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Remarks:
A request for correction of the drawings (Fig.8) has been filed pursuant to Rule 139 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) **Liquid container**

(57) A liquid container includes a liquid chamber and a movable member pivotally positioned within the liquid chamber. The movable member includes a float portion and a contact surface, and the float portion moves based on an amount of liquid within the liquid chamber, and the movable member pivots based on a movement of the float portion. The liquid container further includes a regulating member configured to contact the contact surface when the amount of liquid within the liquid chamber is equal to or greater than a predetermined amount, and a pivotal movement of the movable member is regulated by the regulating member contacting the contact surface. When the amount of liquid within the liquid chamber decreases, the float portion moves such that the contact surface separates from the regulating member, and when the contact surface initially separates from the regulating member, the contact surface is positioned within the liquid.

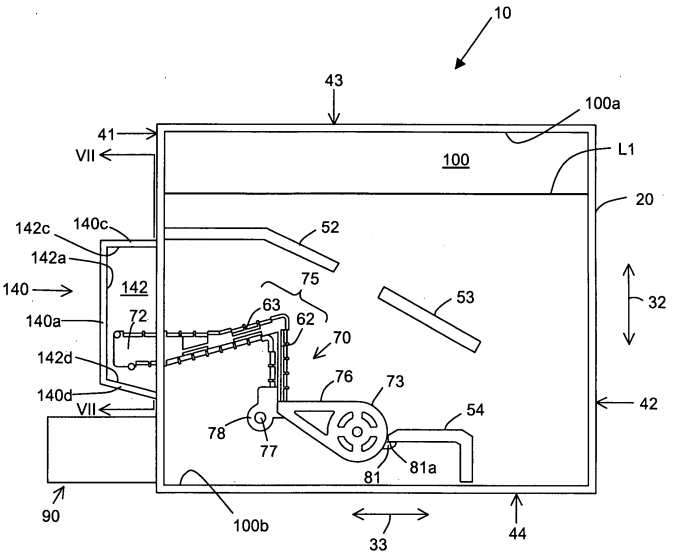

Fig. 2

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates generally to a liquid container comprising a liquid chamber and movable member which indicates whether an amount of liquid stored in the liquid container is sufficient.

2. Description of Related Art

[0002] A known ink cartridge is used with a known inkjet recording apparatus, and is configured to supply ink to a recording head of the inkjet recording apparatus when the ink cartridge is mounted to the inkjet recording apparatus. Another known ink cartridge has a mechanism which indicates an amount of ink in the ink cartridge to a user of the inkjet recording apparatus, or to a controller of the inkjet recording apparatus in order to prevent the inkjet recording apparatus from performing printing with an empty ink cartridge.

[0003] U.S. Patent No. 7,246,894 B2 describes an ink cartridge which has an ink chamber and a movable member pivotally positioned in the ink chamber. The movable member has a signal blocking portion at one end thereof and a float portion at the other end thereof. The specific gravity of the float portion is less than the specific gravity of ink within the ink chamber. The movable member has a pivot center between the signal blocking portion and the float portion. The movable member is attached at the pivot center to a frame defining the ink chamber. The ink cartridge has a translucent portion, and the translucent portion has an inner space formed therein. The inner space of the translucent portion is in fluid communication with the ink chamber. The translucent portion has a plurality of walls, and the plurality of walls defines the inner space. A rib extends from one of the plurality of walls into the inner space. The float portion is configured to move based on the amount of ink within the ink chamber, and the movable member pivots about the pivot center based on the movement of the float portion. When the amount of ink within the ink chamber increases and ink surface within the ink chamber moves up, the float portion moves up, following the movement of the ink surface. When the float portion moves up, the signal blocking portion moves down. When the ink surface within the ink chamber reached a predetermined level, the signal blocking portion contacts the rib within the translucent portion. Even when ink surface moves further up, the pivotal movement of the movable member is restricted by the signal blocking portion contacting the rib, and therefore the float does not follow the movement of the ink surface. Consequently, when the amount of in within the ink chamber is equal to or greater than a predetermined amount, the signal blocking portion contacts the rib. When the ink within the ink chamber is supplied to the inkjet recording apparatus and the amount of ink within the ink chamber decreases from the predetermined amount to an amount less than the predetermined amount, the float portion moves down, following the movement of the ink surface. When the float portion moves down, the signal blocking portion moves up away from the rib. The inkjet recording apparatus determines whether or not the amount of ink within the ink chamber is sufficient by monitoring the movement of the signal blocking portion within the translucent portion.

[0004] When the signal blocking portion begins to separate from the rib, the ink surface is positioned below the translucent portion. Therefore, when the signal blocking portion begins to separate from the rib, the inner space of the translucent portion is filled with air. Nevertheless, a small amount of ink may remain in the inner space of the translucent portion. When the signal blocking portion begins to separate from the rib, a gap is formed between the signal blocking portion and the rib, and a capillary force in the gap draws the ink remaining in the inner space of the translucent portion to the gap between the signal blocking portion and the rib. The surface tension of the ink positioned between the signal blocking portion and the rib pulls the signal blocking portion, which attempts to move away from the rib, toward the rib. Therefore, the pivotal movement of the movable member is hindered, and the timing at which the movable member begins to pivot varies from one cartridge to another. Once inkjet recording apparatus detects the movement of the movable member and determines that the amount of ink within the ink chamber is not sufficient, the inkjet recording apparatus beings to count how many ink droplets are ejected from the recording head. When the counted number of ink droplets reaches a predetermined value, the inkjet recording apparatus stops printing and indicates to a user that the ink cartridge is empty. Ideally, the predetermine value is set such that the amount of ink ejected from the recording head corresponds to the amount ink remaining within the ink chamber when the inkjet recording apparatus begins to count the number of ink droplets. Nevertheless, because the timing at which the movable member begins to pivot varies from one cartridge to another, the predetermine value need to be set to be less than the ideal value to prevent the ink cartridge from becoming empty before the inkjet recording apparatus stops printing, which means that some amount of ink remains unused in some ink cartridges when the inkjet recording apparatus stops printing.

SUMMARY OF THE INVENTION

[0005] Therefore, a need has arisen for a liquid container, such as an ink cartridge, which overcomes these and other shortcomings of the related art. A technical advantage of the present invention is that a movable member of a liquid container pivots smoothly.

[0006] According to the present invention, a liquid container comprises a case comprising a liquid chamber therein for storing liquid therein, a liquid supply portion

configured to supply liquid from an interior of the liquid chamber to an exterior of the liquid chamber, and a movable member positioned within the liquid chamber. The movable member comprises a pivot center, a first portion extending from the pivot center at least in a first direction, and a second portion extending from the pivot center at least in a second direction which is different from the first direction. The movable member is pivotally supported at the pivot center and configured to pivot about the pivot center. The first portion comprises a detection portion, and the second portion comprises a float portion and a contact surface. A specific gravity of the float portion is less than a specific gravity of the liquid within the liquid chamber, and the float portion moves based on an amount of liquid within the liquid chamber, and the movable member pivots based on a movement of the float portion. The liquid container further comprises a regulating member configured to contact the contact surface when the amount of liquid within the liquid chamber is equal to or greater than a predetermined amount, and a pivotal movement of the movable member is regulated by the regulating member contacting the contact surface. When the amount of liquid within the liquid chamber decreases from the predetermined amount to an amount less than the predetermined amount, the float portion moves such that the contact surface separates from the regulating member, and when the contact surface initially separates from the regulating member, the contact surface is positioned within the liquid.

[0007] Because the contact surface is positioned within the liquid when the contact surface initially separates from the regulating member, the contact surface separates from the regulating member smoothly. More specifically, even if liquid exists between the contact surface and the regulating member, the liquid is connected to and surrounded by the bulk of liquid within the liquid chamber, and therefore the surface tension of the liquid, which pulls the contact member toward the regulating member, is small, e.g., is substantially zero. Therefore, the movable member pivots smoothly, and the timing at which the movable member begins to pivot does not vary significantly from one liquid container to another.

[0008] The case may comprise an inner wall surface defining the liquid chamber, and the inner wall surface may comprise a top surface and a bottom surface opposite the top surface. The liquid supply portion may be positioned closer to the bottom surface than to the top surface. A distance between at least a portion of the first portion of the movable member and the top surface may be less than a distance between the second portion of the movable member and the top surface when the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount. The movable member may be configured to pivot in a particular plane. The first portion of the movable member may be separated from the inner wall surface in the particular plane when the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount.

