INFUSION PUMP

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001]

The present invention relates to an infusion pump that delivers an infusion solution through an infusion line.

2. Description of the Related Art

[0002]

In the medical field, as disclosed in Japanese Patent Application Laid-Open No. 2016-220958, an infusion pump is used to deliver an infusion solution such as a blood component or a drug solution into the body of a patient through an infusion line. In situations where an infusion pump is used, since the dose of the infusion solution is small, a pump with high injection accuracy, for example, a peristaltic, that is, peristaltic finger type infusion pump is used. An infusion pump and an infusion bag for supplying an infusion solution to the infusion pump are mounted on a pole-type stand.

[0003]

The infusion bag is mounted on the upper side of the infusion pump and connected to the infusion pump with an infusion tube. Since the infusion pump requires an operation such as setting the amount of infusion solution, the infusion pump is fixed by a clamp device at a height position where the operator can operate it in a standing position.

SUMMARY OF THE INVENTION

[0005]

However, since the infusion pump and the infusion bag are mounted at a predetermined height, the position of the center of gravity of the pole-type stand tends to become high. In addition, the greater the amount of horizontal protrusion of the infusion pump fixed to the pole becomes, the greater the distance from the central axis line of the pole to the center of gravity of the infusion pump becomes, and as a result, the amount of

moment acting in the direction of tilting the pole becomes greater. In some cases, two or more infusion pumps are installed side by side, and the amount of moment that is applied to one pole is increased by an amount corresponding to one laterally adjacent infusion pump. Further, there is also a situation in which there is little room in the installation space of the pole-type stand, and the smaller the infusion pump, the easier it is to install it and the less it interferes with the movement of the user. Under such a situation, it is desirable that the infusion pump be smaller.

[0006]

The present invention has been made to solve the above problem, and has an object to provide an infusion pump that is smaller than that in the related art.

[0007]

An infusion pump according to the present invention includes a main body and a fixing part for fixing the main body to a support member, in which the main body has a mounting portion which is formed on a first side surface provided to face the support member, and on which the fixing part is mounted, and the mounting portion protrudes from the first side surface and is formed integrally with the first side surface.

[0008]

In the infusion pump according to the present invention, since the mounting portion on which the fixing part for fixing the main body to the support member is mounted is formed integrally with the first side surface, waste volume can be reduced as compared with a case where the fixing part is formed separately, and a horizontal protrusion dimension can be reduced, so that the infusion pump is further downsized.

[0009]

Further, in the infusion pump according to the present invention, it is preferable that the fixing part has an operating member, and the first side surface is formed with a first recessed portion corresponding to an outer shape of the operating member.

[0010]

In the infusion pump according to the present invention, since the first side surface is formed with the first recessed portion corresponding to the outer shape of the operating member, a gap space due to the first recessed portion can be secured while

downsizing the infusion pump, and the operating member can be operated without the hand interfering with the first side surface.

[0011]

Further, it is preferable that the main body of the infusion pump according to the present invention includes an opening/closing part having an outer hinge portion and held to be capable of being opened and closed, and a tube pressing part having an inner hinge portion and held to be capable of being opened and closed, inside the opening/closing part, and pressing an infusion tube in a closed state.

[0012]

In the infusion pump according to the present invention, since the tube pressing part pressing an infusion tube in a closed state is provided inside the opening/closing part, it is not necessary to provide a tube clamp for preventing free flow of the infusion solution from the infusion tube in a state where the opening/closing part is opened, and the infusion pump is further downsized accordingly, as compared with that in the related art.

[0013]

Further, it is preferable that the main body of the infusion pump according to the present invention includes a liquid feeding device that sends out an infusion solution, and a first accommodation portion that accommodates the liquid feeding device, the tube pressing part has a pressing member, and the first accommodation portion and the pressing member are made of metal.

[0014]

Since the liquid feeding device that sends out an infusion solution of the infusion pump according to the present invention, and the pressing member are made of metal, a member to which a pressing force is applied can be formed thin, and the infusion pump is further downsized as compared with that in the related art in which the member is formed of resin.

