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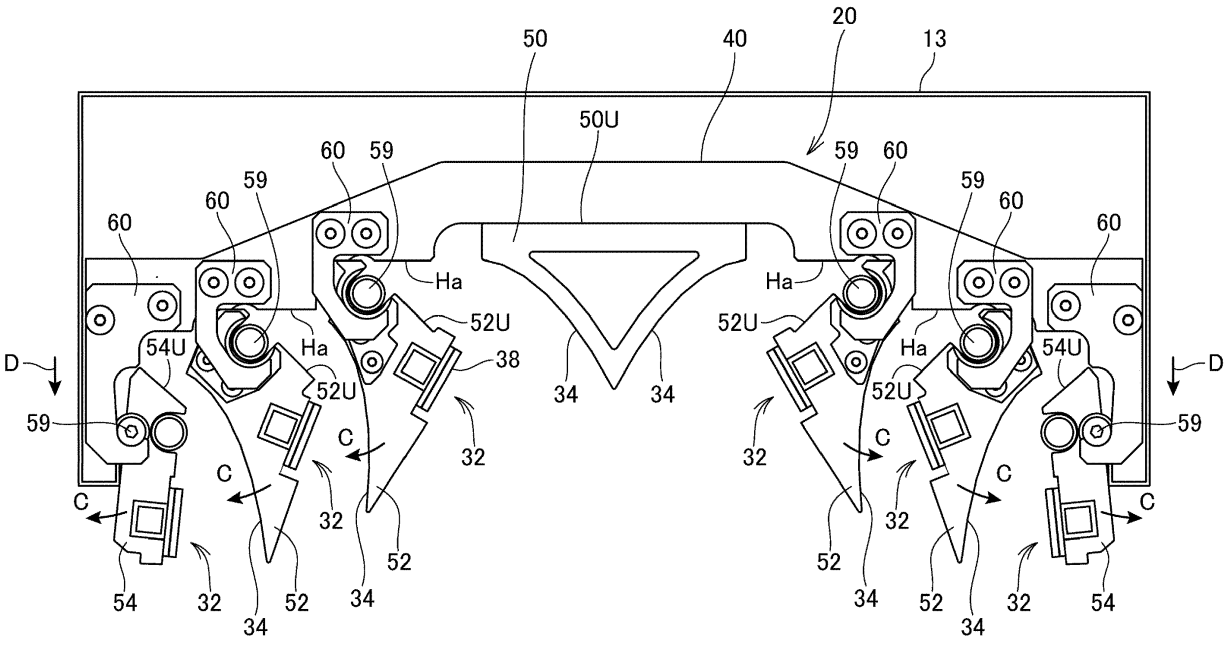
(54) **LINEAR LIGHT IRRADIATION DEVICE**

(57) A light irradiation device is provided which may improve maintainability. In a light irradiation device (10) performing irradiation with line-shaped light, plural pairs of bar-shaped light sources (32) and bar-shaped reflection surfaces (34) are arranged in parallel, each bar-shaped light source (32) having plural light emitting element substrates (38) placed in a straight line manner and radiating line-shaped light, the bar-shaped reflection surface (34) being arranged to be opposed to the bar-shaped light source (32) and condensing the line-shaped light of the bar-shaped light source (32) in a predetermined part in a line shape, and each of the bar-shaped light sources (32) is provided to be movable in a direction to expand a distance from the opposed bar-shaped reflection surface (34).

FIG.7




EP 3 797 994 A1

## Description

BACKGROUND OF THE INVENTION

Field of the Invention

**[0001]** The present invention relates to a light irradiation device.

Description of the Related Art

**[0002]** In related art, a light irradiation device has been known in which plural light source units each of which has a set of opposingly disposed light source and reflection mirror are coupled together in a straight line manner and which performs irradiation with light in a linear shape (hereinafter referred to as "linear light"). Such a light irradiation device is incorporated, as a light source device for curing photo-curable ink, in various printer devices such as sheet-fed printers, for example (for example, see Patent Literature 1).

**[0003]** In this kind of light irradiation device, a space between the light source and the reflection mirror is narrowed, a dimension in an orthogonal direction (hereinafter referred to as "width direction") to an alignment direction (a direction in which the linear light extends) of the light source units is thereby reduced, and down-sizing is intended. However, in a case where maintenance is needed due to degradation or the like of the light source, there may be a case where because the reflection mirror arranged close to the light source becomes an obstacle, it is difficult to detach only the degraded light source from the light source unit. Accordingly, in a work site, a worker usually detaches the whole light source unit having the degraded light source from the light irradiation device and replaces this light source unit with a new light source unit.

Citation List

Patent Literature

**[0004]** Patent Literature 1: Japanese Patent Laid-open No. 2017-30163

SUMMARY OF THE INVENTION

**[0005]** Because each light source unit is connected with a power system and a cooling system of a light irradiation device, work for separating and connecting the light source unit with respect to the power system and the cooling system is necessary for replacement of the light source unit, maintenance work accompanying replacement of the light source unit requests much time and work. Further, there is a case where when a light source is detached from the replaced light source unit by using tools or the like, a reflection mirror is damaged by contact or the like with the tools.

**[0006]** One object of the present invention is to provide a light irradiation device that may improve maintainability.

**[0007]** The present invention provides a light irradiation device performing irradiation with line-shaped light, in which plural pairs of bar-shaped light sources and bar-shaped reflection surfaces are arranged in parallel, the bar-shaped light source having plural light emitting element substrates placed in a straight line manner and radiating line-shaped light, the bar-shaped reflection surface being arranged to be opposed to the bar-shaped light source and condensing the line-shaped light of the bar-shaped light source in a predetermined part in a line shape, and each of the bar-shaped light sources is provided to be movable in a direction to expand a distance from the opposed bar-shaped reflection surface.

**[0008]** The present invention provides the light irradiation device including: plural rod-shaped members to each of which the bar-shaped light source is provided; and a pair of end portion support frames supporting both ends of each of the rod-shaped members, in which the end portion support frame includes a hook portion on which an end portion of the rod-shaped member is hooked and which rotatably supports the end portion.

**[0009]** In the present invention, in the light irradiation device, each of the rod-shaped members has a flat surface for positioning, is positioned in a predetermined position by fixing the flat surface to a flat surface portion formed on the end portion support frame in a surface contact state, and is fastened to the end portion support frame by a bolt, the bolt being inserted in a through hole of the end portion support frame and being screwed into a screw hole formed in the flat surface of the rod-shaped member, and a tapered surface is provided to each of an outer peripheral surface of the bolt and an inner peripheral surface of the through hole, the tapered surface causing centers of the through hole and the screw hole to correspond to each other.

**[0010]** In the present invention, in the light irradiation device, in the rod-shaped member, the bar-shaped light source and a cooling pipe through which a cooling medium flows are provided to a planar surface in a light source carrying surface, and the cooling pipe is provided from one end to another end of the rod-shaped member so as to be flush with the planar surface in the light source carrying surface.

**[0011]** In the present invention, in the light irradiation device, the cooling pipe has a rectangular cross section, and one surface of outside surfaces of the cooling pipe is in surface contact with each of the light emitting element substrates of the bar-shaped light source.

**[0012]** In the present invention, in the light irradiation device, the cooling pipe is formed with a material having a different thermal expansion coefficient from the rod-shaped member and having higher thermal conductivity than the rod-shaped member, is loosely fitted in an attachment groove provided to the planar surface in the light source carrying surface, and is fixed to the attachment groove by an adhesive.

**[0013]** In the present invention, in the light irradiation device, a plate-shaped auxiliary reflection plate is provided between the neighboring light emitting element substrates, the auxiliary reflection plate being orthogonal to a direction in which each of the pairs extends.

**[0014]** The present invention may improve maintainability.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0015]**

Fig. 1 is a schematic diagram of a sheet-fed printer including a light irradiation device according to an embodiment of the present invention;

Fig. 2 is a perspective view of the light irradiation device as seen from above;

Fig. 3 is a perspective view of the light irradiation device as seen from below;

Fig. 4 is a top view illustrating an internal configuration of the light irradiation device in the longitudinal direction;

Fig. 5 is a cross-sectional view illustrating the internal configuration of the light irradiation device in the longitudinal direction;

Fig. 6 is a diagram illustrating a configuration of an irradiator main body when an internal portion is seen from an end portion of the light irradiation device;

Fig. 7 is a diagram illustrating a rotation state of each bar-shaped light source;

Fig. 8 is a cross-sectional view schematically illustrating a fastening structure of a light source carrying reflection mirror bar and an end portion support frame by a bolt;

Fig. 9 is a diagram illustrating a configuration of the light source carrying reflection mirror bar.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0016]** An embodiment of the present invention will hereinafter be described with reference to drawings.

**[0017]** Fig. 1 is a schematic diagram of a sheet-fed printer 1 including a light irradiation device 10 according to this embodiment.

**[0018]** As illustrated in Fig. 1, the sheet-fed printer 1 is configured with a paper feeding device 2, a printing unit 5, a coating unit 6, and a paper discharging device 7.

**[0019]** The sheet-fed printer 1 has the paper feeding device 2, a paper feeding table 3, and the printing unit 5, feeds sheet paper 4 prepared on the paper feeding table 3 to the printing unit 5 by the paper feeding device 2, causes the printing unit 5 to apply ink (active energy ray curable ink) to the sheet paper 4, and thereby prints a desired pattern on the sheet paper 4. Further, the sheet-fed printer 1 includes the coating unit 6 causing the sheet paper 4 to be coated with varnish (active energy ray curable varnish) and the paper discharging device 7 to which the sheet paper 4 printed with ink and varnish is sent from the coating unit 6.

**[0020]** The paper discharging device 7 includes a paper discharging table 8, conveyance means 9, and the light irradiation device 10. The paper discharging device 7 conveys the sheet paper 4 sent from the coating unit 6 to the paper discharging table 8 by the conveyance means 9. The light irradiation device 10 is provided in a predetermined part (more specifically, a predetermined part on the way to the paper discharging table 8) in a conveyance path of the paper discharging device 7, irradiates the sheet paper 4 passing through the predetermined part with ultraviolet rays, and thereby cures the ink and varnish printed on the sheet paper 4 by ultraviolet rays.

**[0021]** The conveyance means 9 includes a sprocket 9A provided above the paper discharging table 8, a sprocket 9B provided in the position corresponding to a sending port of the coating unit 6 for the sheet paper 4, and a paper discharging chain 9C wound around the sprockets 9A and 9B and circulating inter-connectedly with rotations of the sprockets 9A and 9B. The conveyance means 9 conveys the sheet paper 4 sent from the coating unit 6 to the paper discharging table 8 by the circulation of the paper discharging chain 9C.

**[0022]** A circulation path of the paper discharging chain 9C has a forward path through which the sheet paper 4 is moved from one sprocket 9A toward the other sprocket 9B, a return path extending below the forward path while maintaining an equivalent interval from the forward path, and inversion paths in which the paper discharging chain 9C is inverted, from the forward path to the return path or from the return path to the forward path, at sections of the sprockets 9A and 9B.