[0009] When liquid is supplied from the interior of the liquid chamber to the exterior of the liquid chamber via the liquid supply portion positioned adjacent to the bottom surface, the liquid surface within the liquid chamber moves away from the top surface toward the bottom surface. Because the distance between the at least a portion of the first portion of the movable member and the top surface is less than the distance between the second portion of the movable member and the top surface, when liquid is supplied to the exterior of the liquid chamber and the liquid surface moves down, the at least a portion of the first portion of the movable member is exposed from the liquid surface earlier than the second portion of the movable member. When liquid is further supplied to the exterior of the liquid chamber and the amount of liquid within the liquid chamber decreases from the predetermined amount to the amount less than the predetermined amount, the movable member pivots. Because the first portion of the movable member is separated from the inner wall surface in the particular plane when the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount, it is difficult for liquid to remain between the at least a portion of the first portion of the movable member and the inner wall surface in the particular plane when the movable member begins to pivot. Therefore, the problem that the surface tension of liquid positioned between the at least a portion of the first portion of the movable member and the inner wall surface pulls the at least a portion of the first portion of the movable member toward the inner wall surface may not occur.

[0010] The case may comprise an inner wall surface defining the liquid chamber. At least a portion of the first portion of the movable member may be positioned higher than the second portion of the movable member when the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount. The movable member may be configured to pivot in a particular plane. The first portion of the movable member may be separated from the inner wall surface in the particular plane when the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount.

[0011] The second sentence of the previous paragraph means that when the liquid container is positioned in an in-use orientation, the at least a portion of the first portion of the movable member may be positioned higher than the second portion of the movable member when the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount. The in-use orientation is an orientation in which the liquid container is positioned when the liquid container is used to supply liquid to the exterior of the liquid chamber via the liquid supply portion. If the liquid container is used as a cartridge, such as an ink cartridge, configured to be mounted to a main device, such as an inkjet printer, the in-use orientation is an orientation in which the liquid container is positioned when the liquid container is mounted to the main device.

[0012] Because the at least a portion of the first portion

of the movable member is positioned higher than the second portion of the movable member, when liquid is supplied to the exterior of the liquid chamber and the liquid surface moves down, the at least a portion of the first portion of the movable member is exposed from the liquid surface earlier than the second portion of the movable member. When liquid is further supplied to the exterior of the liquid chamber and the amount of liquid within the liquid chamber decreases from the predetermined amount to the amount less than the predetermined amount, the movable member pivots. Because the first portion of the movable member is separated from the inner wall surface in the particular plane when the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount, it is difficult for liquid to remain between the at least a portion of the first portion of the movable member and the inner wall surface in the particular plane when the movable member begins to pivot. Therefore, the problem that the surface tension of liquid positioned between the at least a portion of the first portion of the movable member and the inner wall surface pulls the at least a portion of the first portion of the movable member toward the inner wall surface may not occur.

[0013] The case may comprise an inner wall surface defining the liquid chamber, and the inner wall surface may comprise a top surface and a bottom surface opposite the top surface. The liquid supply portion may be positioned closer to the bottom surface than to the top surface. A distance between the contact surface and the bottom surface may be less than a distance between a pivot center and the bottom surface.

[0014] When liquid is supplied from the interior of the liquid chamber to the exterior of the liquid chamber via the liquid supply portion positioned adjacent to the bottom surface, the liquid surface within the liquid chamber moves toward the bottom surface. Because the contact surface is positioned closer to the bottom surface than the pivot center, the movable member can be configured such that the contact surface begins to separate the regulating member and that the movable member begins to pivot when the liquid surface reaches relatively a low level. Because the detection portion begins to move when the amount of liquid within the liquid chamber becomes relatively a small amount, the fact that the liquid chamber is nearly or almost empty can be indicated.

[0015] The contact surface may be positioned lower than the pivot center when the liquid container is positioned in the in-use orientation

[0016] When liquid is supplied from the interior of the liquid chamber to the exterior of the liquid chamber, the liquid surface within the liquid chamber moves down. Because the contact surface is positioned lower than the pivot center, the movable member can be configured such that the contact surface begins to separate the regulating member and that the movable member begins to pivot when the liquid surface reaches relatively a low level. Because the detection portion begins to move when the amount of liquid within the liquid chamber becomes relatively a small amount, the fact that the liquid chamber is nearly or almost empty can be indicated.

[0017] The case may comprise an inner wall surface defining the liquid chamber, and the inner wall surface may comprise a top surface and a bottom surface opposite the top surface. The liquid supply portion may be positioned closer to the bottom surface than to the top surface. A distance between a center of the float portion and the bottom surface may be less than a distance between a pivot center and the bottom surface.

[0018] When liquid is supplied from the interior of the liquid chamber to the exterior of the liquid chamber via the liquid supply portion positioned adjacent to the bottom surface, the liquid surface within the liquid chamber moves toward the bottom surface. Because the center of the float portion is positioned closer to the bottom surface than the pivot center, the movable member can be configured such that the float portion begins to move and the movable member begins to pivot when the liquid surface reaches relatively a low level. Because the detection portion begins to move when the amount of liquid within the liquid chamber becomes relatively a small amount, the fact that the liquid chamber is nearly or almost empty can be indicated.

[0019] A center of the float portion may be positioned lower than the pivot center when the liquid container is positioned in the in-use orientation.

[0020] When liquid is supplied from the interior of the liquid chamber to the exterior of the liquid chamber via the liquid supply portion, the liquid surface within the liquid chamber moves down. Because the center of the float portion is positioned lower than the pivot center, the movable member can be configured such that the float portion begins to move and the movable member begins to pivot when the liquid surface reaches relatively a low level. Because the detection portion begins to move when the amount of liquid within the liquid chamber becomes relatively a small amount, the fact that the liquid chamber is nearly or almost empty can be indicated.

[0021] The case may have a width in a width direction, a height in a height direction, and a depth in a depth direction, and the width direction, the height direction, and the depth direction are perpendicular to each other. The liquid chamber may comprises a first liquid chamber and a second liquid chamber, and a width of the second liquid chamber may be less than a width of the first liquid chamber in the width direction, and the movable member may move in a plane parallel to the height direction and the depth direction. When the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount, the detection portion may be positioned within the second liquid chamber, and the second portion of the movable member may be positioned within the first liquid chamber.

[0022] Because the detection portion is positioned within the second liquid chamber having a narrow width, the movement of the detection portion readily can be detected, for example, by sandwiching the second liquid

chamber by a light emitting element and a light receiving element of an optical sensor. On the other hand, because the second portion of the movable member is positioned within the first liquid chamber having a wider width, the first liquid chamber and the movable member can be configured such that the second portion of the movable member other than the contact surface does not contact the inner wall surface of the first liquid chamber. Therefore, a problem that the pivotal movement of the movable member is hindered due to contact between the second portion of the movable member and the inner wall surface of the first liquid chamber may not occur.

[0023] The first portion of the movable member may comprise a first sub-portion extending in the first direction and a second sub-portion extending in a third direction which is different from the first direction.

[0024] The case may comprise an inner wall surface defining the liquid chamber, and a portion of the inner wall surface may be positioned between the detection portion and the liquid supply portion. The detection portion of the movable member may be separated from the portion of the inner wall surface when the amount of liquid within the liquid chamber is equal to or greater than the predetermined amount.

[0025] Other features and technical advantages of the present invention will be apparent to persons of ordinary skill in the art in view of the following detailed description of the invention and the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0026] For a more complete understanding of the present invention, the needs satisfied thereby, and the objects, features, and advantages thereof, reference now is made to the following description taken in connection with the accompanying drawings.

[0027] Figs. 1(A) and 1(B) are a front-face perspective view and a rear-face perspective view of an ink cartridge, respectively, according to an embodiment of the present invention.

[0028] Fig. 2 is a side view of the ink cartridge of Figs. 1(A) and 1(B), in which: the ink cartridge is positioned in an in-use orientation; a right side wall of a case and a right side wall of a translucent portion of the case are omitted; and an amount of ink within ink chambers is greater than a predetermined amount such that an ink surface within a first ink chamber is positioned at a level L1 and a movable member is positioned in a first position.

[0029] Fig. 3 is a side view of the ink cartridge of Figs. 1(A) and 1(B), in which: the ink cartridge is positioned in the in-use orientation; the right side wall of the case and the right side wall of the translucent portion are omitted; and the amount of ink within ink chambers is equal to the predetermined amount such that the ink surface within the first ink chamber is positioned at a level L2 and the movable member is positioned in the first position.