[0015]

Further, it is preferable that the infusion pump according to the present invention further includes: a rotary drive device that includes a motor and a plurality of gears for

transmitting rotation of a rotary shaft of the motor; and a second accommodation portion that accommodates all the gears of the rotary drive device, and that the second accommodation portion is made of metal and formed integrally with the first accommodation portion.

[0016]

In the infusion pump according to the present invention, the second accommodation portion that accommodates all the gears of the rotary drive device is made of metal and formed integrally with the first accommodation portion. Therefore, the second accommodation portion to which a driving force is applied can be formed thin, and a member configuring the second accommodation portion is configured integrally with the first accommodation portion, so that the infusion pump is further downsized as compared with that in the related art.

[0017]

Further, in the infusion pump according to the present invention, it is preferable that a packing provided at an upper portion of the opening/closing part has ridges formed to protrude over an entire periphery of an inner surface of a packing groove in which the infusion tube is fitted, at an upper end portion and a lower end portion of the packing groove.

[0018]

The packing included in the infusion pump according to the present invention is incorporated in the upper portion of the opening/closing part and accommodated in a space inside the opening/closing part, so that a packing-incorporated structure is realized in a small-sized infusion pump. In addition, the ridges formed to protrude over the entire periphery of the inner surface of the packing groove are provided at the upper end portion and the lower end portion of the inner surface of the packing groove. Therefore, the ridges bend in response to the outer diameter of the infusion tube that is fitted, and either a thick infusion tube or a thin infusion tube can be in contact with the outer diameter of the infusion tube without gaps, so that the infusion solution flowing along the outer peripheral surface of the infusion tube is sealed.

[0019]

Further, it is preferable that a second recessed portion is formed in an upper portion of the opening/closing part of the infusion pump according to the present invention, at least a part of an upper surface of the packing is exposed in the second recessed portion, and the exposed upper surface of the packing and a surface forming the second recessed portion around the packing are connected without a step.

[0020]

In the infusion pump according to the present invention, the exposed upper surface of the packing incorporated in the upper portion of the opening/closing part and the surface forming the second recessed portion around the packing are connected without a step. Therefore, the infusion solution sealed by the packing smoothly flows on the curved surface formed by the exposed upper surface of the packing and the surface forming the second recessed portion around the packing, so that the possibility of the infusion solution flowing into the main body is reduced. Therefore, a structure in which the packing is incorporated in the opening/closing part can be realized in a small-sized infusion pump, and the reliability of the infusion pump is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a front view of an infusion pump according to an embodiment of the present invention.

FIG. 2 is a plan view of the infusion pump of FIG. 1.

FIG. 3 is a left side view of the infusion pump of FIG. 1.

FIG. 4 is a right side view of the infusion pump of FIG. 1.

FIG. 5 is a back view of the infusion pump of FIG. 1.

FIG. 6 is a sectional perspective view of the infusion pump of FIG. 1 with a portion thereof removed.

FIG. 7 is a perspective view of the infusion pump of FIG. 1.

FIG. 8 is an enlarged perspective view of an upper portion of the infusion pump of FIG. 1.

FIG. 9 is an enlarged perspective view of the inside of an opening/closing part of

the infusion pump of FIG. 1.

FIG. 10 is a perspective view of a drive mechanism of the infusion pump of FIG. 1.

FIG. 11 is a perspective view of a first accommodation portion and a second accommodation portion of the infusion pump of FIG. 1.

FIG. 12 is a top view of a rotary drive device of the infusion pump of FIG. 1.

FIG. 13 is a side view of the rotary drive device of the infusion pump of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022]

<Embodiment>

An infusion pump 100 according to an embodiment of the present invention will be described with reference to FIGS. 1 to 5. FIGS. 1 to 5 are a front view, a top view, a left side view, a right side view, and a back view of the infusion pump 100.

[0023]

The infusion pump 100 is a pump that delivers an infusion solution into the body of a patient through an infusion line. First, the external structure of the infusion pump 100 will be described.