**[0023]** In the circulation path of the paper discharging chain 9C, the forward path and the return path are inclined with respect to the horizontal direction in portions of zones, and the forward path and the return path extend in the horizontal direction in the other zones.

**[0024]** Grippers 9D are provided along the circulation path of the paper discharging chain 9C, the grippers 9D holding the sheet paper 4 and conveying the sheet paper 4 inter-connectedly with travel of the paper discharging chain 9C. The sheet paper 4 is conveyed while a surface printed with the ink and varnish faces the inside of the circulation path.

**[0025]** The light irradiation device 10 is arranged on the inside of the circulation path of the paper discharging chain 9C and is arranged while an irradiation hole of ultraviolet rays faces a printed surface (irradiated surface), the printed surface being printed with the ink and varnish, of the sheet paper 4 moving on an inclined section of the forward path of the circulation path, the inclined section being inclined with respect to the horizontal direction. In this configuration, because when a state of the sheet paper 4 is monitored from above, a monitoring person is not directly irradiated with ultraviolet rays, the monitoring person is enabled to easily monitor a situation of the sheet

paper 4 without feeling glare.

**[0026]** Because the circulation path of the paper discharging chain 9C needs spaces for providing the grippers 9D, an irradiation distance between the irradiation hole of the light irradiation device 10 and the irradiated surface of the sheet paper 4 is set to a comparatively long distance.

**[0027]** Note that a description is made on the assumption that the light irradiation device 10 irradiates the sheet paper 4 with ultraviolet rays, the sheet paper 4 being conveyed inter-connectedly with circulation movement of the paper discharging chain 9C; however, the light irradiation device 10 may be provided in a position for irradiating the sheet paper 4 with ultraviolet rays, the sheet paper 4 having just passed via the printing unit 5 and the coating unit 6.

**[0028]** Fig. 2 is a perspective view of the light irradiation device 10 as seen from above, and Fig. 3 is a perspective view of the light irradiation device 10 as seen from below.

**[0029]** The light irradiation device 10 has a housing 13 in a thin rectangular-parallelepiped shape having a longitudinal direction, a grip portion 16 is provided to one end surface 13T of the housing 13, the grip portion 16 is gripped, and the light irradiation device 10 is thereby pulled and inserted in the longitudinal direction in an installation position of the sheet-fed printer 1. As illustrated in Fig. 3, an irradiation opening 15A emitting ultraviolet rays is formed in a bottom surface 13B of the housing 13. The irradiation opening 15A has a rectangular-parallelepiped shape in a bottom view, and irradiation with line-shaped light extending in the longitudinal direction of the housing 13 is performed from such an irradiation opening 15A. The irradiation opening 15A is covered by a cover 17 being transparent to light, and the cover 17 is formed with a glass material or the like being light-resistant against ultraviolet rays.

**[0030]** As illustrated in Fig. 3, an irradiator main body 20 is attached and fixed to an internal portion of the housing 13. The irradiator main body 20 is an irradiator performing irradiation with line-shaped ultraviolet rays, the ultraviolet rays being condensed in a predetermined position immediately below the housing 13, and a configuration of the irradiator main body 20 will be described later.

**[0031]** On one end portion 13BT side of the bottom surface 13B of the housing 13, a cooling medium inlet port 19A (flow inlet) and a cooling medium outlet port 19B (flow outlet) are provided. A cooling medium ("water" in this embodiment) is supplied from a chiller device (not illustrated) to the cooling medium inlet port 19A and is introduced into the internal portion of the housing 13 through the cooling medium inlet port 19A. The cooling medium cools the irradiator main body 20 in the internal portion of the housing 13, is thereafter discharged to the outside of the housing 13 through the cooling medium outlet port 19B, and is collected by the chiller device.

**[0032]** As illustrated in Fig. 2, a relay unit 18 is provided on one end portion 13UT side of an upper surface 13U of the housing 13. The relay unit 18 is provided with plural power source terminals 62, and power is supplied to the light irradiation device 10 via electric wires connected with the power source terminals 62, the electric wires being not illustrated. In the internal portion of the housing 13, the irradiator main body 20 is connected with each of the power source terminals 62 by wiring, and power is supplied to the irradiator main body 20.

**[0033]** Next, a configuration of the irradiator main body 20 will be described in detail.

**[0034]** Fig. 4 is a top view illustrating an internal configuration of the light irradiation device 10 in the longitudinal direction, and Fig. 5 is a cross-sectional view illustrating the internal configuration of the light irradiation device 10 in the longitudinal direction. Fig. 6 is a diagram illustrating the configuration of the irradiator main body 20 when an internal portion is seen from an end portion of the light irradiation device 10. Note that Fig. 5 illustrates only principal configurations of the end portion of the irradiator main body 20. Further, in Fig. 4 and Fig. 5, configurations of the light irradiation device 10 in the longitudinal direction are appropriately omitted.

**[0035]** As illustrated in Fig. 6, the irradiator main body 20 has plural pairs (six pairs in the illustrated example) of bar-shaped light sources 32 and bar-shaped reflection surfaces 34 arranged to be opposed to the bar-shaped light sources 32 (hereinafter referred to as "light-source reflection-mirror pair 36"). In an orthogonal plane P (see Fig. 5) as a plane orthogonal to a direction in which the line-shaped light extends (hereinafter referred to as "line direction A"), those light-source reflection-mirror pairs 36 are arranged in parallel and in line symmetry with respect to an optical axis K. In this case, as illustrated in Fig. 6, in each of the light-source reflection-mirror pairs 36, in the orthogonal plane P, the bar-shaped reflection surface 34 is arranged on a side closer to the optical axis K than the bar-shaped light source 32.

**[0036]** In each of the light-source reflection-mirror pairs 36, the bar-shaped light source 32 has plural LED substrates 38 on each of which an ultraviolet LED as one example of a light emitting element is mounted, the LED substrates 38 are placed in the line direction A in a straight line manner, and the bar-shaped light source 32 radiates ultraviolet rays in a line shape extending in the line direction A. The bar-shaped reflection surface 34 is a reflection surface having an elliptical cross section, the reflection surface being arranged to be opposed to the bar-shaped light source 32, reflecting the line-shaped ultraviolet rays of the bar-shaped light source 32, thereby condensing light in a predetermined position (a light condensing point not illustrated) on the optical axis K, and extending in a rod shape. As illustrated in Fig. 6, in the orthogonal plane P, the LED substrate 38 is arranged in a position opposed to a base end portion 34T (an end portion on a far side from the light condensing point) of the bar-shaped reflection surface 34, and the ultraviolet rays radiated by the LED substrate 38 are thereby incident on the bar-shaped reflection surface 34 in a wide range and are condensed

in the predetermined position efficiently and precisely.

**[0037]** In the irradiator main body 20, the light-source reflection-mirror pairs 36 are arranged in parallel with each other and condense ultraviolet rays in the same predetermined position in a line shape, and the ultraviolet rays thereby overlap with each other in a line shape in the predetermined position. Accordingly, illuminance non-uniformity may be reduced in the predetermined position, and irradiation light with a high intensity may be obtained.

**[0038]** Here, as illustrated in Fig. 4 and Fig. 5, the irradiator main body 20 of this embodiment includes one pair of end portion support frames 40 arranged in both end portions of the light irradiation device 10 in the longitudinal direction (line direction A) and plural (two in this embodiment) intermediate support frames 41 provided at appropriate intervals between the end portion support frames 40. The end portion support frames 40 and the intermediate support frames 41 are made by forming a metal material such as aluminum into a column shape and are provided in postures to extend in a width direction B of the housing 13 (that is, an orthogonal direction to the line direction A) as illustrated in Fig. 4.

**[0039]** Each of the bar-shaped light sources 32 and each of the bar-shaped reflection surfaces 34 are positioned by being supported by the pair of end portion support frames 40 and being fixed to each of the end portion support frames 40 and the intermediate support frames 41.

**[0040]** In addition, in this embodiment, as illustrated in Fig. 7, each of the bar-shaped light sources 32 is provided to be movable in an opening direction C to expand the distance from the opposed bar-shaped reflection surface 34. The bar-shaped light source 32 is moved in the opening direction C, and a working space is thereby obtained between the bar-shaped light source 32 and the opposed bar-shaped reflection surface 34 (particularly, the base end portion 34T of the bar-shaped reflection surface 34), the working space being sufficient for insertion of a tool such as a screwdriver and for work for detaching the targeted LED substrate 38.

**[0041]** Consequently, when the LED substrate 38 of the bar-shaped light source 32 is replaced in maintenance work, a worker moves the bar-shaped light source 32 including the targeted LED substrate 38 in the opening direction C and may thereby detach and replace the LED substrate 38 without being obstructed by the bar-shaped reflection surface 34. Accordingly, because a light source unit does not have to be detached as in related art, the maintenance work becomes very easy, and the bar-shaped reflection surface 34 may be prevented from being damaged by contact with a tool or the like in the maintenance work.

**[0042]** Next, a more detailed description will be made about the configuration of the irradiator main body 20 in which each of the bar-shaped light sources 32 is movable in the opening direction C.

**[0043]** As illustrated in Fig. 4 and Fig. 5, the irradiator main body 20 includes a central reflection mirror bar 50 in addition to the above-described pair of end portion support frames 40 and the plural intermediate support frames 41. The central reflection mirror bar 50 is a member which extends in parallel with the line direction A and whose upper surface 50A (Fig. 6) is fixed to each of the pair of end portion support frames 40 and the intermediate support frames 41. A framework of the irradiator main body 20 is formed with those central reflection mirror bar 50, end portion support frames 40, and intermediate support frames 41.

**[0044]** As illustrated in Fig. 4, in a top view, in the irradiator main body 20, a portion between each of the end portion support frames 40 and each of the intermediate support frames 41 is covered by an upper light blocking plate 21, and upward leakage of the ultraviolet rays of the bar-shaped light source 32 is prevented in the internal portion of the housing 13. As illustrated in Fig. 4 and Fig. 5, a terminal block 82 with which wiring 37 (Fig. 9) of the LED substrate 38 of the bar-shaped light source 32 is connected is disposed above the central reflection mirror bar 50, the ultraviolet rays are blocked by the upper light blocking plate 21, and degradation of the wiring 37 connected with the terminal block 82 is thereby prevented.

**[0045]** As illustrated in Fig. 6, the central reflection mirror bar 50 includes plural (two in this embodiment) light source carrying reflection mirror bars 52 and one light source carrying bar 54 on each of both sides in the orthogonal plane P, sets of the plural light source carrying reflection mirror bars 52 and the light source carrying bar 54 are arranged in line symmetry with respect to the optical axis K, and both end portions of each of the light source carrying reflection mirror bars 52 and light source carrying bars 54 are supported by the pair of end portion support frames 40.

**[0046]** As illustrated in Fig. 6, the end portion support frame 40 extends in the width direction B of the housing 13, and both end portions 40A and 40A of the end portion support frame 40 are locked to an inner surface 13N of the housing 13 so as to be incapable of falling. In addition, the end portion support frame 40 of this embodiment is provided with J-shaped hook portions 60 on which the light source carrying reflection mirror bars 52 and the light source carrying bars 54 are hooked and which rotatably support the light source carrying reflection mirror bars 52 and the light source carrying bars 54.