[0030] Fig. 4 is a side view of the ink cartridge of Figs. 1(A) and 1(B), in which: the ink cartridge is positioned in the in-use orientation; the right side wall of the case and the right side wall of the translucent portion are omitted; and the amount of ink within ink chambers is less than the predetermined amount such that the ink surface within the first ink chamber is positioned at a level L3 and the movable member is positioned in the second position.

[0031] Fig. 5 is a rear-face perspective view of the ink cartridge of Figs. 1(A) and 1(B), in which an ink supply portion, an air intake hole, and some of reinforcing walls are omitted, and the case and the translucent portion are depicted in alternate long and short dash lines.

[0032] Figs. 6(A) and 6(B) are a front perspective view and a rear perspective view of the movable member, respectively.

[0033] Fig. 7 is a cross-sectional view taken along a line VII-VII in Fig. 2.

[0034] Fig. 8 shows distances between elements of the ink cartridge shown in Fig. 2.

DETAILED DESCRIPTION OF EMBODIMENTS

[0035] Embodiments of the present invention and their features and technical advantages may be understood by referring to Figs. 1(A)-8, like numerals being used for like corresponding portions in the various drawings.

[0036] Referring to Figs. 1(A) and 1(B), an ink cartridge 10 as an example of a liquid container according to an embodiment of the present invention is depicted. The ink cartridge 10 is configured to be used in combination with an ink-jet printer (not shown). The ink cartridge 10 is configured to be removably mounted to a mounting portion of the printer. When the ink cartridge 10 is mounted to the mounting portion, ink is supplied from the ink cartridge 10 to a recording head (not shown) of the printer.

[0037] The ink cartridge 10 has a substantially flat, hexahedron shape. A width of the ink cartridge 10 in a width direction, as indicated by an arrow 31, is relatively short, and each of a height of the ink cartridge 10 in a height direction, as indicated by an arrow 32, and a depth of the ink cartridge 10 in a depth direction, as indicated by an arrow 33, is greater than the width of the ink cartridge 10. The ink cartridge 10 is inserted into a printer in a direction indicated by an arrow 30.

[0038] Referring to Figs. 1(A)-4, the ink cartridge 10 comprises a case 20, a movable member 70, and an ink supply portion 90. The case 20 comprises a first ink chamber 100 therein for storing ink. The case 20 is formed of a translucent resin material, such as a transparent or semi-transparent resin material, e.g., a resin comprising polyacetal, nylon, polyethylene, polypropylene, or the like, or any combination thereof, to allow light to pass therethrough. The case 20 comprises a front wall 41, a rear wall 42, a top wall 43, and a bottom wall 44. The case 20 also comprises a right side wall 45 and a left side wall 46 which oppose each other, and each of the side walls 45 and 46 is connected to the front wall 41, the rear wall 42, the top wall 43, and the bottom wall 44. Each of the side walls 45 and 46 has a surface area

which is greater than each of a surface area of the front wall 41, a surface area of the rear wall 42, a surface area of the top wall 43, and a surface area of the bottom wall 44. The case 20 further comprises reinforcing walls 52, 53, and 54 positioned within the first ink chamber 100 and extending from one of the side walls 45 and 46 to the other of the side walls 45 and 46 to reinforce the rigidity of the case 20. When the ink cartridge 10 is mounted to the printer, the ink cartridge 10 is positioned in an in-use orientation. When the ink cartridge 10 is positioned in the in-use orientation, the top wall 43 is positioned above the bottom wall 44 as in Figs. 2 to 4.

[0039] The case 20 comprises an inner wall surface defining the first ink chamber 100. The inner wall surface comprises a top surface 100a and a bottom surface 100b opposite the top surface 100a.

[0040] The ink supply portion 90 is positioned at the front wall 41 at a position adjacent to the bottom wall 44. The ink supply portion 90 is positioned closer to the bottom surface 100b than to the top surface 100a. A valve (not shown) is disposed within the ink supply portion 90. When the ink cartridge is not mounted to the mounting portion of the printer, the valve is closed, and fluid communication between the interior of the first ink chamber 100 and the exterior of the ink cartridge 10 via the ink supply portion 90 is prevented. When the ink cartridge is mounted to the mounting portion of the printer, a pipe (not shown) positioned in the mounting portion enters the ink supply portion 90 and pushes the valve to open within the ink supply portion 90. When the valve is opened, the first ink chamber 100 is brought into fluid communication with the exterior of the ink cartridge 10 via the ink supply portion 90, and ink is supplied from the interior of the first ink chamber 100 to the recording head of the printer via the pipe. Such a valve is known and described in, for example, US2007/0070138 A1.

[0041] An air intake hole 80 is formed through the top wall 43. Before the ink cartridge 10 is used, a sticker (not shown) is placed on the top wall 43 to cover the air intake hole 80, and fluid communication between the interior of the first ink chamber 100 and the exterior of the ink cartridge 10 via the air intake hole 80 is prevented. When a user intends to use the ink cartridge 10, the user removes the sticker from the top wall 43, and thereby the first ink chamber 100 is brought into fluid communication with the exterior of the ink cartridge 10 via the air intake hole 80.

[0042] The case 20 comprises a translucent portion 140 positioned at a center portion of the front wall 41 of the case 20, and the translucent portion 140 extends in a direction away from the front wall 41. An amount of ink stored in the first ink chamber 100 is optically or visually detected through the translucent portion 140. The translucent portion 140 is integral with the case 20, and is formed of the same material as the case 20.

[0043] The translucent portion 140 comprises five walls, and has a substantially a hollow box shape. For example, the translucent portion 140 comprises a front wall 140a, a pair of side walls 140b, a top wall 140c, and a bottom wall 140d. Each of the front wall 140a, side walls 140b, the top wall 140c, and the bottom wall 140d has substantially a rectangular shape. The front wall 140a extends parallel to the front wall 41 and is separated from the front wall 41 by a predetermined distance. The pair of side walls 140b are connected to the front wall 41 and the front wall 140a, the top wall 140c is connected to top ends of the front wall 140a and the side walls 140b, and the bottom wall 140d is connected to bottom ends of the front wall 140a and the side walls 140b. Moreover, a width of the front wall 140a is less than a width of the front wall 41 in the width direction 31.

[0044] The translucent portion 140 has a second ink chamber 142 formed therein, which is defined by inner wall surfaces 142a, 142b, 142c and 142d of the front wall 140a, the side walls 140b, the top wall 140c and the bottom wall 140d, respectively. The second ink chamber 142 is configured to be in fluid communication with the interior of the first ink chamber 100, e.g., there is no wall positioned between the second ink chamber 142 and the first ink chamber 100. Referring to Fig. 5, a width of the second ink chamber 142 is less than a width of the first ink chamber 100 in the width direction 31. Referring back to Figs. 1(A) to 4, the movable member 70 is configured to move between a first position and a second position based on an amount of ink within the first and second ink chambers 100 and 142. When the movable member 70 is in the first position, a detection portion 72 of the movable member 70 is positioned within the lower portion of the second ink chamber 142, as in Figs. 2 and 3. When the movable member 70 is positioned in the second position, the detection portion 72 is positioned within a middle portion of the second ink chamber 142 in the height direction 32, as in Fig. 4.

[0045] When the ink cartridge 10 is mounted to the printer, a lower portion of the translucent portion 140 is configured to be sandwiched between a light-emitting element (not shown) and a light-receiving element (not shown) of an optical sensor (not shown), e.g. a photo interrupter, which is positioned in the printer. Light emitted by the light-emitting element passes through the side walls 140b, and is received by the light-receiving element when the detection portion 72 is positioned above the lower portion of the second ink chamber 142, e.g., when positioned within the middle portion of the second ink chamber 142. The light is blocked by the detection portion 72, and is not receive by the light-receiving element when the detection portion 72 is positioned within the lower portion of the second ink chamber 142. As such, the position of the detection portion 72 can be monitored by the optical sensor.