[0024]

[External Structure of Infusion Pump 100]

The infusion pump 100 includes a main body 10 and a fixing part 30 for fixing the main body 10 to a pole P that is a support member. The main body 10 is formed in a substantially rectangular parallelepiped shape whose up-down direction is a longitudinal direction, and has an outer peripheral surface made of resin, and all the corner portions of the outer peripheral surface are rounded. The infusion pump 100 has a first side surface 11, a second side surface 12, a third side surface 13, a fourth side surface 14, an upper surface 15, and a lower surface 16. The main body 10 has an opening/closing part 40 that includes the second side surface 12. In FIG. 2, the opening/closing part 40 in an opened state is indicated by a dashed line.

[0025]

The fixing part 30 is provided on the first side surface 11, that is, the surface facing the pole P of the infusion pump 100. The first side surface 11 has a mounting portion 21 for mounting the fixing part 30. The mounting portion 21 is a substantially rectangular parallelepiped-shaped portion that protrudes in the vertical direction from the first side surface 11, and has a mounting portion end surface 22 that is a protruding end surface. The mounting portion 21 is formed integrally with the first side surface 11. As illustrated in FIG. 3, a first recessed portion 23 is provided on the first side surface 11 and between the mounting portion 21 and the end portion on the fourth side surface 14 side of the first side surface 11. The first recessed portion 23 is formed by recessing a portion of the first side surface 11 into a curved surface shape having an arc-shaped cross section, and is formed to extend in the horizontal direction. The first recessed portion 23 is formed continuously without a step over the first side surface 11 and the fourth side surface 14.

[0026]

The effect of the mounting portion 21 formed on the first side surface 11 will be described with reference to FIGS. 2 and 3. In the related art, the fixing part 30, that is, a clamp device is designed on the assumption that it is removed from the main body of an infusion pump. Therefore, the clamp device is configured as a completely separate part from the main body, and is configured such that it can be mounted and dismounted by the hand without using a tool. As a result, the clamp device itself needs to have sufficient strength and rigidity. Therefore, there is a limit to downsizing the infusion pump including the clamp device. In the infusion pump 100 of the present invention, it is assumed that the fixing part 30 is not removed, and the mounting portion 21 corresponding to the mounting of the fixing part 30 is integrally formed on the first side surface 11 for fixing the fixing part 30. In this way, in the infusion pump 100, the size of the combination of the infusion pump main body and the clamp device is minimized by minimizing wasteful portions when designing them individually. The fixing part 30 is fixed to the mounting portion 21 with a fastener using a tool when the main body 10 is assembled.

[0027]

The fixing part 30 has a clamping member 31 that contacts with the pole P, which is a support member, and an operating member 36 that clamps the pole P together with the clamping member 31. The clamping member 31 has a clamping member base portion 32 that is fixed to the mounting portion 21, a clamping piece 33 provided at an end on one side in the horizontal direction of the clamping member base portion 32, and an operating member holding portion 34 provided at an end on the other side in the horizontal direction of the clamping member base portion 32. The clamping piece 33 and the operating member holding portion 34 are formed integrally with the clamping member base portion 32.

[0028]

The clamping member base portion 32 is a substantially rectangular parallelepiped-shaped member having a bottom surface that contacts with the mounting portion end surface 22 of the protruding mounting portion 21. A clamping member bottom surface 35 of the clamping member base portion 32 has the same rectangular shape and size as the mounting portion end surface 22. Therefore, when the clamping member base portion 32 is mounted on the mounting portion 21, each of four side surfaces that are the outer surfaces of the clamping member base portion 32 and each of four side surfaces that are the outer surfaces of the mounting portion 21, which are in contact with each other, are connected to each other without a step to form a continuous plane.