**[0047]** The intermediate support frame 41 is a member having generally the same configuration as the end portion support frame 40 except a point that the hook portion 60 is not provided.

**[0048]** The central reflection mirror bar 50 is formed into a rod shape by extrusion molding of a metal material such as aluminum, for example, and the bar-shaped reflection surfaces 34 are formed on both of left and right sides of the central reflection mirror bar 50 in the orthogonal plane P. More specifically, the central reflection mirror bar 50 is molded in a column shape having a generally triangular cross section, thin plates with high reflectance

are adhered to surfaces of both of the sides in the orthogonal plane P, and the bar-shaped reflection surfaces 34 are thereby formed. Further, the central reflection mirror bar 50 is formed to have a hollow internal portion, weight reduction is intended, and a hollow portion 50H also functions as a heat discharging path causing heat to flow in the line direction A. Through holes 51 are formed at appropriate intervals in the upper surface 50A of the central reflection mirror bar 50, and the heat flowing through the hollow portion 50H is discharged to a portion above the central reflection mirror bar 50 through each of the through holes 51.

**[0049]** As illustrated in Fig. 6 mentioned above, the light source carrying reflection mirror bar 52 is a rod-shaped member carrying one set of the bar-shaped light source 32 and the bar-shaped reflection surface 34 in a back-to-back manner and is formed by extrusion molding of a metal material such as aluminum. The light source carrying reflection mirror bar 52 has a generally triangular cross section, the bar-shaped light source 32 is provided on a light source carrying surface 52K as one of two planar surfaces opposed to each other in the orthogonal plane P, and the bar-shaped reflection surface 34 is formed by adhering a thin plate with high reflectance to a reflection surface carrying surface 52R as the other of the two planar surfaces.

**[0050]** Such a light source carrying reflection mirror bar 52 is supported by the pair of end portion support frames 40 in a posture, in which the bar-shaped light source 32 faces an inner side (a side closer to the optical axis K) in the width direction B of the housing 13, and is fixed by a bolt 70 (Fig. 6) in a state where an upper surface 52U (Fig. 7) as a flat surface for positioning is in surface contact with each of the flat surface portions Ha (Fig. 7) of the end portion support frames 40 and the intermediate support frames 41. The upper surface 52U for positioning of the light source carrying reflection mirror bar 52 is in surface contact with the flat surface portions Ha of the end portion support frames 40 and the intermediate support frames 41, and the light source carrying reflection mirror bar 52 (that is, the set of the bar-shaped light source 32 and the bar-shaped reflection surface 34) is thereby accurately positioned in a predetermined position.

**[0051]** The light source carrying bar 54 is a rod-shaped member carrying one bar-shaped light source 32 by a light source carrying surface 54K and having a generally oblong cross section and is arranged on the outside of the light source carrying reflection mirror bar 52 in the orthogonal plane P, and both end portions of the light source carrying bar 54 are supported by the pair of end portion support frames 40. Similarly to the light source carrying reflection mirror bar 52, such a light source carrying bar 54 is fixed by the bolt 70 in a posture, in which the bar-shaped light source 32 faces an inner side (a side closer to the optical axis K) in the width direction B of the housing 13, and in a state where an upper surface 54U as a flat surface for positioning the light source carrying bar 54 is in surface contact with each of the flat surface portions (not illustrated) of the end portion support frames 40 and the intermediate support frames 41. Accordingly, the light source carrying bar 54 (that is, the bar-shaped light source 32) is accurately positioned in a predetermined position.

**[0052]** In those light source carrying reflection mirror bars 52 and light source carrying bars 54, one recess portion 63 extending in the line direction A is provided in each of the light source carrying surfaces 52K and 54K, and the bar-shaped light source 32 (LED substrate 38) is accommodated in the recess portion 63. Accordingly, in the width direction B (in the orthogonal plane P) of the housing 13, because a space between the light source carrying reflection mirror bars 52 and the light source carrying bars 54 may be narrowed without narrowing a separation distance between the bar-shaped light source 32 and the bar-shaped reflection surface 34 opposed thereto, the dimension of the irradiator main body 20 in the width direction B may be shortened.

**[0053]** Further, an auxiliary reflection surface 52H reflecting light incident thereon is provided in a portion, other than the recess portion 63, of the light source carrying surface 52K of the light source carrying reflection mirror bar 52, and an improvement in irradiation efficiency is intended. Note that an auxiliary reflection plate (not illustrated) may also be attached to the light source carrying bar 54, the auxiliary reflection plate causing a similar effect to the auxiliary reflection surface 52H of the light source carrying surface 52K of the light source carrying reflection mirror bar 52.

**[0054]** As illustrated in Fig. 6, in the irradiator main body 20, a rotation shaft 59 is provided in each of end portions of the light source carrying reflection mirror bars 52 and light source carrying bars 54, and each of the rotation shafts 59 is hooked on the respective hook portions 60 of the end portion support frames 40.

**[0055]** Consequently, by removing the bolts 70 fastening the light source carrying reflection mirror bars 52 and the light source carrying bars 54 to the end portion support frames 40 and the intermediate support frames 41, those light source carrying reflection mirror bars 52 and light source carrying bars 54 become a state of being rotatably supported by the respective hook portions 60. Further, the light source carrying reflection mirror bars 52 and the light source carrying bars 54 are rotated in the opening direction C, the bar-shaped light sources 32 are thereby moved in the opening direction C to expand the distances from the bar-shaped reflection surfaces 34, and the working space is secured.

**[0056]** Note that in the irradiator main body 20, the light source carrying bar 54 is arranged close to the light source carrying reflection mirror bar 52 to the extent that when rotated in the opening direction C, the neighboring light source carrying reflection mirror bar 52 contacts with the light source carrying bar 54. Accordingly, in order to avoid the contact, the hook portion 60 corresponding to the light source carrying bar 54 is formed such that the

light source carrying bar 54 is hooked on the hook portion 60 in a position, in which the contact is avoided in rotation of the light source carrying reflection mirror bar 52, when the light source carrying bar 54 moves in a downward direction D.

**[0057]** Incidentally, when the maintenance work is finished, each of the light source carrying reflection mirror bars 52 and light source carrying bars 54 is fixed to the end portion support frames 40 and the intermediate support frames 41 by the bolts 70. In this fixing, as described above, the upper surfaces 52U and 54U of the light source carrying reflection mirror bars 52 and light source carrying bars 54 are in surface contact with the flat surface portions Ha of the end portion support frames 40 and the intermediate support frames 41, and those light source carrying reflection mirror bars 52 and light source carrying bars 54 are thereby positioned in predetermined positions.

**[0058]** Fig. 8 is a cross-sectional view schematically illustrating a fastening structure of the end portion support frame 40 and the light source carrying reflection mirror bar 52 by the bolt 70.

**[0059]** As illustrated in Fig. 8, the bolt 70 has a shaft portion 71 in which a male thread is formed and a head portion 72. A frame-side bolt insertion hole Fa is formed in the end portion support frame 40, the frame-side bolt insertion hole Fa being a through hole in which the head portion 72 of such a bolt 70 is inserted, and a bar-side bolt fastening hole Ba is formed in the light source carrying reflection mirror bar 52, the bar-side bolt fastening hole Ba being the screw hole in which a female thread is formed. Further, the bolt 70 is inserted in the end portion support frame 40, the shaft portion 71 is screwed into the bar-side bolt fastening hole Ba, and the end portion support frame 40 and the light source carrying reflection mirror bar 52 are thereby fastened together.

**[0060]** In such a fastening structure, in a case where the bolt 70 is fastened in a state where centers G of both of the bar-side bolt fastening hole Ba of the light source carrying reflection mirror bar 52 and the frame-side bolt insertion hole Fa of the end portion support frame 40 are misaligned from each other, if no measure is taken, the bolt 70 is fastened obliquely to the flat surface portion Ha. Thus, a gap occurs between the upper surface 52U for positioning and the flat surface portion Ha, for example, the surface contact then becomes an inadequate state, and positioning precision lowers.

**[0061]** Accordingly, in this embodiment, the misalignment between the respective centers G of the bar-side bolt fastening hole Ba and the frame-side bolt insertion hole Fa is corrected.

**[0062]** Specifically, the bolt 70 has a cylindrical portion 73 with a larger diameter than the head portion 72, and a tapered surface 73A whose diameter is reduced in a depth direction L is provided in a lower end portion of an outer peripheral surface of the cylindrical portion 73.

**[0063]** Meanwhile, a tapered surface 75A, whose diameter is reduced in the depth direction L similarly to the tapered surface 73A of the cylindrical portion 73 of the bolt 70, is provided to an inner peripheral surface of an entrance portion 75 of the frame-side bolt insertion hole Fa.

**[0064]** In such a configuration, even in a case where the bolt 70 is inserted in the frame-side bolt insertion hole Fa in a state where the centers G of the bar-side bolt fastening hole Ba and the frame-side bolt insertion hole Fa are misaligned from each other, the tapered surface 73A of the cylindrical portion 73 is engaged with the tapered surface 75A of the entrance portion 75, the cylindrical portion 73 is thereby guided to the position corresponding to the center G, and the center G of the shaft portion 71 of the bolt 70 is caused to correspond to the center G of the frame-side bolt insertion hole Fa. The bolt 70 is fastened in this state, the center G of the bar-side bolt fastening hole Ba into which the shaft portion 71 is screwed is also caused to correspond to the center G of the frame-side bolt insertion hole Fa, and the misalignment between the centers G is thereby corrected. Accordingly, when the light source carrying reflection mirror bar 52 is fixed by the bolt 70, position misalignment due to misalignment between the centers G is inhibited.

**[0065]** Note that a fastening structure of the light source carrying reflection mirror bar 52 and the intermediate support frame 41 by the bolt 70 and fastening structures of the light source carrying bar 54 and the end portion support frame 40 and the intermediate support frame 41 by the bolts 70 are similar to the fastening structure illustrated in Fig. 8.

**[0066]** Next, a configuration of the light source carrying reflection mirror bar 52 will be described more in detail.

**[0067]** Fig. 9 is a diagram illustrating the configuration of the light source carrying reflection mirror bar 52.

**[0068]** As described above, the light source carrying reflection mirror bar 52 is a rod-shaped member extending in the line direction A, and the recess portion 63 and the auxiliary reflection surface 52H are provided to the light source carrying surface 52K, the recess portion 63 extending in the line direction A, the auxiliary reflection surface 52H being formed in a remaining portion other than the recess portion 63. Plural LED substrates 38 are accommodated in and screwed to the recess portion 63 while being placed in a straight line manner. In the LED substrate 38, a thin and long light emitting portion 39 is configured by aligning the ultraviolet LED along the line direction A in a straight line manner on a mounting substrate in an oblong shape long in the line direction A, the wiring 37 is electrically connected with the terminal block 82, and lighting control of the LED substrate 38 is performed by a control device via electric wires connected with the power source terminals 62, the electric wires being not illustrated.