[0046] The movable member 70 is configured to indicate whether the first and second ink chambers 100 and 142 has a sufficient amount of ink stored therein. Referring to Figs. 2 to 6(B), the movable member 70 comprises a pivot center, e.g., a middle portion 78 having a shaft hole 78a formed therethrough. The case 20 further comprises a supporting shaft 77 positioned within the first ink

chamber 100 and extending from one of the side walls 45 and 46 to the other of the side walls 45 and 46. The supporting shaft 77 extends in the width direction 31 through the shaft hole 78a, such that the movable member 70 is supported at the middle portion 78 and pivots about the middle portion 78, i.e., about the supporting shaft 77 and the shaft hole 78a in a particular plane which is substantially parallel to the height direction 32 and the depth direction 33. The movable member 70 comprises a first portion 75 extending from the middle portion 78, and the first portion 75 comprises the detection portion 72. More specifically, the first portion 75 comprises a first sub-portion 62 extending in a first direction from a first end of the first sub-portion 62 which is connected to the middle portion 78 to a second end of the first sub-portion 62, and a second sub-portion 63 extending in a third direction from a first end of the second sub-portion 63 which is connected to the second end of the first sub-portion 62 to a second end of the second sub-portion 63. The third direction is different from the first direction. The second end of the second sub-portion 63 comprises the detection portion 72. The movable member 70 also comprises a second portion 76 extending from the middle portion 78, and the second portion 76 comprises a float portion 73. More specifically, the second portion 76 extends in a second direction from a first end of the second portion 76 which is connected to the middle portion 78 to a second end of the second portion 76. The second direction is different from the first direction. The second end of the second portion 76 comprises the float portion 73.

[0047] The specific gravity of the float portion 73 is less than the specific gravity of ink stored in the first and second ink chambers 100 and 142. The float portion 73 has a hollow formed therein, and the float portion 73 floats on ink, such that the float portion 73 moves upward and downward based on the amount of ink within the first and second ink chambers 100 and 142. The movable member 70 pivots based on the movement of the float portion 73. In another embodiment, the float portion 73 may not have the hollow, and may be formed of a material having a specific gravity less than the specific gravity of ink.

[0048] The mass and the volume of the second portion 76 are greater than the mass and the volume of the first portion 75, respectively.

[0049] The second portion 76 of the movable member 70 further comprises a contact portion 81 extending from the float portion 73, and the contact portion 81 comprises a contact surface 81a.

[0050] As the amount of ink within the first and second ink chambers 100 and 142 increases, the ink surface within the first and second ink chambers 100 and 142 moves up, and the float portion 73 moves up, following the movement of the ink surface, such that the movable member 70 pivots. Nevertheless, when the amount of ink within the first and second ink chambers 100 and 142 is equal to or greater than a predetermined amount and the ink surface within the first ink chamber 100 is at a level L2 or higher than the level L2, e.g., at a level L1, the contact surface 81a contacts a regulating member, e.g., an end of the reinforcing wall 54 as shown in Figs. 2 and 3, such that the float portion 73 does not move further up. The pivotal movement of the movable member 70 is regulated by the contact surface 81a contacting the end of the reinforcing wall 54, such that the movable member 70 is positioned in the first position. When the amount of ink within the first and second ink chambers 100 and 142 is equal to or greater than a predetermined amount such that the movable member 70 is positioned in the first position, the contact surface 81 a is positioned within the ink, i.e., is submerged in the ink. Referring to Figs. 2, 3, 5, 7 and 8, when the amount of ink within the first and second ink chambers 100 and 142 is equal to or greater than a predetermined amount such that the movable member 70 is positioned in the first position, the first portion 75 of the movable member 70 is separated from the inner wall surfaces of the case 20 in the particular plane. In particular, the detection portion 72 is separated from inner wall surfaces 142a, 142b, 142c, and 142d of front wall 140a, side walls 140b, top wall 140c, and the bottom wall 140d, respectively. Incidentally, the inner wall surface 142d of the bottom wall 140d is positioned between the detection portion 72 and the ink supply portion 90. Moreover, at least a portion of the first portion 75 of the movable member 70 is positioned higher than the second portion 76 of the movable member 70. More specifically, a distance between at least a portion of the first portion 75 of the movable member 70 and the top surface 100a is less than a distance between the second portion 76 of the movable member 70 and the top surface 100a. For example, a distance D1 between the detection portion 72 and the top surface 100a is less than a distance D3 between the second portion 76 of the movable member 70 and the top surface 100a in a direction perpendicular to the top surface 100a, and a distance D2 between the second end of the first sub-portion 62 of the first portion 75 is less than the distance D3 in the direction perpendicular to the top surface 100a, as shown in Fig. 8. Moreover, the contact surface 81a is positioned lower than the middle portion 78 of the movable member 70. More specifically, a distance D5 between the contact surface 81a and the bottom surface 100b is less than a distance D4 between the middle portion 78 and the bottom surface 100b in a direction perpendicular to the bottom surface 100b. Moreover, the center of the float portion 73 is positioned lower than the middle portion 78 of the movable member 70. More specifically, a distance D6 between the center of the float portion 73 and the bottom surface 100b is less than the distance D4 in the direction perpendicular to the bottom surface 100b. Moreover, the detection portion 72 is positioned within the second ink chamber 142 and the second portion 76 of the movable member 70 is positioned within the first ink chamber 100.

[0051] When ink is supplied from the first and second ink chambers 100 and 142 to the exterior of the ink cartridge 10, and the amount of ink within the first and second

ink chambers 100 and 142 decreases from the predetermined amount to an amount less than the predetermined amount, the float portion 73 moves down, following the ink surface, and separates from the end of the reinforcing wall 54. Because the contact surface 81a is positioned within the ink when the amount of ink within the first and second ink chambers 100 and 142 is equal to or greater than a predetermined amount, the contact surface 81a is positioned within the ink when the contact surface 81a initially separates form the end of the reinforcing wall 54. Therefore, the timing at which the movable member 70 begins to pivot does not vary significantly from one ink cartridge to another. When the float portion 73 moves down, the movable member 70 pivots such that the detection portion 72 moves up.

[0052] Referring to Fig, 4, as the amount of ink within the first and second ink chambers 100 and 142 further decreases, the float portion 73 moves further down toward the bottom surface 100b. When the ink surface within the first ink chamber 100 reaches a level L3, the float portion 73 contacts the bottom surface 100b such the movable member 70 stops pivoting in the second position as shown in Fig. 4, and the movable member 70 remains in the second position when the amount of ink within the first and second ink chamber 100 and 142 further decreases.

[0053] When the movable member 70 is in the first position, in which the detection portion 72 is positioned within the lower portion of the second ink chamber 142, it is determined that the first and second ink chambers 100 and 142 have a sufficient amount of ink. When the movable member 70 moves from the first position to the second position, in which the detection portion 72 is positioned within the middle portion of the second ink chamber 142 in the height direction 32, it is determined that the first and second ink chambers 100 and 142 do not have a sufficient amount of ink. Whether or not the first and second ink chambers 100 and 142 have a sufficient amount of ink stored therein is determined by a user viewing the position of the detection portion 72 in the second ink chamber 142, or by using the optical sensor to monitor the position of the detection portion 72. For example, once the printer detects the movement of the movable member 70 by the optical sensor and determines that the first and second ink chambers 100 and 142 do not have a sufficient amount of ink, the printer begins to count how many ink droplets are ejected from the recording head. When the counted number of ink droplets reaches a predetermined value, the printer stops printing and indicates to a user that the ink cartridge 10 is empty. Ideally, the predetermined value is set such that the amount of ink ejected from the recording head corresponds to the amount of ink remaining in the ink cartridge 10 when the printer begins to count the number of ink droplet. Because the timing at which the movable member 70 begins to pivot does not vary significantly from one ink cartridge to another according to the present invention, the predetermined value can be set to be equal to or close to the ideal value, which means that the amount of ink remains unused in the ink cartridge 10 when the printer stops printing is small or almost zero, and therefore ink is consumed efficiently.

[0054] The detection portion 72 comprises a plurality of pin members 131 and 132. The pin member 131 is positioned at an upper front end of the detection portion 72. The pin member 132 is positioned at the lower end of the detection portion 72. Each of the pin members 131 and 132 has a column shape and is integral with the movable member 70. Each of the pin members 131 and 132 extends in the width direction 31, i.e., extends left to right in Fig. 7. Each of the pin members 131 and 132 projects from both sides of detection portion 72 towards side walls 140b. If the detection portion 72 moves in the width direction 31, the pin members 131 and 132 may contact the inner wall surface 142b of the side wall 140b, such that detection portion 72 does not contact the inner wall surface 142b of the side wall 140b. Consequently, the distance between the detection portion 72 and the inner wall surfaces 142b of the side walls 140b is maintained within a predetermined distance range. Therefore, the movement of the detection portion 72 is smoothened without being affected by the surface tension of the ink between the side walls 140b and the detection portion 72, and the width of the translucent portion 140 can be made relatively narrow.

