wire (first wire) **38** is a wire for light emission control that electrically connects the light source **36** and a control board **42** (see FIG. **5**) described later. The wire (second wire) **39** is a wire for a stick operation control that electrically connects the sensor substrate **30** and the control board **42**. The wires **38** and **39** can be configured with, for example, flexible printed circuits (FPC).

[0047] The wire **38** is disposed such that one end portion (first end portion **38***a*) thereof passes through a back surface (Z2-side surface) **28***e* side of the support plate **28** and covers the through-hole **28***a*. The light source **36** is mounted on a surface of a portion of the first end portion **38***a* that covers the through-hole **28***a*. Accordingly, at least a part of the light source **36** is disposed in the

through-hole **28***a*.
[0048] In the wire **39**, one end portion (first end portion **39***a*) passes from one surface **30***e* of the sensor substrate **30** to the front surface (Z1-side surface) **28***f* side of the support plate **28**. The first end portion **39***a* of the wire **39** is formed in a circular shape having, for example, a shape substantially the same as the outer shape of the sensor substrate **30**. An opening portion **39***c* and a plurality of notches **39***d* are formed in the first end portion **39***a* (see FIGS. **2** and **3**). The opening portion **39***c* is a rectangular cutout hole into which the support columnar member **32** is inserted. The notch **39***d* is a portion that is cut out to recess the outer peripheral edge portion of the first end portion **39***a*, and is disposed coaxially with each support hole **30***d*.
[0049] As illustrated in FIGS. **2** to **4**, in the assembly structure of the operation device **18**, the sensor substrate **30** is disposed on the front surface **28***f* of the support plate **28** via the metal washer **40**. The through-holes **28***a* and **30***c* are disposed coaxially, and an inner peripheral opening of the metal washer **40** is also disposed between the through-hole **28***a* and the through-hole **30***c*. The caulking pin **44** is inserted into the through-holes **28***a* and **30***c*, for example, from the Z1 side toward the Z2 side (see FIG. **3**). The caulking pin **44** connects the sensor substrate **30** and the support plate **28** to each other, for example, by caulking both upper and lower ends in a flange shape.
[0050] The first end portion **39***a* of the wire **39** is connected to one surface **30***e* of the sensor substrate **30** connected to the support plate **28**. The wire **38** is disposed on the back surface **28***e* of the support plate **28**, and the light source **36** is inserted into the through-hole **28***a*. The second end portions **38***b* and **39***b* of the respective wires **38** and **39** are connected to the control board **42**, respectively (see FIG. **5**). That is, at least two wires **38** and **39** branch off from the control board **42** and extend. An assembly structure of the operation device **18** is constructed as described above.
[0051] Next, an example of a mounting structure of the operation device **18** to the keyboard device **20** will be described.
[0052] As illustrated in FIGS. **1** and **4**, the keyboard device **20** includes a plurality of key tops **46** disposed to be arranged in the X direction and the Y direction. The adjacent key tops **46** and **46** are partitioned by an isolation frame **48**. The isolation frame **48** is a mesh-like plate in which a plurality of hole portions into which each key top **46** is inserted to be vertically movable is formed. The isolation frame **48** may be integrally molded with the first cover material **24** forming the surface **12***a* of the chassis **12**, or may be configured to be separate from the first cover material **24**.
[0053] As illustrated in FIG. **4**, the keyboard device **20** includes a plate-like member **50** that serves as an attachment plate for each key top **46**. The plate-like member **50** is a laminated plate having a three-layer structure including, for example, a base plate, a membrane sheet laminated on a Z1-side surface of the base plate, and a waterproof sheet laminated on a Z2-side surface of the base plate. The base plate can be configured such that cutting-raising or cutting-out is performed at various portions of a thin metal plate such as stainless steel. The membrane sheet can be configured with a switch sheet in which a fixed contact and a movable contact are closely attached to each other to close the contact in a case where a position where the fixed contact and the movable contact overlap each other is pressed. The waterproof sheet can be provided to cover the lower surface side of the base plate. Instead of the waterproof sheet, a light guide plate that guides and reflects light emitted from a light source such as a predetermined LED element and irradiates each key top **46** with light from below can also be installed.
[0054] FIG. **5** is a schematic bottom view of the keyboard device **20**.
[0055] As illustrated in FIG. **5**, the plate-like member **50** is screwed and fixed to the isolation frame **48** by a screw **52** that penetrates the plate-like member **50** from the lower surface (Z2-side surface) in the Z1 direction, and thus the plate-like member **50** is attached to the chassis **12**.
[0056] As illustrated in FIGS. **4** and **5**, the plate-like member **50** has a hole portion **50***a* that penetrates in a plate thickness direction. The operation device **18** is installed in the hole portion **50***a*. In the mounting structure of the operation device **18** to the keyboard device **20**, the support