**[0069]** Further, in the light source carrying reflection mirror bar 52, a slit 83 into which an auxiliary reflection plate 84 is interposed and fixed is formed in a position for demarcating each of the LED substrates 38 (that is, between the neighboring LED substrates 38). As illus-

trated in Fig. 3 mentioned above, such a slit 83 is also provided to the central reflection mirror bar 50 of the irradiator main body 20 and is similarly provided to the light source carrying bar 54 although not illustrated.

**[0070]** The auxiliary reflection plate 84 is a plate material whose both surfaces are formed into reflection surfaces, is interposed into the slit 83 of each of the central reflection mirror bar 50, light source carrying reflection mirror bars 52, and light source carrying bars 54 (that is, all the light-source reflection-mirror pairs 36), is fixed by a plate spring, and is thereby arranged orthogonally to the direction (line direction A) in which the central reflection mirror bar 50, light source carrying reflection mirror bars 52, and light source carrying bars 54 extend. Accordingly, all the light-source reflection-mirror pairs 36 are partitioned by the auxiliary reflection plates 84 in the line direction A, with respect to the LED substrates 38 as units. Accordingly, in each range partitioned by the auxiliary reflection plates 84 in the line direction A, illuminance between the light-source reflection-mirror pairs 36 arranged in parallel is supplemented, and the irradiation efficiency is thus enhanced.

**[0071]** Further, in the irradiator main body 20, the terminal block 82 is provided to each of ranges in the line direction A, the ranges being partitioned by the auxiliary reflection plates 84, and each of the LED substrates 38 belonging to the range is connected by wiring with the terminal block 82 corresponding to the range. Accordingly, in each of the ranges partitioned by the auxiliary reflection plates 84, the irradiator main body 20 may execute lighting control of each of the LED substrates 38 through each of the terminal blocks 82. Consequently, the irradiator main body 20 makes the irradiation range (the length of line-shaped light) in the line direction A or the illuminance distribution become variable, controls a current caused to flow through each of the LED substrates 38 in accordance with the temperature gradients of the bar-shaped light source 32 and bar-shaped reflection surface 34 in the line direction A, thereby reduces temperature differences, and may intend to inhibit the illuminance non-uniformity due to the temperature differences.

**[0072]** As illustrated in Fig. 9, in the light source carrying reflection mirror bar 52, a cooling pipe 85 for cooling the bar-shaped light source 32 is provided in the recess portion 63 along the line direction A. One end portion 85T1 of this cooling pipe 85 is connected with the cooling medium inlet port 19A, the other end portion 85T2 is connected with the cooling medium outlet port 19B through a return pipe 86 passing through an internal portion of the light source carrying reflection mirror bar 52 in the line direction A, and the cooling medium flows through an internal portion of the cooling pipe 85 from the one end portion 85T1 to the other end portion 85T2. As described above, the return pipe 86 passes through the internal portion of the light source carrying reflection mirror bar 52, cooling effect is thereby enhanced, and space saving is intended.

**[0073]** Note that the rotation shaft 59 of the light source carrying reflection mirror bar 52 is configured with both of the end portions 85T1 and 85T2 of the cooling pipe 85 or guides (also referred to as "collar") provided for those, and those end portions 85T1 and 85T2 or the guides are rotatably hooked on the hook portions 60.

**[0074]** Here, in this embodiment, as illustrated in Fig. 6 mentioned above, the cooling pipe 85 is formed to have a rectangular cross section by extrusion molding of a copper material, the copper material having higher thermal conductivity than aluminum as a base material of the light source carrying reflection mirror bar 52, and is embedded in the recess portion 63 in a state where a contact surface 85H as one surface of outside surfaces of the cooling pipe 85 is exposed. A surface of this recess portion 63 is formed into a planar flat surface, and each of the LED substrates 38 is attached to the surface in a state where each of the LED substrates 38 is in surface contact with the contact surface 85H of the cooling pipe 85. Excellent cooling performance is realized by such surface contact and the high thermal conductivity of the cooling pipe 85. In addition to this, because the cooling pipe 85 is made of copper, corrosion resistance may also be improved.

**[0075]** Further, the cooling pipe 85 of this embodiment is fixed to an attachment groove 63M by using an adhesive in a state where the cooling pipe 85 is loosely fitted in the attachment groove 63M formed in the planar surface of the recess portion 63, surface processes such as cutting and polishing are thereafter conducted for the surface of the recess portion 63, and the planar surface of the recess portion 63 is thereby made flush with the contact surface 85H of the cooling pipe 85.

**[0076]** As described above, by providing a certain gap between the attachment groove 63M and the cooling pipe 85, even if a difference in the coefficient of thermal expansion is present between the light source carrying reflection mirror bar 52 and the cooling pipe 85, the difference is absorbed by the gap, and the surface of the recess portion 63 and the contact surface 85H of the cooling pipe 85 are maintained to be flush with each other. Accordingly, because a surface contact state of the LED substrate 38 and the contact surface 85H is maintained, excellent cooling performance is not impaired.

**[0077]** Note that it is matter of course that a thermally conductive material such as thermally conductive grease is applied to the contact surface 85H of the cooling pipe 85 and the thermal conductivity between each of the LED substrates 38 and the contact surface 85H may thereby be enhanced.

**[0078]** Further, in the light source carrying bar 54, the cooling pipe 85 or the like is provided to the recess portion 63 of the light source carrying surface 54K in a similar configuration to the light source carrying reflection mirror bar 52.

**[0079]** The above-described embodiment provides the following effects.

**[0080]** In the light irradiation device 10 of this embod-

iment, each of the bar-shaped light sources 32 included in the irradiator main body 20 is provided to be rotatable in the opening direction C to expand the distance from the opposed bar-shaped reflection surface 34. Accordingly, in the maintenance work, the worker rotates the bar-shaped light source 32 in the opening direction C, a working space is thereby obtained between the bar-shaped light source 32 and the opposed bar-shaped reflection surface 34, the working space being sufficient for insertion of a tool such as a screwdriver and for work for detaching the targeted LED substrate 38, and maintainability is thereby enhanced.

**[0081]** The light irradiation device 10 of this embodiment has the light source carrying reflection mirror bars 52, the light source carrying bars 54, and the pair of end portion support frames 40, the light source carrying reflection mirror bars 52 and light source carrying bars 54 being provided with the bar-shaped light sources 32, the pair of end portion support frames 40 supporting both of the ends of each of those light source carrying reflection mirror bars 52 and light source carrying bars 54, and each of the end portion support frames 40 includes the hook portions 60 on which each of the end portions of the light source carrying reflection mirror bars 52 and light source carrying bars 54 is hooked and which rotatably supports each of the end portions.

**[0082]** Accordingly, rotation of the bar-shaped light sources 32 may be realized by a simple configuration in which the end portions of the light source carrying reflection mirror bars 52 and light source carrying bars 54 are hooked on the hook portions 60, and simplification of the configuration and cost reduction may be intended.

**[0083]** The light irradiation device 10 of this embodiment is configured such that the light source carrying reflection mirror bars 52 and the light source carrying bars 54 respectively have the upper surfaces 52U and 54U as the flat surfaces for positioning, the upper surfaces 52U and 54U are fixed, in a surface contact state, to the flat surface portions Ha formed on the end portion support frames 40, and the light source carrying reflection mirror bars 52 and the light source carrying bars 54 are thereby positioned in predetermined positions.

**[0084]** In addition, those light source carrying reflection mirror bars 52 and the light source carrying bars 54 are configured to be fastened to the end portion support frames 40 by the bolts 70, the bolts 70 being inserted in the frame-side bolt insertion holes Fa of the end portion support frames 40 and being screwed into the bar-side bolt fastening holes Ba formed in the upper surfaces 52U and 54U.

**[0085]** Furthermore, the tapered surfaces 73A and 75A are respectively provided to the outer peripheral surface of the cylindrical portion 73 included in the bolt 70 and to the inner peripheral surface of the frame-side bolt insertion hole Fa, the tapered surfaces 73A and 75A causing the centers G of the frame-side bolt insertion hole Fa and bar-side bolt fastening hole Ba to correspond to each other.

**[0086]** In those configurations, even in a case where the bolt 70 is inserted in the frame-side bolt insertion hole Fa in a state where the centers G of the bar-side bolt fastening hole Ba and the frame-side bolt insertion hole Fa are misaligned from each other, the tapered surfaces 73A and 75A of both of the cylindrical portion 73 and the entrance portion 75 are engaged with each other, the cylindrical portion 73 is thereby guided to the position corresponding to the center G, the center G of the bar-side bolt fastening hole Ba is caused to correspond to the center G of the frame-side bolt insertion hole Fa, and misalignment between the centers G is corrected. Accordingly, when the light source carrying reflection mirror bar 52 is fixed by the bolt 70, position misalignment due to misalignment between the centers G may be inhibited.

**[0087]** The light irradiation device 10 of this embodiment includes the light source carrying reflection mirror bars 52 and light source carrying bars 54 as plural rod-shaped members, in which the bar-shaped light source 32 and the cooling pipes 85 through which the cooling medium flows are provided to the planar surfaces (the surfaces of the recess portions 63) in the light source carrying surfaces 52K and 54K. Further, the cooling pipe 85 is provided from one end to the other end of each of the light source carrying reflection mirror bars 52 and light source carrying bars 54 so as to be flush with the surface of each of the light source carrying surfaces 52K and 54K.

**[0088]** Accordingly, each of the LED substrates 38 of the bar-shaped light sources 32 and the cooling pipe 85 are in proper surface contact with each other, and the cooling performance is enhanced.

**[0089]** In the light irradiation device 10 of this embodiment, the cooling pipe 85 has a rectangular cross section, and the contact surface 85H as one surface of the outside surfaces is in surface contact with a back surface of each of the LED substrates 38 of the bar-shaped light source 32.

**[0090]** Accordingly, the contact area between the cooling pipe 85 and each of the LED substrates 38 is increased, and the cooling performance is further enhanced.

**[0091]** In the light irradiation device 10 of this embodiment, the cooling pipe 85 is formed with a copper material, the copper material being a material having a different thermal expansion coefficient from aluminum as the material of the light source carrying reflection mirror bars 52 and light source carrying bars 54 and having higher thermal conductivity than aluminum, is loosely fitted in the attachment groove 63M provided in the surface of each of the light source carrying surfaces 52K and 54K, and is fixed to the attachment groove 63M by an adhesive.

**[0092]** Accordingly, because a certain gap is present between the attachment groove 63M and the cooling pipe 85, even if a difference in the coefficient of thermal expansion is present between the light source carrying reflection mirror bar 52 and the cooling pipe 85, the differ-

ence is absorbed by the gap, and the surface of the recess portion 63 and the contact surface 85H of the cooling pipe 85 are maintained to be flush with each other. Accordingly, because a surface contact state of the LED substrate 38 and the contact surface 85H is maintained, excellent cooling performance may be maintained.

**[0093]** In the light irradiation device 10 of this embodiment, the plate-shaped auxiliary reflection plate 84 is provided between the neighboring LED substrates 38, the auxiliary reflection plate 84 being orthogonal to a direction in which the light-source reflection-mirror pair 36 extends.

**[0094]** Accordingly, in each of the ranges partitioned by the auxiliary reflection plates 84 in the line direction A, illuminance between the light-source reflection-mirror pairs 36 arranged in parallel is supplemented, and the irradiation efficiency is thus enhanced.