[0055] Ends of the pin members 131 and 132 are spherical. Therefore, even if the ends of the pin member 131 and 132 contact the inner wall surface of the side wall 140b, it is a single point of contact. Therefore, the movement of the detection portion 72 is not be significantly affected by such contact between the pin member 131 and 132 and the inner wall surface of the side wall 140b.

[0056] While the invention has been described in connection with exemplary embodiments, it will be understood by those skilled in the art that other variations and modifications of the exemplary embodiments described above may be made without departing from the scope of the invention. Other embodiments will be apparent to those skilled in the art from a consideration of the specification or practice of the invention disclosed herein. It is intended that the specification and the described examples are considered merely as exemplary of the invention, with the true scope of the invention being indicated by the flowing claims.

Claims

1. A liquid container (10) comprising:

a case (20) comprising a liquid chamber (100, 142) therein, the liquid chamber (100, 142) storing liquid therein;

a liquid supply portion (90) configured to supply liquid from an interior of the liquid chamber (100,

142) to an exterior of the liquid chamber (100, 142);
a movable member (70) positioned within the liquid chamber (100, 142), wherein the movable member (70) comprises:

a pivot center (78), wherein the movable member (70) is pivotally supported at the pivot center (78) and configured to pivot about the pivot center (78);
a first portion (75) extending from the pivot center (78) at least in a first direction, wherein the first portion (75) comprises a detection portion (72); and
a second portion (76) extending from the pivot center (78) at least in a second direction which is different from the first direction, and the second portion (76) comprises a float portion (73) and a contact surface (81a), and wherein a specific gravity of the float portion (73) is less than a specific gravity of the liquid within the liquid chamber (100, 142), and the float portion (73) moves based on an amount of liquid within the liquid chamber (100, 142), and the movable member (70) pivots based on a movement of the float portion (73); and

a regulating member (54) configured to contact the contact surface (81a) when the amount of liquid within the liquid chamber (100, 142) is equal to or greater than a predetermined amount, and a pivotal movement of the movable member (70) is regulated by the regulating member (54) contacting the contact surface (8 1 a),

wherein when the amount of liquid within the liquid chamber (100, 142) decreases from the predetermined amount to an amount less than the predetermined amount, the float portion (73) moves such that the contact surface (81a) separates from the regulating member (54), and when the contact surface (81a) initially separates from the regulating member (54), the contact surface (81a) is positioned within the liquid.

2. The liquid container (10) of claim 1, wherein
the case (20) comprises an inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) defining the liquid chamber (100, 142), and a portion (142d) of the inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) is positioned between the detection portion (72) and the liquid supply portion (90), and
the detection portion (72) of the movable member (70) is separated from the portion (142d) of the inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) when the amount of liquid within the liquid chamber (100, 142) is equal to or greater than the predetermined amount.

3. The liquid container (10) of any one of claims 1 to 2, wherein:

the case (20) comprises an inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) defining the liquid chamber (100, 142), and the inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) comprises a top surface (100a) and a bottom surface (100b) opposite the top surface (100a);
the liquid supply portion (90) is positioned closer to the bottom surface (100b) than to the top surface (100a);
a distance between at least a portion of the first portion (75) of the movable member (70) and the top surface (100a) is less than a distance between the second portion (76) of the movable member (70) and the top surface (100a) when the amount of liquid within the liquid chamber (100, 142) is equal to or greater than the predetermined amount;
the movable member (70) is configured to pivot in a particular plane; and
the first portion (75) of the movable member (70) is separated from the inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) in the particular plane when the amount of liquid within the liquid chamber (100, 142) is equal to or greater than the predetermined amount.

4. The liquid container (10) of any one of claims 1 to 3, wherein:

the case (20) comprises an inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) defining the liquid chamber (100, 142), and the inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) comprises a top surface (100a) and a bottom surface (100b) opposite the top surface (100a);
the liquid supply portion (90) is positioned closer to the bottom surface (100b) than to the top surface (100a); and
a distance between the contact surface (81a) and the bottom surface (100b) is less than a distance between a pivot center (78) and the bottom surface (100b).

5. The liquid container (10) of any one of claims 1 to 4, wherein:

the case (20) comprises an inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) defining the liquid chamber (100, 142), and the inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) comprises a top surface (100a) and a bottom surface (100b) opposite the top surface (100a);

the liquid supply portion (90) is positioned closer to the bottom surface (100b) than to the top surface (100a); and
a distance between a center of the float portion (73) and the bottom surface (100b) is less than a distance between a pivot center (78) and the bottom surface (100b).

6. The liquid container (10) of claim 1, wherein:

the case (20) comprises an inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) defining the liquid chamber (100, 142),
at least a portion of the first portion (75) of the movable member (70) is positioned higher than the second portion (76) of the movable member (70) when the amount of liquid within the liquid chamber (100, 142) is equal to or greater than the predetermined amount;
the movable member (70) is configured to pivot in a particular plane; and
the first portion (75) of the movable member (70) is separated from the inner wall surface (100a, 100b, 142a, 142b, 142c, 142d) in the particular plane when the amount of liquid within the liquid chamber (100, 142) is equal to or greater than the predetermined amount.

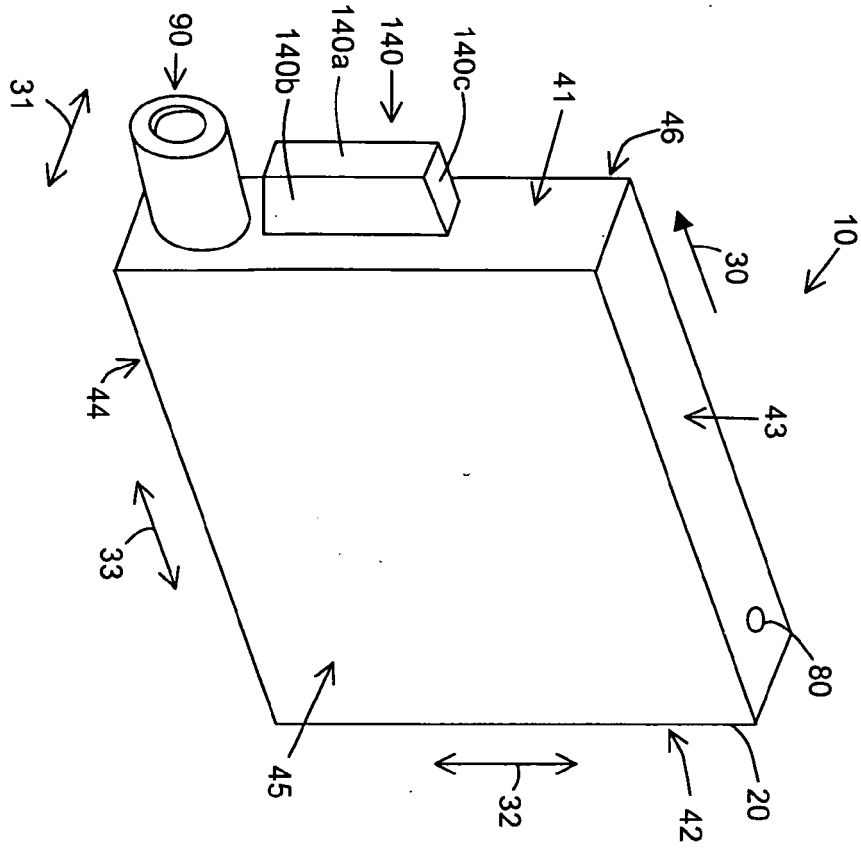
7. The liquid container (10) of any one of claims 1 and 6, wherein the contact surface (81a) is positioned lower than the pivot center (78).

8. The liquid container (10) of any one of claims 1, 6, and 7, wherein a center of the float portion (73) is positioned lower than the pivot center (78).

9. The liquid container (10) of any one of claims 1 to 8, wherein:

the case (20) has a width in a width direction (31), a height in a height direction (32), and a depth in a depth direction (33), and the width direction (31), the height direction (32), and the depth direction (33) are perpendicular to each other;
the liquid chamber (100, 142) comprises a first liquid chamber (100) and a second liquid chamber (142), and a width of the second liquid chamber (142) is less than a width of the first liquid chamber (100) in the width direction (31), and
the movable member (70) moves in a plane parallel to the height direction (32) and the depth direction (33); and
when the amount of liquid within the liquid chamber (100, 142) is equal to or greater than the predetermined amount, the detection portion (72) is positioned within the second liquid chamber (142), and the second portion (76) of the movable member (70) is positioned within the first liquid chamber (100).