[0029]

The clamping piece 33 is formed at an end on one side in the horizontal direction of the clamping member base portion 32 so as to extend from the clamping member base portion 32 perpendicularly to the first side surface 11. The clamping piece 33 is formed at each of an upper end and a lower end on one end side in the horizontal direction of the clamping member base portion 32. The vertical dimension of the clamping piece 33 from the surface of the clamping member base portion 32 is formed substantially equal to the diameter of the pole P that is a support member. As illustrated in FIG. 2, the surface of the clamping piece 33 facing the pole P is formed to have a recessed shape at an intermediate portion in the longitudinal direction of the clamping piece 33, when viewed

from the above, such that the clamping piece 33 can easily grip the pole P having a circular cross section.

[0030]

The operating member holding portion 34 is formed at an end on the other side in the horizontal direction of the clamping member base portion 32 so as to extend in the vertical direction from the clamping member base portion 32. The vertical dimension of the operating member holding portion 34 is formed substantially equal to or slightly shorter than the diameter of the pole P that is a support member. The operating member holding portion 34 is provided with a screw hole corresponding to the operating member 36. The position of the screw hole is the position which is substantially in the center of the operating member holding portion 34 in the up-down direction, and at which the substantially central axis line of the pole P to be fixed and the operating member holding portion 34 overlap when viewed from the side, in the horizontal direction of the operating member holding portion 34.

[0031]

The operating member 36 has a grip portion 37, a cylindrical member having a central axis line coaxial with the grip portion 37 and connected to one surface side of the grip portion 37, and a screw portion 38 having a central axis line coaxial with the cylindrical member and mounted on an end surface on one surface side of the cylindrical member. The grip portion 37 is formed in a substantially disc shape, and the outer periphery of the grip portion 37 formed to have a predetermined radius R1 is provided with a plurality of, for example, three dents at equal intervals in the circumferential direction. In the operating member 36, the screw portion 38 is screwed into the screw hole of the operating member holding portion 34 by rotating the grip portion 37. In a state where the operating member 36 is screwed into the screw hole of the holding portion 34, the operating member 36 is rotated, whereby the tip of the screw portion 38 protrudes. The pole P is sandwiched between the tip portion of the screw portion 38 and the clamping piece 33, and the main body 10 is fixed to the pole P, which is a support member.

[0032]

The effect of the first recessed portion 23 formed on the first side surface 11 will be described with reference to FIG. 3. As described above, as a result of promoting downsizing of the infusion pump 100, the distance between the infusion pump 100 and the pole P becomes narrower than in an infusion pump in the related art. Therefore, the first recessed portion 23 is formed on the first side surface 11 so as to allow the hand holding the grip portion 37 to be rotated without interfering with the first side surface 11 when rotating the operating member 36. The curved surface of the first recessed portion 23 whose cross section is formed in an arc shape is formed so as to coincide with the outer peripheral surface of an imaginary cylinder T centered on a rotation center axis line X of the grip portion 37 and formed to have a radius R2.

[0033]

That is, the central axis line X of an imaginary cylindrical surface S that coincides with an outer peripheral surface 39 of the grip portion 37 and the central axis line X of the imaginary cylindrical surface T that coincides with the curved surface of the first recessed portion 23 coincide with each other. Therefore, a constant gap is maintained between the outer peripheral surface 39 of the grip portion 37 formed to have the radius R1 and the first recessed portion 23 on the first side surface 11. Therefore, a gap necessary for rotating the grip part 37 is always secured even if the outer peripheral surface of the grip portion 37 is gripped at any angular position. In the related art, the gap between the infusion pump and the pole P is about 30 mm, whereas in the case of the infusion pump 100 of the present invention, the gap is about 17 mm, for example. The distance of the infusion pump 100 from the pole P when it has been fixed to the pole P can be reduced by 10 mm or more, and the amount of protrusion of the infusion pump 100 from the pole P can be reduced by at least the amount. In the infusion pump 100 of the present invention, both a reduction in the amount of protrusion from the pole P and good operability of the fixing part 30 when mounting the infusion pump 100 are achieved.