plate **28** is fixed to the lower surface **50***b* side of the plate-like member **50**. In the support plate **28**, for example, the attachment hole **28***c* is fixed to the plate-like member **50** with the screw **53**, and the engagement portion **28***d* is engaged with the engagement piece **54** cut and raised from the support plate **28**.

[0057] The support columnar member **32** passes through the hole portion **50***a* from the Z2 side to the Z1 side, and thus protrudes to the upper surface **50***c* side of the plate-like member **50**. The sensor substrate **30** can be disposed in the hole portion **50***a*. An operation member **34** is mounted on an upper portion of the support columnar member **32** inserted through the hole portion **50***a*. Accordingly, the operation device **18** is attached to the keyboard device **20**. In other words, a keyboard device **20** to which the operation device **18** is attached is configured. The operation member **34** is disposed near the center of the keyboard device **20**, and the periphery of the operation member **34** is surrounded by the key tops **46** (see FIGS. **1** and **4**).

[0058] The wire **38** is provided to extend from the back surface **28***e* side of the support plate **28** to the lower surface **50***b* side of the plate-like member **50**. The second end portion **38***b* of the wire **38** is connected to, for example, the control board **42** installed below or on the side of the keyboard device **20**.

[0059] The wire **39** is provided to pass from the one surface **30***e* side of the sensor substrate **30** to the front surface **28***f* side of the support plate **28** and to be extended to the lower surface **50***b* side of the plate-like member **50**. The two wires **38** and **39** can be laminated by overlapping a part near the first end portions **38***a* and **39***a* on the support plate **28** side with each other. The second end portion **39***b* of the wire **39** is connected to the control board **42** separately from the wire **38**.

[0060] As illustrated in FIG. **5**, the keyboard device **20** is connected to a motherboard **56** by using a flexible printed circuit (FPC) **55**. The motherboard **56** is a printed circuit board assembly (PCBA) that performs main control of the electronic apparatus **10**. The motherboard **56** can mount various electronic components such as a central processing unit (CPU), a graphics processing unit (GPU), a storage device, and a communication module. The control board **42** of the operation device **18** can join the flexible printed circuit **55**, for example, by using a flexible printed circuit **58** different from the wires **38** and **39**, and can be connected to the motherboard **56**.

[0061] Next, the light emission operation and the effects of the operation device **18** will be described.

[0062] FIG. **6** is a schematic side cross-sectional view illustrating the light emission operation of the operation device **18**. In FIG. **6**, the cross-sectional hatching of the support columnar member **32** and the operation member **34** is not illustrated, and the same applies to FIGS. **7** and **8**. An arrow illustrated by a one-dot chain line in FIG. **6** schematically illustrates a trajectory of the light emitted from the light source **36**, and the same applies to FIGS. **7** and **8**.

[0063] In the operation device **18** of the configuration example (first configuration example) illustrated in FIG. **6**, the light irradiation surface **36***a* of the light source **36** is disposed to face the Z1 side in the through-hole **28***a* of the support plate **28**. That is, the light irradiation surface **36***a* faces the through-hole **30***c* of the sensor substrate **30** and the support columnar member **32** at the end of the through-hole **30***c*.