**[0095]** Note that the above-described embodiment merely represents one aspect of the present invention as an example, and any modification and application are possible without departing from the scope of the gist of the present invention.

**[0096]** In the above-described embodiment, the ultraviolet LED is raised as one example of a light emitting element; however, the light emitting element is not limited to this, and an appropriate LED radiating light at another wavelength may be used as the light emitting element.

**[0097]** In the above-described embodiment, as long as in the light source carrying surface 52K of the light source carrying reflection mirror bar 52, at least a part with which the bar-shaped light source 32 contacts (that is, the surface of the recess portion 63) is a planar flat surface, the shape of a surface of the other section (for example, the auxiliary reflection surface 52H) does not have to be a planar flat surface.

**[0098]** Further, the light irradiation device 10 of this embodiment is not limited to lighting for photo-curing in the sheet-fed printer 1 but may be used for lighting of any usage.

**[0099]** Directions such as horizontal and vertical directions and various kinds of values and shapes in the above-described embodiment include a range providing the same work and effects as those directions, values, and shapes (so-called range of equivalents) unless otherwise mentioned.

**[0100]** A light irradiation device is provided which may improve maintainability. In a light irradiation device 10 performing irradiation with line-shaped light, plural pairs of bar-shaped light sources 32 and bar-shaped reflection surfaces 34 are arranged in parallel, the bar-shaped light source 32 having plural light emitting element substrates placed in a straight line manner and radiating line-shaped light, the bar-shaped reflection surface 34 being arranged to be opposed to the bar-shaped light source 32 and condensing the line-shaped light of the bar-shaped light source 32 in a predetermined part in a line shape, and each of the bar-shaped light sources 32 is provided to be movable in a direction to expand a distance from the opposed bar-shaped reflection surface 34.

Reference Signs List

**[0101]**

10 light irradiation device
20 irradiator main body
32 bar-shaped light source
34 bar-shaped reflection surface
36 light-source reflection-mirror pair (pair of bar-shaped light source and bar-shaped reflection surface)
38 LED substrate (light emitting element substrate)
40 end portion support frame
41 intermediate support frame
50 central reflection mirror bar
52 light source carrying reflection mirror bar (rod-shaped member)
52K, 54K light source carrying surface
52U, 54U upper surface (flat surface for positioning)
52H auxiliary reflection surface
54 light source carrying bar (rod-shaped member)
59 rotation shaft
60 hook portion
63 recess portion
70 bolt
73 cylindrical portion
73A, 75A tapered surface
82 terminal block
84 auxiliary reflection plate
85 cooling pipe
85H contact surface
A line direction
Ba bar-side bolt fastening hole (screw hole)
Fa frame-side bolt insertion hole (through hole)
Ha flat surface portion
K optical axis

## Claims

1. A light irradiation device,
the light irradiation device performing irradiation with line-shaped light, **characterized in that**
plural pairs of bar-shaped light sources (32) and bar-shaped reflection surfaces (34) are arranged in parallel, the bar-shaped light source having plural light emitting element substrates (38) placed in a straight line manner and radiating line-shaped light, the bar-shaped reflection surface being arranged to be opposed to the bar-shaped light source and condensing the line-shaped light of the bar-shaped light source in a predetermined part in a line shape, and each of the bar-shaped light sources is provided to be movable in a direction to expand a distance from the opposed bar-shaped reflection surface.

2. The light irradiation device according to claim 1, comprising:

plural rod-shaped members (52, 54) to each of which the bar-shaped light source is provided; and
a pair of end portion support frames (40) supporting both ends of each of the rod-shaped members,
wherein the end portion support frame includes a hook portion (60) on which an end portion of the rod-shaped member is hooked and which rotatably supports the end portion.

3. The light irradiation device according to claim 2, wherein each of the rod-shaped members
has a flat surface (52U, 54U) for positioning,
is positioned in a predetermined position by fixing the flat surface to a flat surface portion (Ha) formed on the end portion support frame in a surface contact state, and
is fastened to the end portion support frame by a bolt (70), the bolt being inserted in a through hole (Fa) of the end portion support frame and being screwed into a screw hole (Ba) formed in the flat surface of the rod-shaped member, and
wherein a tapered surface (73A, 75A) is provided to each of an outer peripheral surface of the bolt and an inner peripheral surface of the through hole, the tapered surface causing centers (G) of the through hole and the screw hole to correspond to each other.

4. The light irradiation device according to claim 2 or 3, wherein in the rod-shaped member,
the bar-shaped light source and a cooling pipe (85) through which a cooling medium flows are provided to a planar surface in a light source carrying surface (52K, 54K), and
wherein the cooling pipe
is provided from one end to another end of the rod-shaped member so as to be flush with the planar surface in the light source carrying surface.

5. The light irradiation device according to claim 4, wherein the cooling pipe
has a rectangular cross section, and one surface of outside surfaces of the cooling pipe is in surface contact with each of the light emitting element substrates of the bar-shaped light source.

6. The light irradiation device according to claim 4 or 5, wherein the cooling pipe
is formed with a material having a different thermal expansion coefficient from the rod-shaped member and having higher thermal conductivity than the rod-shaped member,
is loosely fitted in an attachment groove (63M) provided to the planar surface in the light source carrying surface, and is fixed to the attachment groove by an adhesive.

7. The light irradiation device according to any of claims 1 to 6, wherein a plate-shaped auxiliary reflection plate (84) is provided between the neighboring light emitting element substrates, the auxiliary reflection plate being orthogonal to a direction in which each of the pairs extends.