10. The liquid container (10) of any one of claims 1 to 9, wherein the first portion (75) of the movable member (70) comprises a first sub-portion (62) extending in the first direction and a second sub-portion (63) extending in a third direction which is different from the first direction.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140b
140a
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140c
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Fig. 1(A)

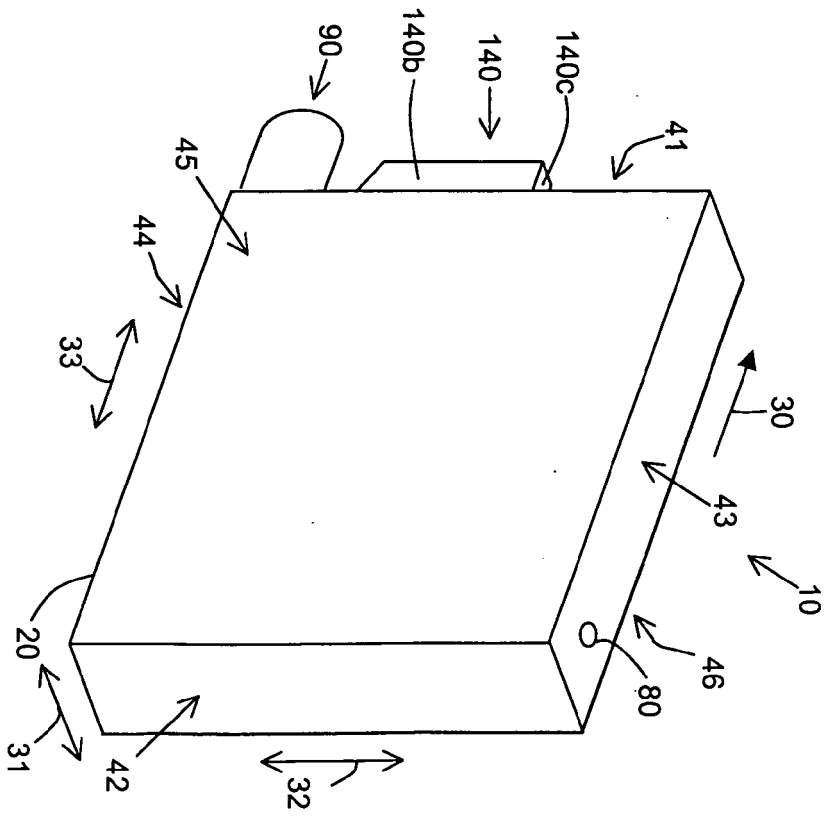
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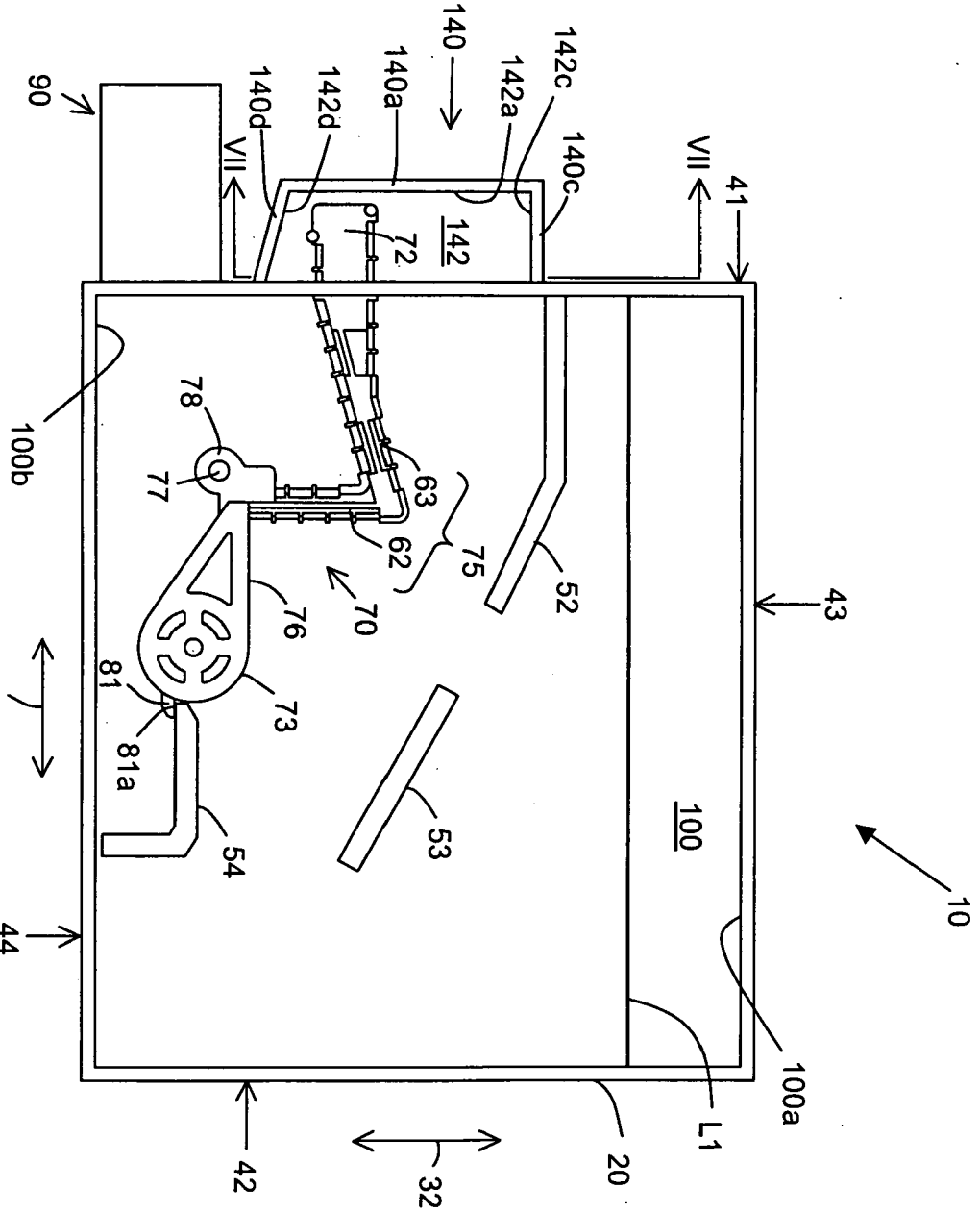
Fig. 1(B)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142d
140d
90
VII
VII
41
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78
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62
75
52
100b
43
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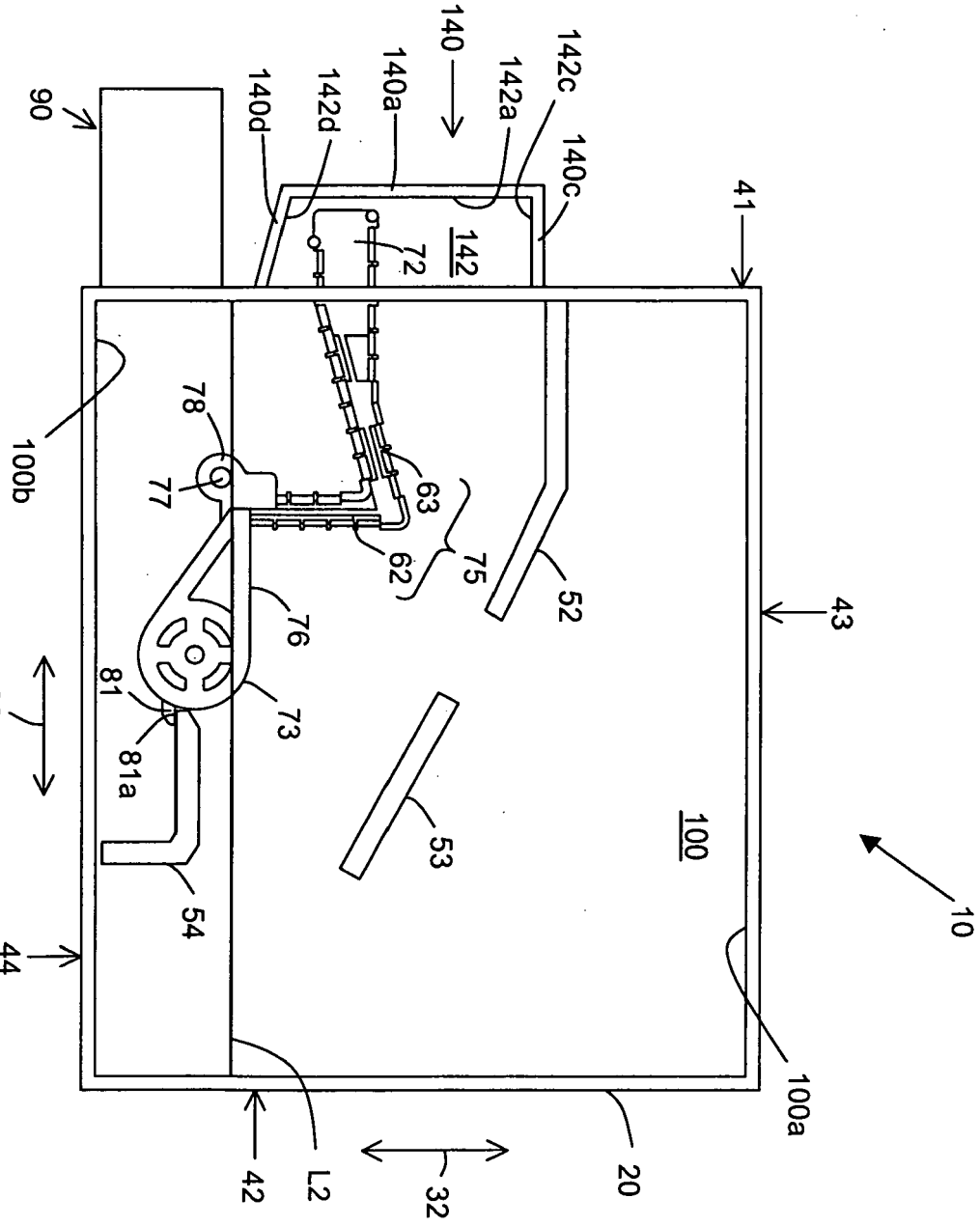
70
33
81
73
81a
54
53
100
10
44
L1
100a
42
32
20