[0064] In the operation device **18**, the light emitted from the light irradiation surface **36***a* passes through the through-hole **28***a* and the through-hole **30***c*, and at the same time, is reflected by the inner peripheral wall of the through-hole **30***c* while passing through the through-hole **30***c*. The light that has passed through the through-hole **30***c* is guided and diffused by the support columnar member **32** formed of a light-transmitting material. In this way, the support columnar member **32** functions as a light guide member. Since the support columnar member **32** has a prismatic shape, the introduced light is reflected by the outer circumferential side surface **32***b* of the support columnar member **32** and is efficiently diffused. Then, the light guided by the support columnar member **32** passes through the Z1-side surface (upper surface **32***a*) of the support columnar member **32** and is appropriately refracted to cause the operation member **34** to emit light from the

inside. Since the operation member **34** is a thin rubber member, the light guided by the support columnar member **32** is widely emitted from the entire operation member **34**.

[0065] As described above, the operation device **18** can include the support columnar member **32** that is formed of a light-transmitting material and is provided to stand up from one surface **30***e* of the sensor substrate **30** at a position at which the through-hole **30***c* is blocked, the operation member **34** that has light-transmitting property and is attached to the support columnar member **32**, and the light source **36** that irradiates the support columnar member **32** with light through the through-hole **30***c*.

[0066] As described above, the operation device **18** uses the support columnar member **32** on which the operation member **34** is mounted as the light guide member. Accordingly, the operation device **18** can cause the operation member **34** to emit light by light passing through the through-hole **30***c* of the sensor substrate **30**. Therefore, although the operation device **18** has a simple configuration in which the light source **36** is substantially added to the pointing stick in the related art, the operation device **18** can efficiently cause the operation member **34** to emit light. In particular, in a case where the operation device **18** is mounted on the keyboard device **20**, the diameter of the operation member **34** is extremely small, for example, about 8 mm. Even in this case, since the operation device **18** has the above-described simple configuration, the operation member **34** can be caused to emit light.

[0067] In the electronic apparatus **10** including the keyboard device **20**, the operation member **34** emits light, so that not only the designability is improved, but also the user experience can be further improved and cooperation with various functions can be achieved.

[0068] For example, the electronic apparatus **10** can notify that the power of the apparatus is turned on or that the memory is being trained by the light emission of the operation member **34** after a power button is pressed and before the display **16** is displayed. For example, the electronic apparatus **10** can notify of a mute state or the like of a speaker or a microphone by the light emission of the operation member **34**. For example, the electronic apparatus **10** can notify that the electronic apparatus **10** is in a sleep state by the light emission of the operation member **34**.

[0069] In addition, the operation device **18** can include the wire **38** in which the light source **36** is mounted on the first end portion **38***a* and which passes through the back surface **28***e* side of the support plate **28**, the wire **39** through which the first end portion **39***a* is connected to the sensor substrate **30** and which passes through the front surface **28***f* side of the support plate **28**, and the control board **42** to which the second end portions **38***b* and **39***b* of the respective wires **38** and **39** are connected, respectively.

[0070] In this way, in the operation device **18**, the wires **38** and **39** connected to the light source **36** and the sensor substrate **30** are branched off at the control board **42** and pass through the back surface **28***e* side and the front surface **28***f* side of the support plate **28**, respectively. As a result, the operation device **18** can connect the wires **38** and **39** while having a simple configuration in which only the wire **38** on which the light source **36** is substantially mounted is added to the pointing stick in the related art. In particular, in a case where the operation device **18** is mounted on the keyboard device **20**, the operation member **34** is extremely small and the surrounding space is also limited. Even in this case, the operation device **18** includes the above-described wires **38** and **39**, so that the wire **39** required for the control signal and the wire **38** required for the light emission can be easily connected to each other.