FIG. 1

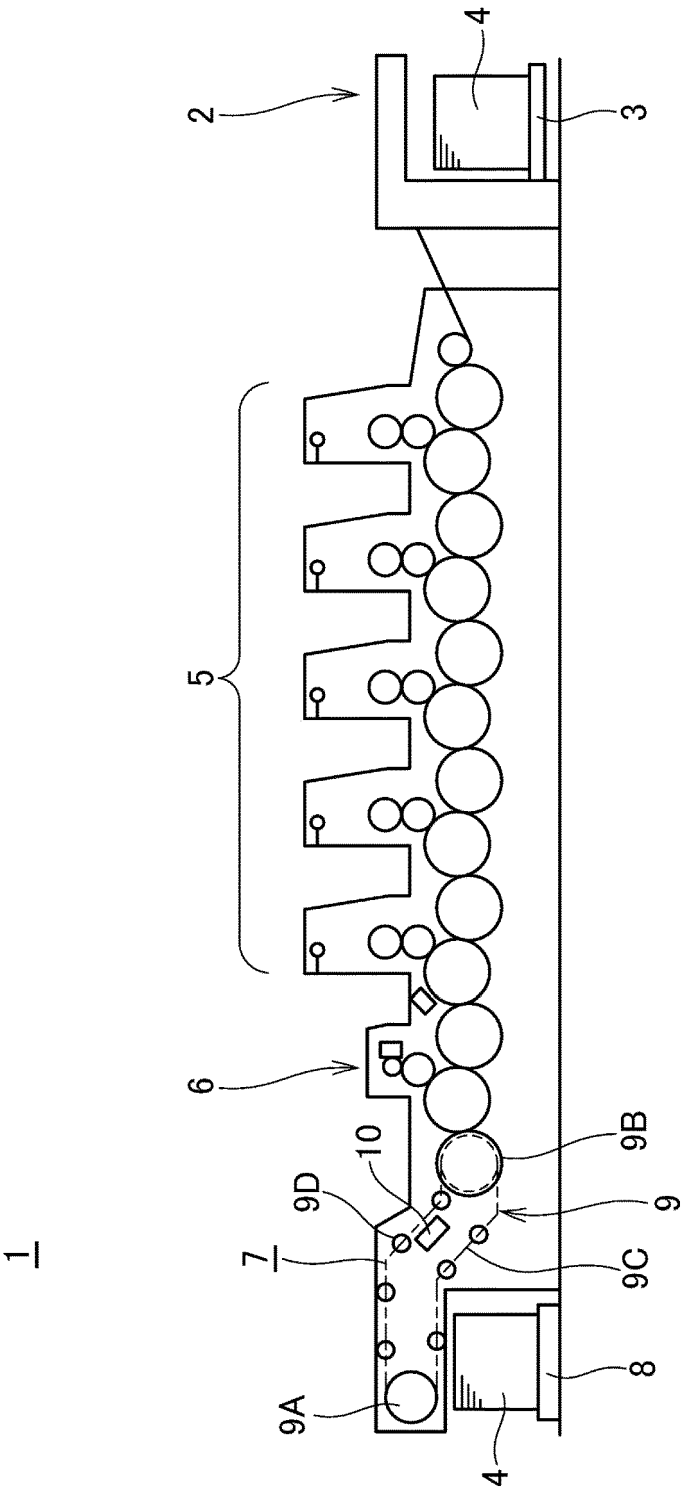


FIG.2

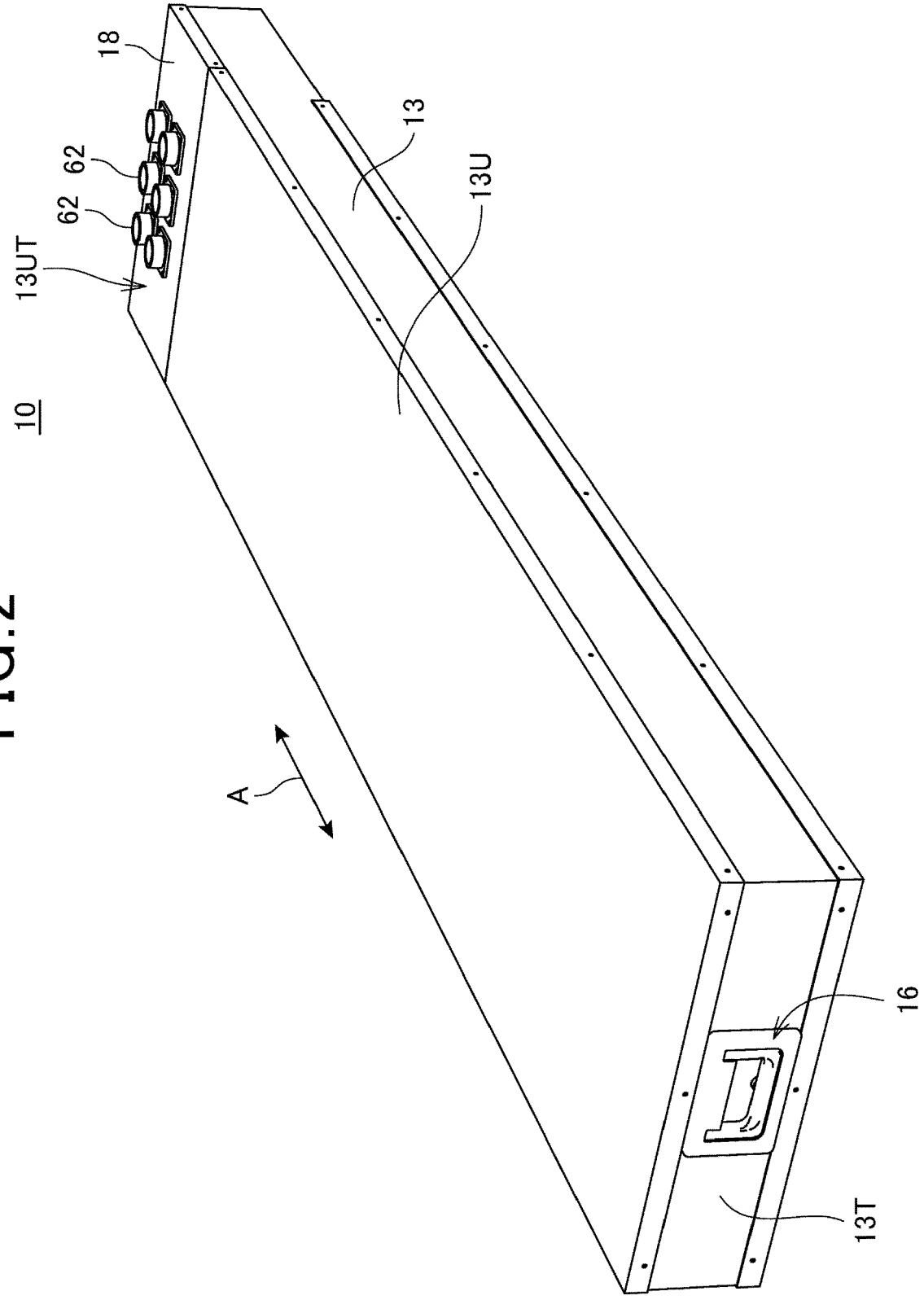


FIG.3

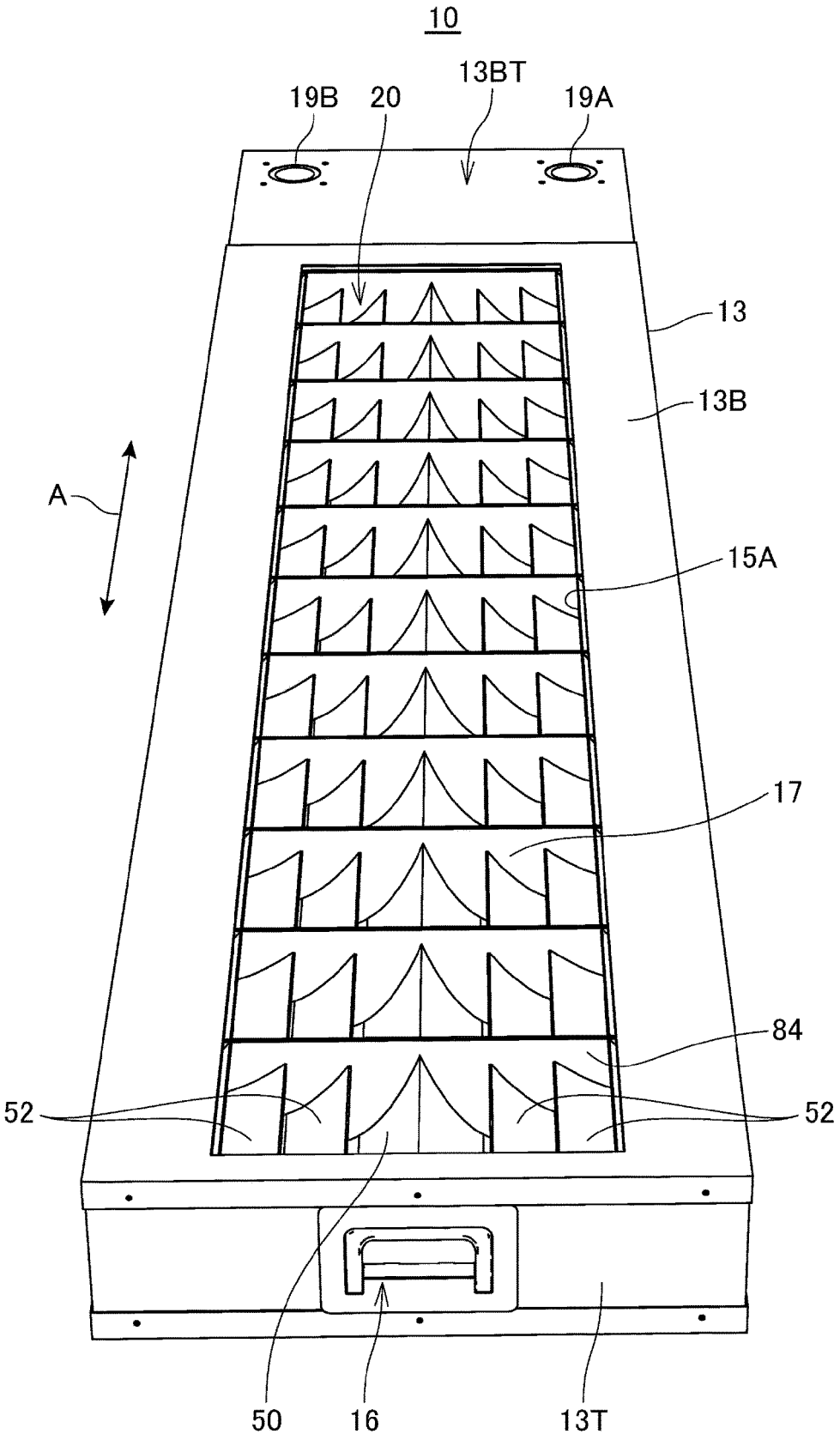


FIG.4

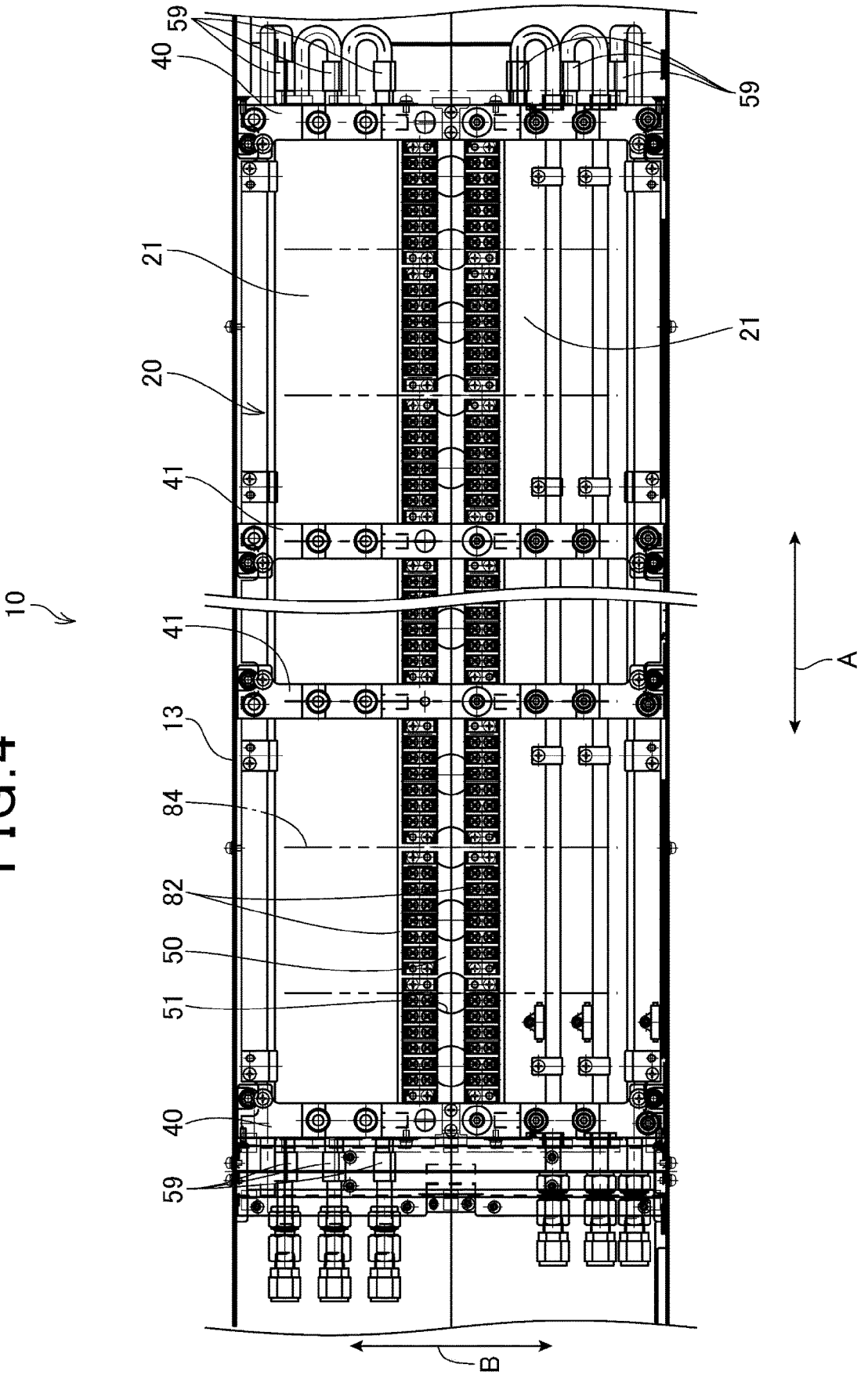


FIG.5

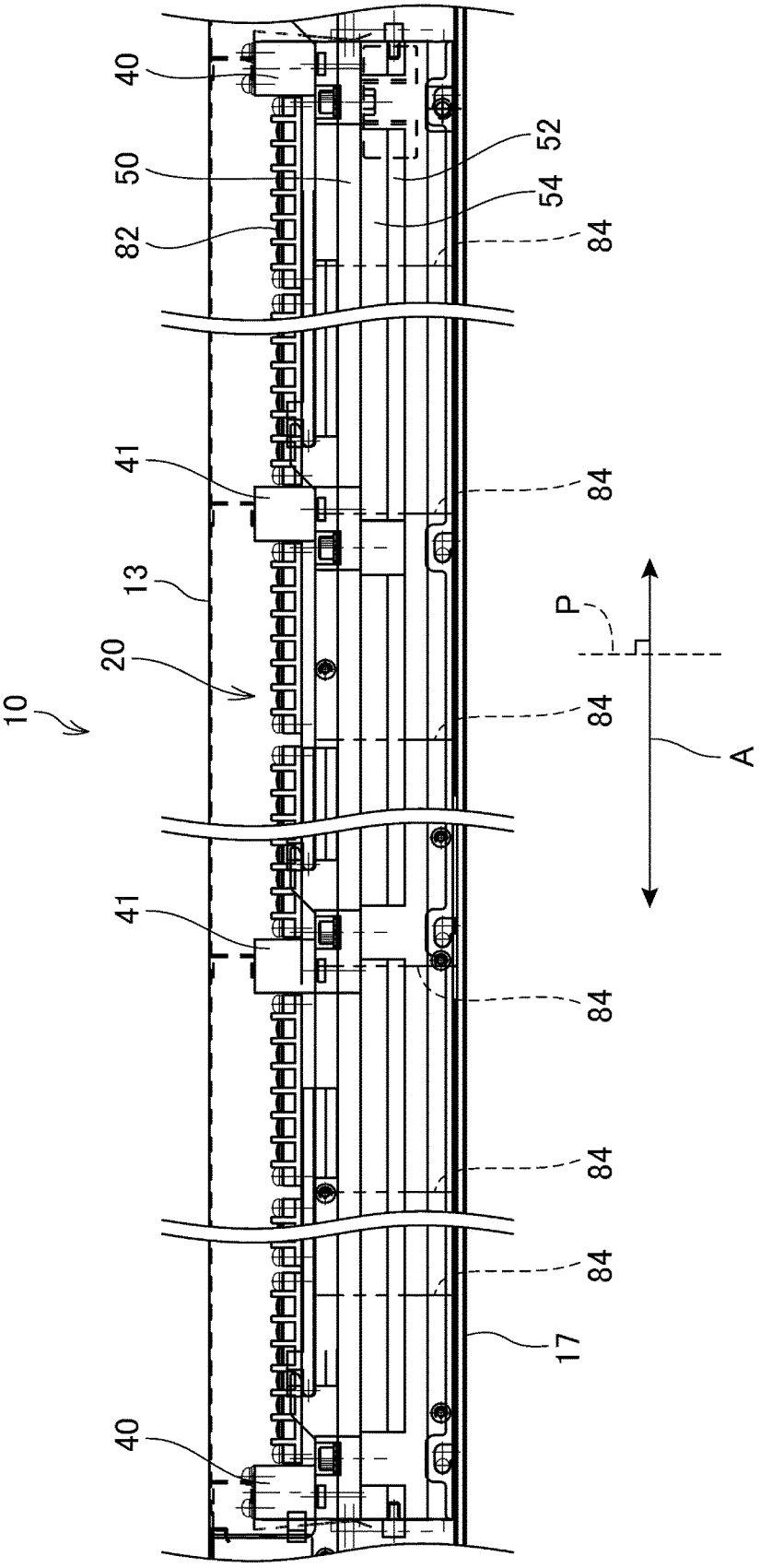
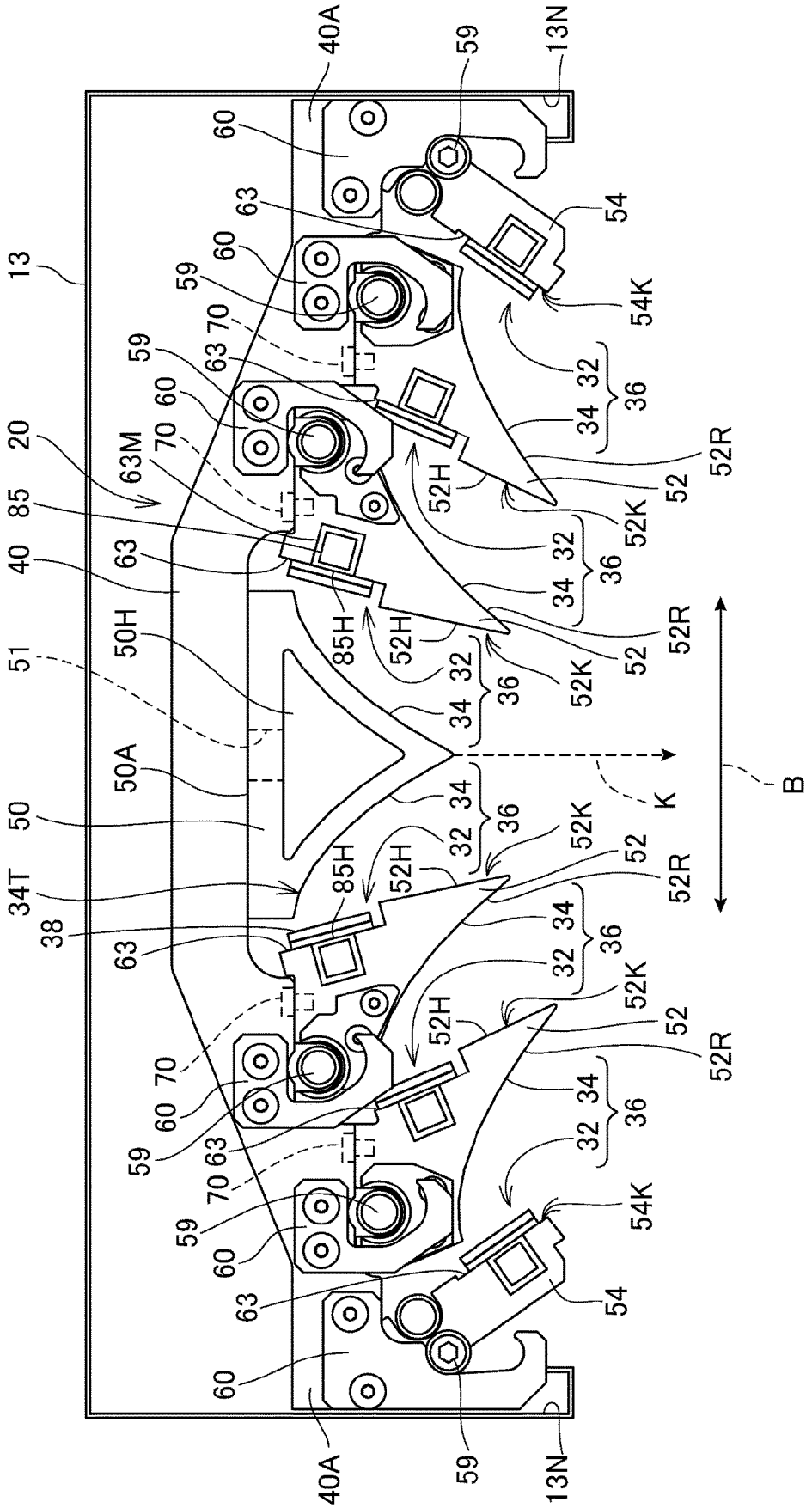


FIG.6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51
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50A
50H
34T
38
63
63M
85
85H
52H
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52K
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54K
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70
40A
13N
K
B