Fig. 2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53
100
10
54
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100a
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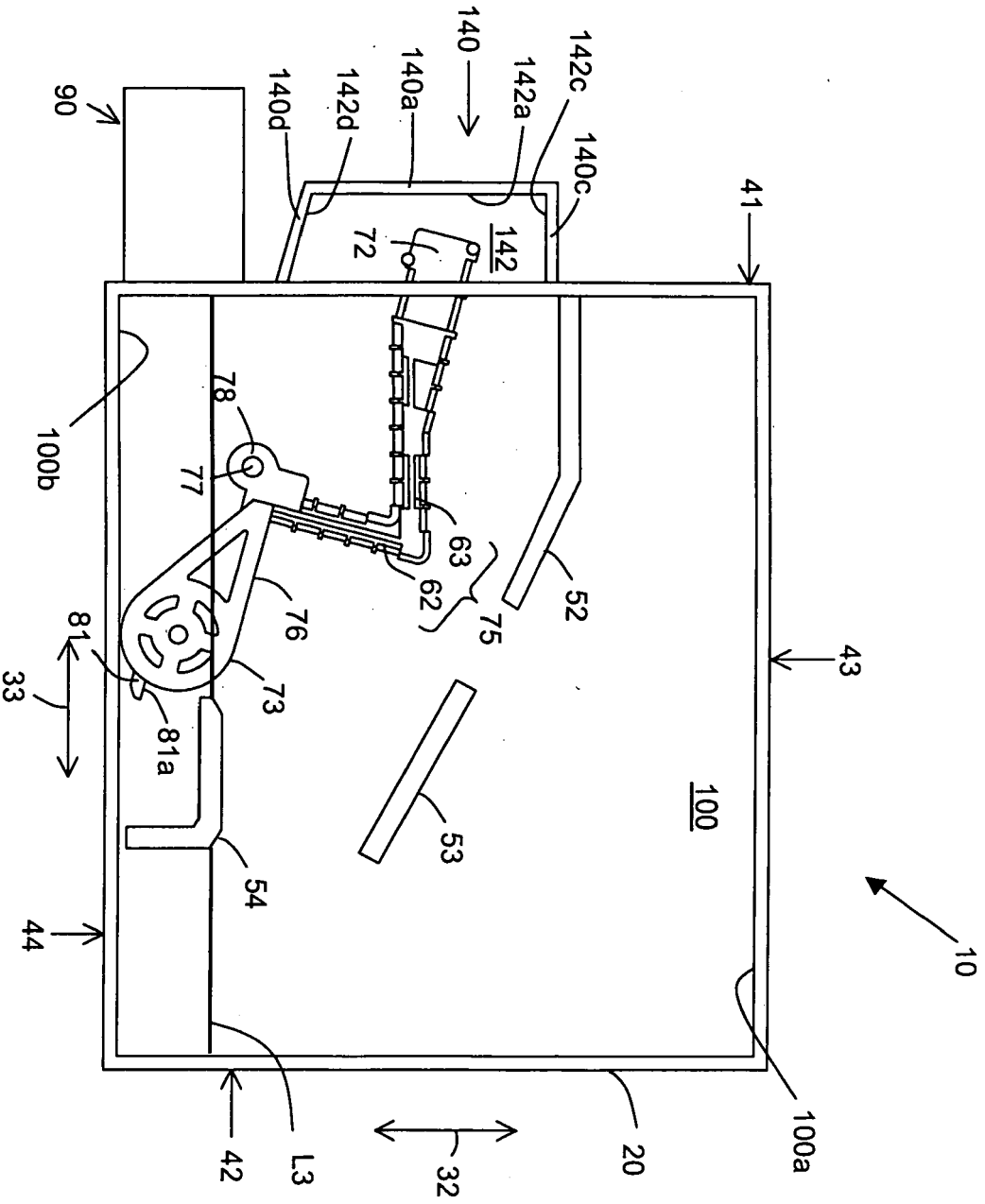
L2
32
20

Fig. 3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10
42
L3
32
20
100a

Fig. 4

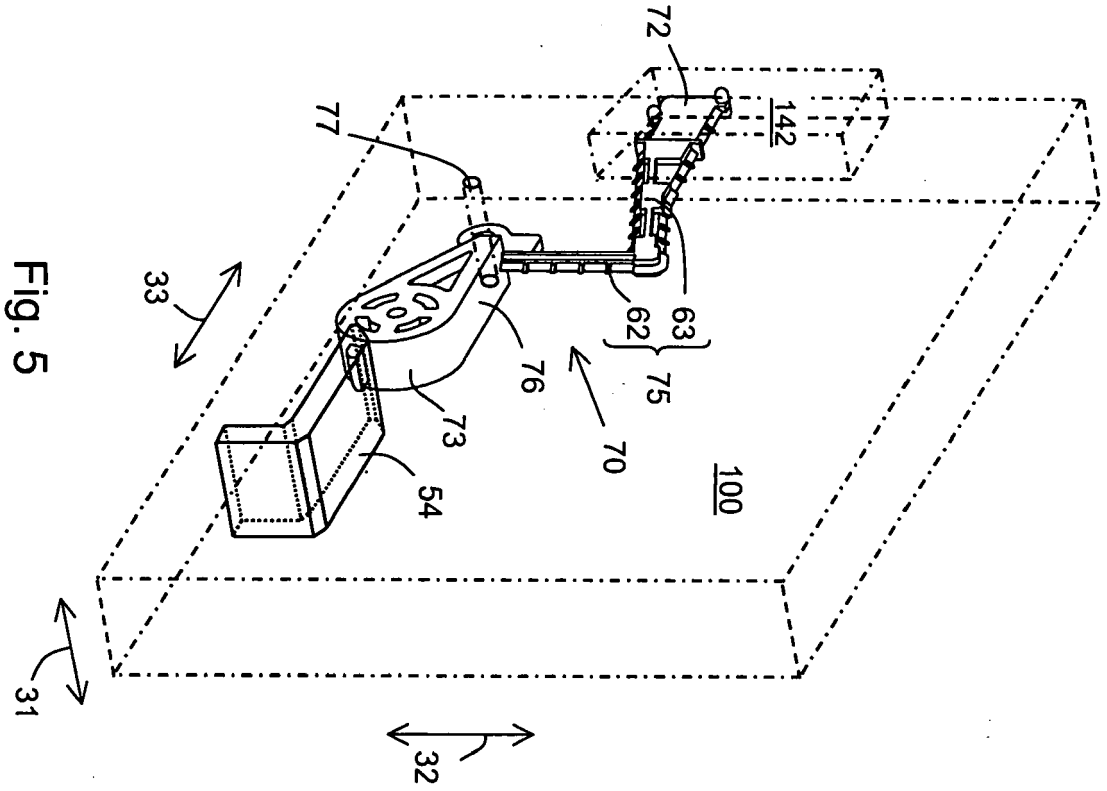
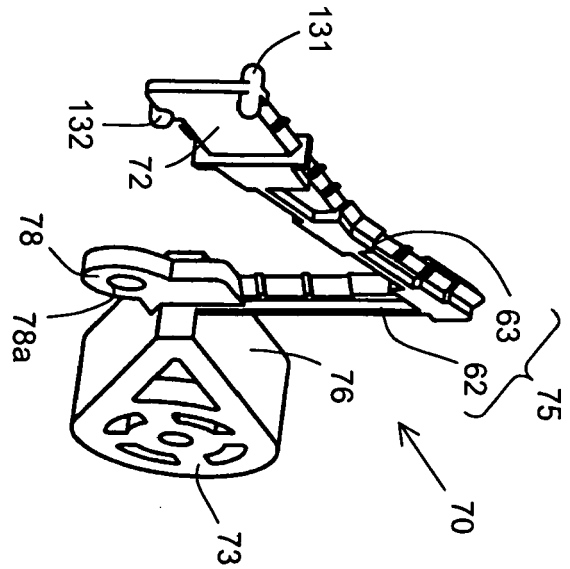