[0071] FIG. **7** is a schematic side cross-sectional view illustrating a light emission operation of an operation device **18**A according to the second configuration example. In FIG. **7**, the same reference numerals as the reference numerals illustrated in FIGS. **1** to **6** indicate the same or similar configurations, and thus, detailed description thereof will be omitted since the same or similar functions and effects are exhibited, and the same applies to FIGS. **8** and **9**.

[0072] The operation device **18**A illustrated in FIG. **7** includes a light source **60** that has a height larger than that of the light source **36** illustrated in FIG. **6** in the Z direction. The light source **60**

has, for example, a Z-direction height larger than the Z-direction height of the through-hole **28***a*, that is, the plate thickness of the support plate **28**. Accordingly, the light irradiation surface **36***a* of the light source **60** is disposed in, for example, the through-hole **30***c* of the sensor substrate **30** and faces the Z1 side.

[0073] In the operation device **18**A, the light emitted from the light irradiation surface **36***a* passes through the through-hole **30***c* and simultaneously passes through the through-hole **30***c* while being reflected by the inner peripheral wall of the through-hole **30***c*. The light that has passed through the through-hole **30***c* is guided by the support columnar member **32** formed of a light-transmitting material, and is diffused while being reflected by the outer circumferential side surface **32***b*. Then, the light guided by the support columnar member **32** passes through the upper surface **32***a* of the support columnar member **32** and is appropriately refracted, and the operation member **34** emits light from the inside.

[0074] In the operation device **18**A illustrated in FIG. **7**, the light irradiation surface **36***a* is located at a position offset upward (Z1 side) as compared with the operation device **18** illustrated in FIG. **6**. That is, the operation device **18**A has the light irradiation surface **36***a* at a position closer to the light guide member (support columnar member **32**) than the operation device **18**. Therefore, the operation device **18**A can widen the range of the light diffused from the support columnar member **32**, and the light emission range of the operation surface **34***b* is expanded. As a result, in the operation device **18**A, the operation member **34** emits light more evenly in a wider range.

[0075] For example, in a case where the diameter of the operation member **34** is 8 mm, the diameter of the light emission range on the operation surface **34***b* of the operation device **18** is 3.6 mm. Meanwhile, the diameter of the light emission range on the operation surface **34***b* of the operation device **18**A is 4.4 mm.

[0076] As illustrated by two-dot chain lines in FIG. **7**, the height of the light source **60** may be set such that the light irradiation surface **36***a* is disposed, for example, above (Z1 side) the through-hole **28***a* of the support plate **28**.

[0077] FIG. **8** is a schematic side cross-sectional view illustrating a light emission operation of an operation device **18**B according to a third configuration example.

[0078] The operation device **18**B illustrated in FIG. **8** is different from the operation devices **18** and **18**A illustrated in FIGS. **6** and **7** in that the support columnar member **32** has a recessed hole portion **32***c*. The hole portion **32***c* is a prismatic hole having the same shape as the shape of the support columnar member **32**. The hole portion **32***c* is open on the lower surface (Z2-side surface) of the support columnar member **32** and communicates with the through-holes **30***c* and **28***a*. The back portion (upper portion) of the hole portion **32***c* is closed.

[0079] In the operation device **18**B, the light emitted from the light irradiation surface **36***a* passes through the through-hole **30***c* and simultaneously passes through the through-hole **30***c* while being reflected by the inner peripheral wall of the through-hole **30***c*. The light that has passed through the through-hole **30***c* is introduced into the hole portion **32***c* of the support columnar member **32**. The light introduced into the hole portion **32***c* is reflected and refracted by an inner peripheral wall surface of the hole portion **32***c*. The light that has passed through the hole portion **32***c* is then guided by the support columnar member **32** formed of a light-transmitting material, and is diffused while being reflected by the outer circumferential side surface **32***b*. Then, the light guided by the support columnar member **32** passes through the upper surface **32***a* of the support columnar member **32** and is appropriately refracted, and the operation member **34** emits light from the inside.