[0034]

The third side surface 13 is one side surface on the front side, and has operation buttons 18 and a display part 19. The operation buttons 18 include a main power switch, a flow rate setting switch, a liquid feeding start switch, a liquid feeding stop switch, and

an increase/decrease adjustment switch for setting numerical values of a flow rate and the like. The display part 19 displays the set flow rate and the like when the main power switch is on. When using the infusion pump 100, the user operates the operation buttons 18 while confirming the display part 19 to perform various settings of the amount of liquid to be fed and the like and control of a liquid feeding state. The operation buttons 18 and the display part 19 are all intensively disposed on the third side surface 13, so that the infusion pump 100 is configured such that the user performs necessary operations and confirmations when performing liquid feeding to a patient only on one side surface.

[0035]

The right end portion of the infusion pump 100 is provided with the opening/closing part 40 that covers the entire right end portion from the upper end to the lower end and that can be opened and closed. The opening/closing part 40 covers a fifth side surface 50 in a closed state. The opening/closing part 40 is formed to have a substantially constant plate thickness as a whole, and the inner surface side of the opening/closing part 40 is formed in a recessed shape. The opening/closing part 40 includes the second side surface 12 on the outer surface thereof, and each of connection portions with the first side surface 11, the third side surface 13, the upper surface 15, and the lower surface 16 with which the opening/closing part 40 contacts when the opening/closing part 40 is closed has a continuous surface without a step.

[0036]

Inside of Opening/closing Part 40 and Fifth Side Surface 50

The structure of the inside of the opening/closing part 40 and the structure of the fifth side surface 50 will be described with reference to FIGS. 6 and 7. FIG. 6 is a perspective view illustrating a state where the opening/closing part 40 and a tube pressing part 60 are opened, with the entire surface on the third side surface 13 side taken as a cross section. FIG. 7 is a perspective view illustrating a state where the opening/closing part 40 is opened and the tube pressing part 60 is closed.

[0037]

The opening/closing part 40 has an outer hinge portion 41, a lock portion 42, a packing holding portion 43, and a packing 46 accommodated in the packing holding

portion 43.

[0038]

The outer hinge portion 41 is provided at each of upper and lower positions at the end portion on the first side surface 11 side of the inside of the opening/closing part 40. The outer hinge portion 41 has a flat surface portion which is formed to extend from an end portion fixed to the inner surface of the opening/closing part 40 toward a corner portion formed by the fifth side surface 50 and the first side surface 11 and which has an engagement portion provided at a tip thereof. The engagement portion is provided with a U-shaped groove that is U-shaped when viewed from the above. At the corner portion formed by the fifth side surface 50 and the first side surface 11, a shaft portion having a circular cross section with an outer diameter slightly larger than the width of the U-shaped groove is provided at each of upper and lower positions. The U-shaped groove of the outer hinge portion 41 is fitted to the shaft portion. The opening/closing part 40 can be opened and closed with the shaft portion as the center of rotation by the outer hinge portion 41. The opening direction of an opening portion of the U-shaped groove is directed to between the third side surface 13 and the fifth side surface 50 when viewed from the above, when the opening/closing part 40 is opened by 90° from the closed state, and is formed to have an angular position in the range of 20° to 40° in the direction from the third side surface 13 to the fifth side surface 50.

[0039]

With the above structure, a configuration is made such that the opening/closing part 40 can be removed by removing the shaft portion from the U-shaped groove in a state where the opening/closing part 40 is opened by 90° or more from the closed state, that is, in a state where the opening/closing part 40 is opened beyond the angular position where the second side surface 12 is substantially parallel to the third side surface 13. By pulling the opening/closing part 40 in the direction away from the fifth side surface 50 in the above-described angular state of the opening/closing part 40, the outer hinge portion 41 can be pulled out from the shaft portion. The opening/closing part 40 can be removed for cleaning.

[0040]

The opening/closing part 40 has the lock portion 42 at the central portion in the up-down direction of the end portion on the third side surface 13 side of the opening/closing part 40. The lock portion 42 is coupled to one or more projections 52 provided on the fifth side surface 50 to hold the opening/closing part 40 so as not to be opened, when the opening/closing part 40 is closed. Further, when the lock portion 42 is pushed, the coupling to the fifth side surface 50 is released such that the opening/closing part 40 is opened.