Fig. 5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132
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78a
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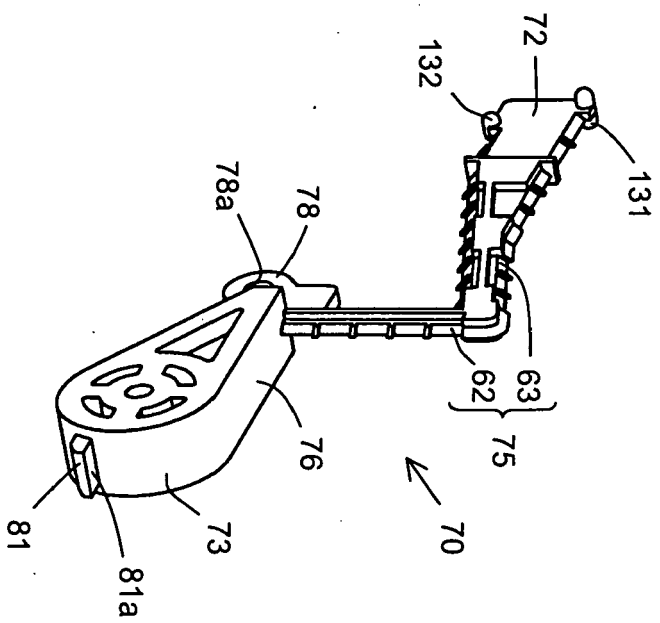
75
76
73
70

Fig. 6(A)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70
81
81a

Fig. 6(B)

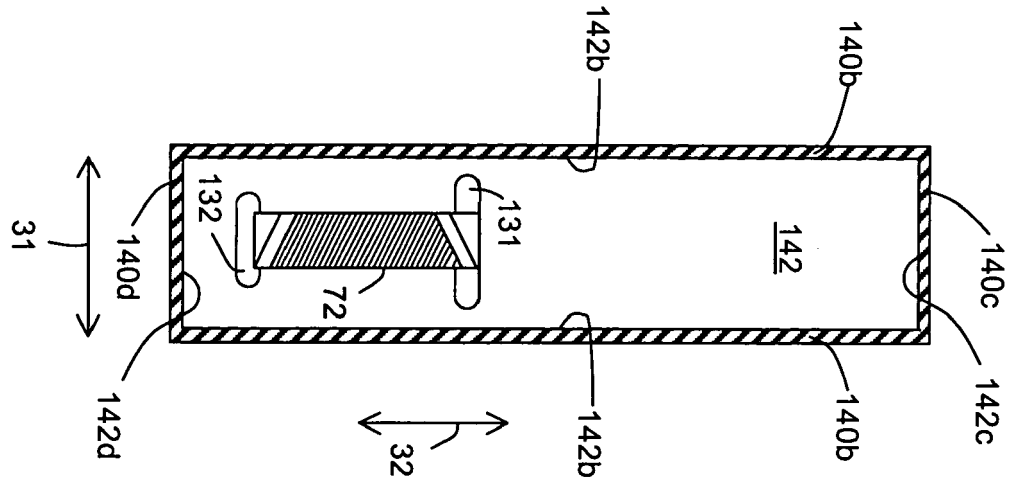

Fig. 7

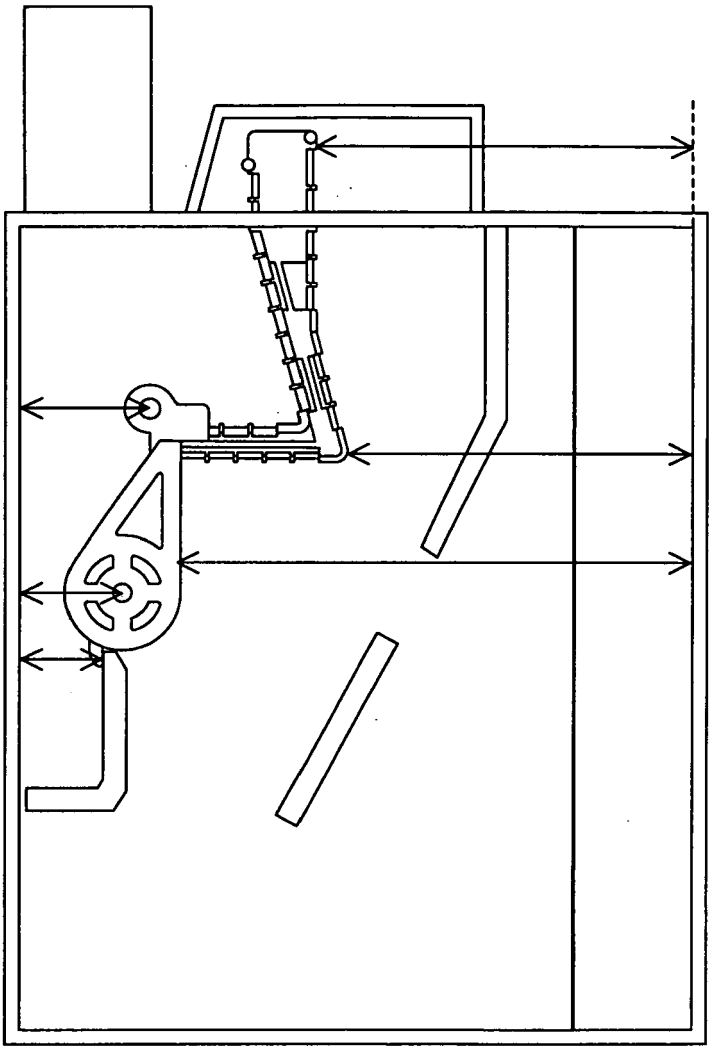

Fig. 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 00 3710

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2006/033789 A1 (SASAKI TOYONORI [JP] ET AL) 16 February 2006 (2006-02-16) * paragraphs [0006], [0096] - [0106]; figures 1,4 *	1	INV. B41J2/175
D,A	US 2007/070153 A1 (HATTORI SHINGO [JP] ET AL) 29 March 2007 (2007-03-29) * paragraph [0025]; figures 3,4 *	1	
D,A	US 2007/070138 A1 (HATTORI SHINGO [JP] ET AL) 29 March 2007 (2007-03-29) * paragraph [0621] - paragraph [0627]; figures 84-86 * * paragraph [0539]; figure 59 *	1	
A	EP 1 839 872 A (BROTHER IND LTD [JP]) 3 October 2007 (2007-10-03) * paragraph [0035]; figure 6 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 April 2008	Van Oorschot, Hans

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23-04-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006033789 A1	16-02-2006	US 2007291088 A1	20-12-2007
US 2007070153 A1	29-03-2007	NONE	
US 2007070138 A1	29-03-2007	NONE	
EP 1839872 A	03-10-2007	CN 101015993 A	15-08-2007
		JP 2007268948 A	18-10-2007

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Patent documents cited in the description

- US 7246894 B2 **[0003]**
- US 20070070138 A1 **[0040]**