[0080] In the operation device **18**B illustrated in FIG. **8**, the support columnar member **32** has the hole portion **32***c* as compared with the above-described operation devices **18** and **18**A, so that light is further dispersed in a lateral direction. Therefore, the operation device **18**B can further widen the range of the light diffused from the support columnar member **32**, and the light emission range of the operation surface **34***b* is further expanded. As a result, in the operation device **18**, the operation member **34** emits light more evenly in a wider range.

[0081] FIG. **8** illustrates a configuration in which the light source **60** that is higher than the light source **36** illustrated in FIG. **6** is used. However, the hole portion **32***c* of the support columnar member **32** can also be used in combination with the light source **36** illustrated in FIG. **6**.
[0082] For example, in a case where the diameter of the operation member **34** is 8 mm, the diameter of the light emission range on the operation surface **34***b* in the operation device **18**B is 6.8 mm. In the operation device **18**B using the support columnar member **32** having the hole portion **32***c*, in a case where the light source is changed to the low-profile light source **36**, the diameter of the light emission range on the operation surface **34***b* is 5.4 mm.
[0083] FIG. **9** is a schematic side cross-sectional view illustrating a light emission operation of an operation device **18**C according to the fourth configuration example.
[0084] The operation device **18**C illustrated in FIG. **9** is different from the operation devices **18**, **18**A, and **18**B illustrated in FIGS. **6** to **8** in that the support columnar member **32** has embossed portions **32***d* on the upper surface **32***a*. The embossed portion **32***d* is a minute unevenness formed on the upper surface **32***a*. As a result, the upper surface **32***a* of the support columnar member **32** is formed to have a sandblasted surface by the embossed portions **32***d*.
[0085] In the operation device **18**C, the light emitted from the light irradiation surface **36***a* passes through the through-hole **30***c* and simultaneously passes through the through-hole **30***c* while being reflected by the inner peripheral wall of the through-hole **30***c*. The light that has passed through the through-hole **30***c* is introduced into the hole portion **32***c* of the support columnar member **32**. The light introduced into the hole portion **32***c* is reflected and refracted by an inner peripheral wall surface of the hole portion **32***c*. The light that has passed through the hole portion **32***c* is then guided by the support columnar member **32** formed of a light-transmitting material, and is diffused while being reflected by the outer circumferential side surface **32***b*. In addition, in a case where the light guided by the support columnar member **32** passes through the upper surface **32***a* of the support columnar member **32**, the light is diffusely reflected by the embossed portion **32***d* and is appropriately refracted, and the operation member **34** emits light from the inside.
[0086] In the operation device **18**C illustrated in FIG. **9**, the support columnar member **32** has the embossed portion **32***d*, and thus light is diffusely reflected, compared to the operation devices **18**, **18**A, and **18**B. Therefore, the operation device **18**C can suppress the occurrence of unevenness (unevenness of light) in the light diffused from the support columnar member **32**, and the operation member **34** emits light more evenly.
[0087] FIG. **9** illustrates an example of a configuration in which a light source **60** that is higher than the light source **36** illustrated in FIG. **6** is used. However, the embossed portion **32***d* can also be used in combination with the light source **36** illustrated in FIG. **6**. In addition, FIG. **9** illustrates an example of a configuration in which the support columnar member **32** having the hole portion **32***c* illustrated in FIG. **8** is used. However, the embossed portion **32***d* can also be formed on the support columnar member **32** that does not have the hole portion **32***c* illustrated in FIGS. **6** and **7**.
[0088] It goes without saying that the present invention is not limited to the embodiments described above, and is able to be freely modified without departing from the gist of the present invention.
[0089] In the above description, the operation devices **18**, **18**A to **18**C are exemplified as being mounted on the keyboard device **20**, but the operation devices **18**, **18**A to **18**C can also be used as a single operation device. In addition, the keyboard device **20** including the operation devices **18**, **18**A to **18**C can also be used as a single keyboard device without being mounted on the electronic apparatus **10**.