[0041]

The main body 10 has a tube pressing part 60 on the fifth side surface 50. The tube pressing part 60 is a member that contacts with one side of an infusion tube Q to hold the infusion tube Q. The tube pressing part 60 has an inner hinge portion 61 that holds the tube pressing part 60 so as to be capable of being opened and closed, a pressing member 62 that contacts with and presses the infusion tube Q, a pressing part main body 63 that covers the entire outer side of the pressing member 62, and a lock portion 64 that holds a state where the tube pressing part 60 is closed to the fifth side surface 50.

[0042]

The inner hinge portion 61 is provided at each of an upper end portion and a lower end portion of the end surface on the first side surface 11 side of the tube pressing part 60. The inner hinge portion 61 has two plate-like portions and a pivot portion that holds the plate-like portions to be relatively rotatable. The plate-like portions on one side of the two inner hinges portion 61 are fixed to the pressing member 62, and the plate-like portions on the other side are fixed directly to a first accommodation portion 71 (described later), or via another member. The tube pressing part 60 can be opened and closed with the inner hinge portion 61 as the center of rotation by the inner hinge portion 61. The lock portion 64 is a substantially plate-like member having a concave portion or a convex portion having a shape fitting to a mating member to be coupled. The lock portion 64 is supported by the end surface on the third side surface 13 side of the pressing portion main body 63.

[0043]

The pressing member 62 and the inner hinge portion 61 are made of metal, for

example, an SUS304 plate material that is a stainless steel material. In this way, the pressing member 62, which receives a reaction force against a pressing force on the infusion tube Q in a state where the tube pressing part 60 is closed, and the inner hinge portion 61 are made to have high rigidity. Therefore, the tensile strength of PBT resin is in a range of about 96 MPa to about 131 MPa, and the tensile strength of stainless steel SUS304 is about 520 MPa or more. Although it varies according to the shapes of the pressing member 62 and the inner hinge portion 61, in a case where the pressing member 62 and the inner hinge portion 61 are made of resin, in order to maintain the desired strength and rigidity, it is necessary to form them with a wall thickness of generally three times to five times. Therefore, in a case where the pressing member 62 and the inner hinge portion 61 are made of metal, as compared with a case where they are made of resin, the desired strength and rigidity are maintained even in the pressing member 62 and the inner hinge portion 61 formed thin. That is, the pressing member 62 and the inner hinge portion 61 are made of metal, so that the infusion pump 100 is downsized.

[0044]

A substantially rectangular opening portion 51 is provided in the central portion of the fifth side surface 50. A liquid feeding device 80 (described later) accommodated inside the main body 10 presses the infusion tube Q through the opening portion 51. The two projections 52 to which the lock portion 42 is coupled are provided to be spaced apart from each other at the central portion of the end portion on the third side surface 13 side of the fifth side surface 50. Further, a projection 53 to which the lock portion 64 of the tube pressing part 60 is coupled is provided at the central portion in the up-down direction on the third side surface 13 side of the first accommodation portion 71 (described later). In a state where the tube pressing part 60 is closed and the lock portion 64 is coupled, the pressing member 62 is in contact with the surface on the side opposite to the liquid feeding device 80 of the infusion tube Q that is pressed by the liquid feeding device 80, and the liquid feeding device 80 and the pressing member 62 sandwich and hold the infusion tube Q therebetween.

[0045]

In the related art, an infusion pump has a tube clamp portion at its main body

such that an infusion solution does not flow even when an opening/closing part is opened. However, the infusion pump 100 according to the present invention is provided with the tube pressing part 60 that is opened and closed separately from the opening/closing part 40, so that even in a state where the opening/closing part 40 is opened, the tube pressing part 60 is kept in a closed state and the infusion solution is prevented from freely flowing by the tube pressing part 60. Therefore, the infusion pump 100 does not need to be provided with a tube clamp portion, and the above structure contributes to downsizing of the infusion pump 100.