FIG.7

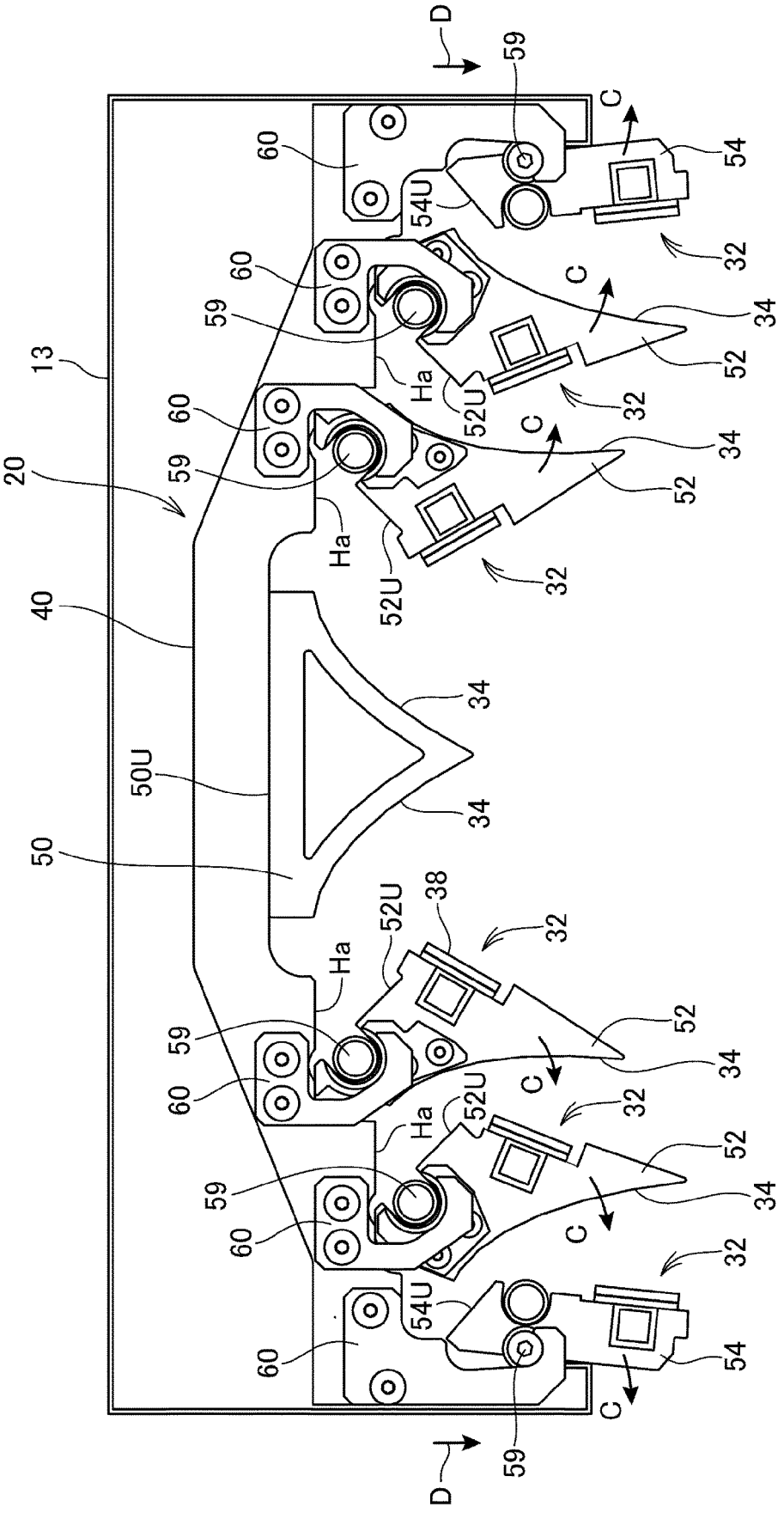


FIG.8

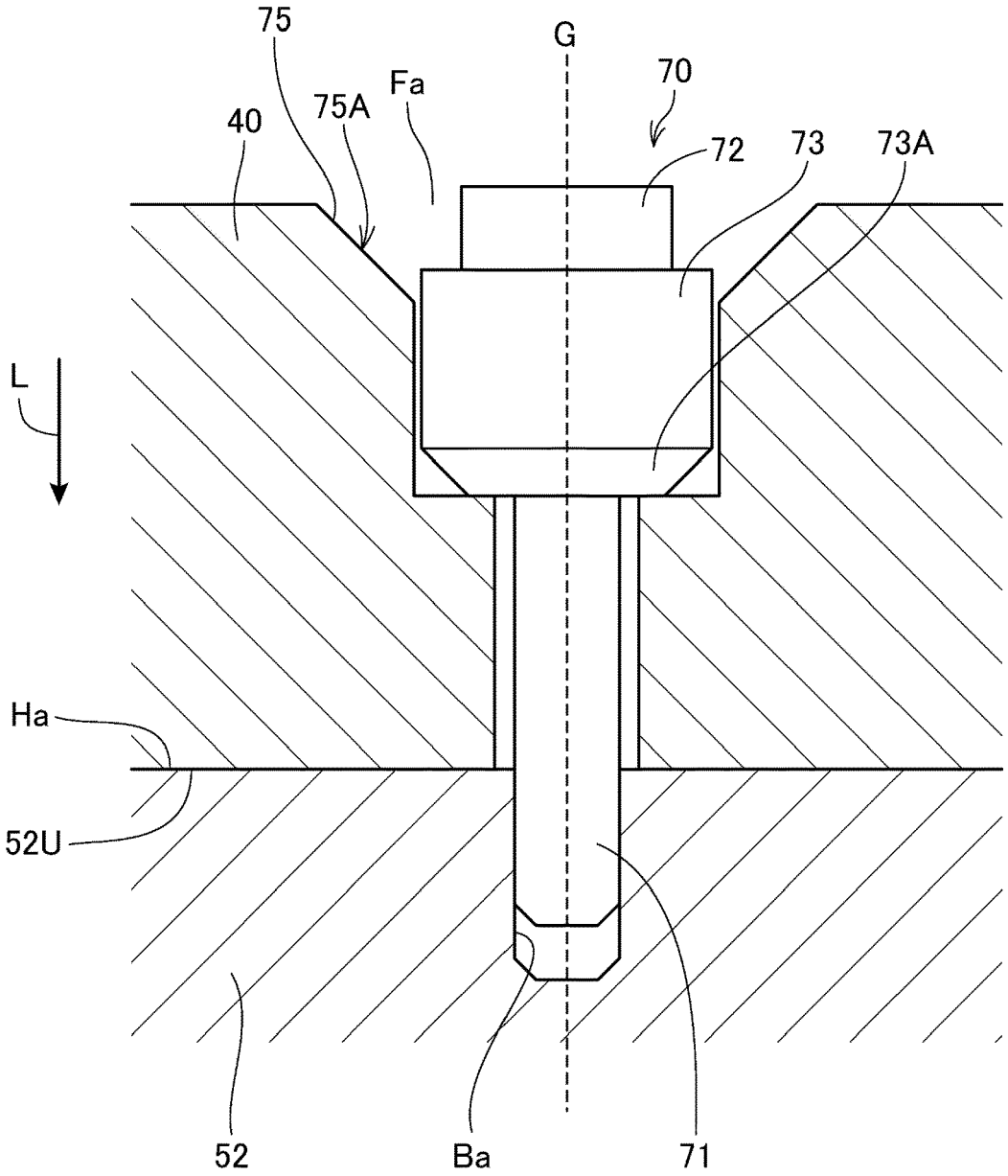
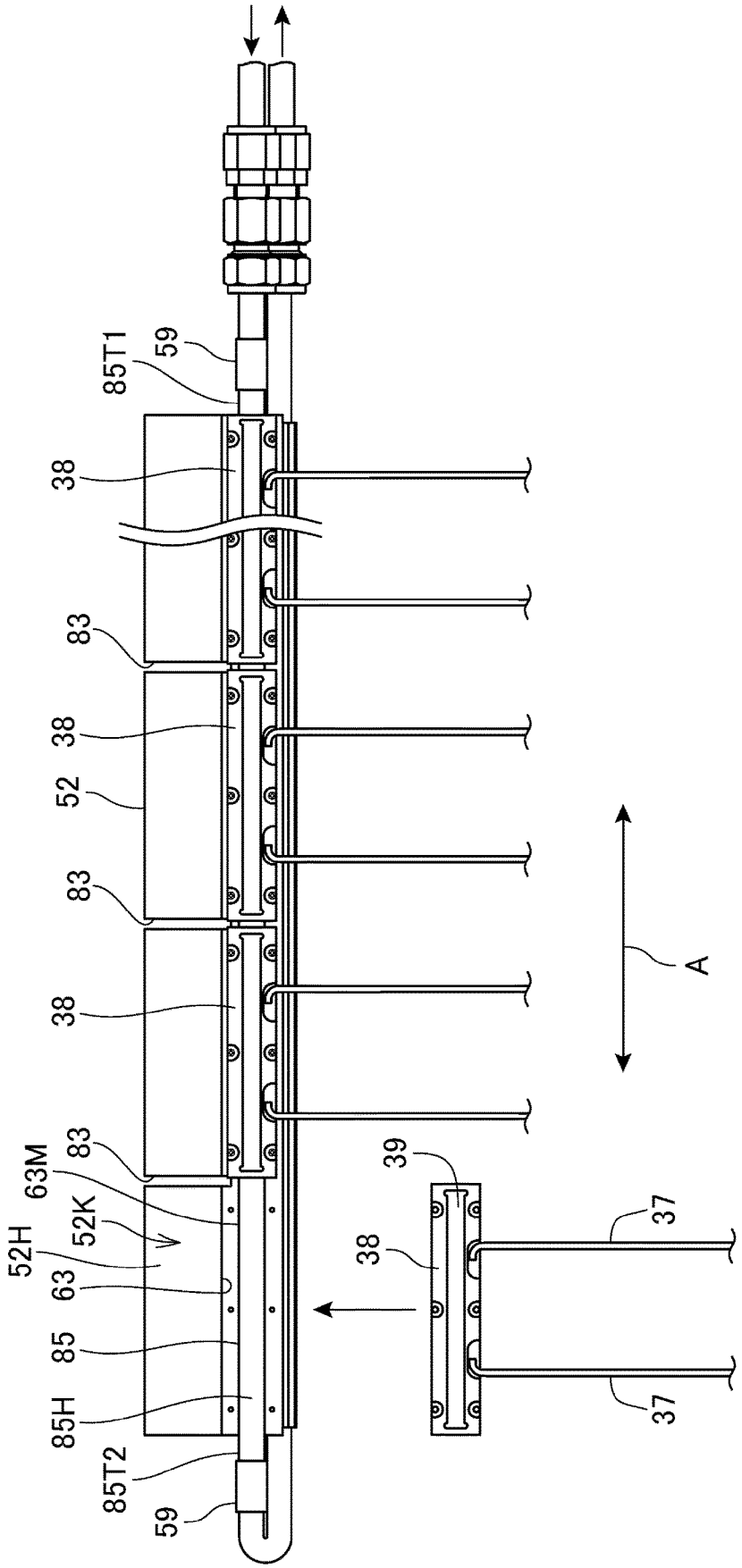


FIG.9


85T1
59
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52
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63M
52K
52H
63
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85H
85T2
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Office européen des brevets

# EUROPEAN SEARCH REPORT

Application Number
EP 20 19 7095

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| Y<br>A | EP 1 914 084 A1 (USHIODENKI KABUSHIKI KAISHA) 23 April 2008 (2008-04-23)<br>* see abstract;<br>paragraph [0001]; claims 1-8; figures 1-10b *<br>* paragraph [0031] - paragraph [0056] * | 1,4-7<br>2,3 | INV.<br>B41F23/04<br>B41J11/00<br>F21V19/04 |
| Y<br>A | EP 0 146 998 A1 (SCREEN PRINTING SUPPLIES PTY LIMITED) 3 July 1985 (1985-07-03)<br>* see abstract;<br>page 4, line 25 - page 8, line 20; claims 1-4; figures 1-4 * | 1,4-7<br>2,3 | |
| Y | WO 2016/067247 A1 (KBA-NOTASYS SA) 6 May 2016 (2016-05-06)<br>* see abstract;<br>page 8, line 6 - page 11, line 28; figures 2-6 * | 4-6 | |
| A | EP 2 944 469 A1 (GEW (EC) LIMITED) 18 November 2015 (2015-11-18)<br>* the whole document * | 1-7 | TECHNICAL FIELDS SEARCHED (IPC) |
| A | US 2011/049392 A1 (AARON D. MARTINEZ) 3 March 2011 (2011-03-03)<br>* the whole document * | 1-7 | B41F<br>B41J<br>F21V |
| A | DE 10 2016 105681 A1 (HOYA CANDEO OPTRONICS CORP.) 6 October 2016 (2016-10-06)<br>* the whole document * | 1-7 | |
| A,D | JP 2017 030163 A (IWASAKI ELECTRIC CO LTD) 9 February 2017 (2017-02-09)<br>* the whole document * | 1-7 | |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 15 February 2021 | Greiner, Ernst |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 19 7095

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15-02-2021

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 1914084 A1 | 23-04-2008 | CN 101165848 A | 23-04-2008 |
| | | EP 1914084 A1 | 23-04-2008 |
| | | JP 2008103143 A | 01-05-2008 |
| | | KR 20080035451 A | 23-04-2008 |
| | | TW 200819307 A | 01-05-2008 |
| | | US 2008094460 A1 | 24-04-2008 |
| EP 0146998 A1 | 03-07-1985 | AU 2935384 A | 03-01-1985 |
| | | EP 0146998 A1 | 03-07-1985 |
| | | JP S6024951 A | 07-02-1985 |
| WO 2016067247 A1 | 06-05-2016 | AU 2015338712 A1 | 06-04-2017 |
| | | BR 112017008831 A2 | 27-03-2018 |
| | | CA 2962878 A1 | 06-05-2016 |
| | | CN 107073929 A | 18-08-2017 |
| | | EP 3015266 A1 | 04-05-2016 |
| | | EP 3096951 A1 | 30-11-2016 |
| | | JP 2017532228 A | 02-11-2017 |
| | | KR 20170078776 A | 07-07-2017 |
| | | PH 12017500796 A1 | 02-10-2017 |
| | | RU 2017116372 A | 04-12-2018 |
| | | US 2017326873 A1 | 16-11-2017 |
| | | WO 2016067247 A1 | 06-05-2016 |
| EP 2944469 A1 | 18-11-2015 | DK 2944469 T3 | 20-11-2017 |
| | | EP 2944469 A1 | 18-11-2015 |
| | | ES 2645493 T3 | 05-12-2017 |
| | | GB 2525905 A | 11-11-2015 |
| | | PL 2944469 T3 | 30-03-2018 |
| | | US 2015323251 A1 | 12-11-2015 |
| US 2011049392 A1 | 03-03-2011 | CA 2771764 A1 | 17-03-2011 |
| | | CN 102574149 A | 11-07-2012 |
| | | EP 2470309 A2 | 04-07-2012 |
| | | JP 5714586 B2 | 07-05-2015 |
| | | JP 2013503448 A | 31-01-2013 |
| | | KR 20130056845 A | 30-05-2013 |
| | | US 2011049392 A1 | 03-03-2011 |
| | | US 2011128680 A1 | 02-06-2011 |
| | | US 2014014857 A1 | 16-01-2014 |
| | | WO 2011031526 A2 | 17-03-2011 |
| | | WO 2011031529 A2 | 17-03-2011 |
| DE 102016105681 A1 | 06-10-2016 | CN 106004029 A | 12-10-2016 |
| | | DE 102016105681 A1 | 06-10-2016 |
| | | JP 2016193505 A | 17-11-2016 |

EPO FORM P0459

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 19 7095

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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15-02-2021

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| | | KR 20160117187 A | 10-10-2016 |
| | | TW 201700306 A | 01-01-2017 |
| | | US 2016288532 A1 | 06-10-2016 |
| JP 2017030163 A | 09-02-2017 | JP 6575201 B2 | 18-09-2019 |
| | | JP 2017030163 A | 09-02-2017 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- JP 2017030163 A **[0004]**