Claims

1. An operation device that is a stick-type operation device configured to perform a tilt operation, the operation device comprising: a support plate; a sensor substrate supported by a front surface of the support plate; a support columnar member that extends upwardly from one surface of the sensor

substrate; an operation member having light-transmitting property and attached to the support columnar member; a light source configured to irradiate the operation member with light; a first wire having a first end portion on which the light source is mounted and configured to pass through a back surface side of the support plate; a second wire having another first end portion connected to the sensor substrate and configured to pass through a front surface side of the support plate; and a control board to which a second end portion of the first wire and another second end portion of the second wire are each connected.

2. The operation device according to claim 1, wherein the sensor substrate has a first through-hole in a plate thickness direction, the support plate has a second through-hole in the plate thickness direction and that communicates with the first through-hole, and at least a part of the light source is disposed in the second through-hole.

3. The operation device according to claim 2, wherein the light source has a light irradiation surface configured to emit light, the support columnar member is formed of a light-transmitting material and extends upwardly from the one surface of the sensor substrate whereby the first through-hole is blocked, and the light irradiation surface is in the first through-hole or the second through-hole and faces a support columnar member side.

4. A keyboard device comprising: a plate-like member; a plurality of key tops supported on an upper surface side of the plate-like member; and a stick-type operation device supported by the plate-like member, wherein the stick-type operation device has an operation member wherein a periphery of the operation member is surrounded by the key tops, and the stick-type operation device is configured to perform a tilt operation on the operation member, wherein the operation device includes: a support plate, a sensor substrate supported by a front surface of the support plate, a support columnar member that extends upwardly from one surface of the sensor substrate, an operation member having light-transmitting property and attached to the support columnar member, a light source configured to irradiate the operation member with light, a first wire having a first end portion on which the light source is mounted and configured to extend from a back surface side of the support plate to a lower surface side of the plate-like member, a second wire having another first end portion connected to the sensor substrate and configured to extend from a front surface side of the support plate to the lower surface side of the plate-like member, and a control board to which a second end portion of the first wire and another second end portion of the second wire are each connected.

5. The keyboard device according to claim 4, wherein the plate-like member has a hole portion extending in a plate thickness direction, and in the operation device, the support plate is fixed to the lower surface side of the plate-like member, and the support columnar member protrudes to the upper surface side of the plate-like member through the hole portion.

6. The keyboard device according to claim 5, wherein the sensor substrate has a first through-hole in the plate thickness direction, the support plate has a second through-hole in the plate thickness direction and that communicates with the first through-hole, and at least a part of the light source is disposed in the second through-hole.

7. An electronic apparatus comprising: a chassis on which a motherboard is mounted; and a keyboard device that faces a front surface of the chassis, wherein the keyboard device includes a plate-like member, a plurality of key tops supported on an upper surface side of the plate-like member, and a stick-type operation device supported by the plate-like member, wherein the stick-type operation device has an operation member disposed at a position wherein a periphery of the operation member is surrounded by the key tops, and the stick-type operation device is configured to perform a tilt operation on the operation member, and the operation device includes: a support plate, a sensor substrate supported by a front surface of the support plate, a support columnar member that extends upwardly from one surface of the sensor substrate, an operation member having light-transmitting property and attached to the support columnar member, a light source configured to irradiate the operation member with light, a first wire having a first end portion on

which the light source is mounted and configured to extend from a back surface side of the support plate to a lower surface side of the plate-like member, a second wire having another first end portion connected to the sensor substrate and configured to extend from a front surface side of the support plate to the lower surface side of the plate-like member, and a control board which is electrically connected to the motherboard, and to which a second end portion of the first wire and another second end portion of the second wire are each connected.