[0046]

In the vicinity of the upper end portion and the lower end portion of the fifth side surface 50, grooves each having a groove width substantially equal to the outer diameter of the infusion tube Q are formed, and tube holding portions 54 and 57 for holding the fitted infusion tube Q are provided. An air bubble sensor 55 having a structure for sandwiching and holding the infusion tube Q is provided immediately below the tube holding portion 54. The air bubble sensor 55 detects air bubbles contained in the infusion solution flowing through the infusion tube Q. Further, a downstream blockage sensor 56 is provided immediately above the tube holding portion 57 in the vicinity of the lower end portion. The downstream blockage sensor 56 detects blockage in the flow path downstream of the infusion pump 100, or tube collapse or clogging.

[0047]

The tube holding portion 54, the air bubble sensor 55, the downstream blockage sensor 56, and the tube holding portion 57 are all disposed in the central portion in the horizontal direction of the fifth side surface 50, and are disposed in positions that substantially overlap each other in the up-down direction. Therefore, the infusion tube Q can be linearly mounted on the fifth side surface 50. The downstream blockage sensor 56 is disposed so as to overlap the infusion tube Q when viewed from the side, when the infusion tube Q is mounted at the normal position.

[0048]

A drip-proof structure for preventing the infusion solution that has leaked along the outer surface of the infusion tube Q from entering the infusion pump 100 will be

described with reference to FIGS. 8 and 9. At the time of replacement or the like of a connection portion when replacing the infusion bag, the infusion solution may leak and flow along the outer surface of the infusion tube Q to the infusion pump 100. If the leaked infusion solution enters the infusion pump 100 and the infusion solution sticks to the inside of the infusion pump 100, it causes the infusion pump 100 to malfunction. In order to prevent this, the infusion pump 100 has a drip-proof structure at the upper portion of the main body 10. The drip-proof structure includes the tube holding portion 54 provided in the vicinity of the upper end portion of the fifth side surface 50, and the packing 46 provided in the vicinity of the upper end portion of the inside of the opening/closing part 40.

[0049]

FIG. 8 is a perspective view of the infusion pump 100 in a state where the infusion tube Q is mounted and the opening/closing part 40 is closed. FIG. 9 is a perspective view of the upper end portion of the opening/closing part 40 as viewed from the inside.

[0050]

A second recessed portion 44 that is a part of the outer surface of the opening/closing part 40 and is formed of a single curved surface is provided at the upper end portion of the opening/closing part 40. The packing holding portion 43 for fixing the packing 46 is provided immediately below the second recessed portion 44. The packing holding portion 43 is open on the side contacting with the fifth side surface 50, and an internal space in which the packing 46 is accommodated extends in the horizontal direction from the opening. A cutout portion 45 is formed in the second recessed portion 44, and the internal space of the packing holding portion 43 immediately below the second recessed portion 44 is open upward due to the cutout portion 45.

[0051]

The packing 46 will be described with reference to FIG. 9. The packing 46 is a substantially plate-like member formed to have a predetermined thickness. The packing 46 has an upper surface 47, and the upper surface 47 has a peripheral edge portion 47b formed at a peripheral edge portion of the upper surface 47 excluding the fifth side

surface 50 side, and a curved surface portion 47a that is the majority of the upper surface 47 surrounded by the peripheral edge portion 47b and an end surface 49 on the fifth side surface 50 side. The upper surface of the peripheral edge portion 47b is formed in a horizontal plane. The curved surface portion 47a is formed in a curved surface having a concave central portion. The packing 46 is formed of rubber or flexible synthetic resin.

[0052]

The packing 46 is horizontally inserted into and accommodated in the packing holding portion 43. When the packing 46 is inserted into the packing holding portion 43, the upper surface of the peripheral edge portion 47b of the packing 46 is held in contact with the lower surface of the peripheral edge portion of the cutout portion 45 of the second recessed portion 44, and is inserted to the normal position while sliding. When viewed from the above, the shape of the cutout portion 45 is a shape that fits to the shape of the curved surface portion 47a, and the curved surface portion 47a of the upper surface 47 of the packing 46 inserted into the packing holding portion 43 and accommodated at the normal position is exposed at the cutout portion 45 of the second recessed portion 44. In a state where the packing 46 is inserted to the normal position, the exposed curved surface portion 47a of the packing 46 and the surface forming the second recessed portion 44 around the packing 46 are connected without a step and configure a continuous and identical curved surface.

[0053]

The end surface 49 on the fifth side surface 50 side of the packing 46 is formed to slightly protrude from the end surface on the fifth side surface 50 side of a packing groove 48, and the end surface 49 is in contact with the fifth side surface 50 when the opening/closing part 40 is closed.

[0054]

The packing 46 has the packing groove 48 which is formed in the central portion in the horizontal direction of the packing 46, and into which the infusion tube Q is fitted. The packing groove 48 is formed to be cut out in a U-shape from the end surface 49 on the fifth side surface 50 side of the packing 46. The packing groove 48 is formed to penetrate from the upper surface 47 to the lower surface. The packing groove 48 has

ridges 48a and 48b formed to protrude over the entire periphery of the inner surface of the packing groove 48 at the upper end portion and the lower end portion of the packing groove 48. The upper surface of the ridge 48a and the lower surface of the ridge 48b are connected to the upper surface 47 and the lower surface of the packing without steps to form the same surface.

[0055]

The packing groove 48 has the ridges 48a and 48b, so that even in a case where the infusion tube Q with a different thickness is fitted, the ridges 48a and 48b bend in response to the thickness of the infusion tube Q which is fitted, and reliably hold the infusion tube Q without any gap. The interval between the facing portions of each of the U-shaped ridges 48a and 48b is formed slightly smaller than the infusion tube Q having an outer diameter of 3.6 mm. Further, the interval between the facing surfaces of the inner surface of the packing groove 48 other than the ridges 48a and 48b is formed slightly smaller than the infusion tube Q having an outer diameter of 4.5 mm. Therefore, the packing groove 48 can be in contact with the infusion tube Q without any gap even in a case where either the thin infusion tube Q or the thick infusion tube Q is fitted. Therefore, the packing 46 stops the flow of the infusion solution that has leaked along the outer surface of the infusion tube Q and reliably seals the infusion solution.

[0056]

Next, the state of the tube holding portion 54 and the packing 46 when the opening/closing part 40 is closed will be described. The horizontal dimension of the tube holding portion 54 facing the second recessed portion 44 is slightly smaller than the horizontal dimension of the second recessed portion 44 of the opening/closing part 40. Therefore, as illustrated in FIG. 8, when the opening/closing part 40 is closed, the tube holding portion 54 is formed so as to fit in the recessed space formed by the second recessed portion 44 and the upper surface 47 of the packing 46. Further, the lower surface of the tube holding portions 54 is disposed in a positional relationship in the up-down direction with the second recessed portion 44 so as to be in contact with the second recessed portion 44.

[0057]

Further, the end surface 49 on the fifth side surface 50 side of the packing 46 is formed to protrude from the packing groove 48 by a predetermined amount. Therefore, when the opening/closing part 40 is closed, the packing 46 comes into contact with the fifth side surface 50 and is in close contact with the fifth side surface 50 while being pressed and contracted. Therefore, the infusion solution flowing down along the infusion tube Q is reliably sealed without entering the inside of the main body 10 due to the above-described structures provided at the opening/closing part 40 and the fifth side surface 50. The infusion solution sealed by the packing 46 smoothly flows on the curved surface formed by connecting the curved surface portion 47a and the second recessed portion 44 without a step, as indicated by an arrow in FIG. 8.

[0058]

[Internal Structure of Main Body 10]

The internal structure of the main body 10 will be described with reference to FIGS. 10 to 13. FIG. 10 is a perspective view of a drive mechanism 70 that operates the infusion pump 100. FIG. 11 is a perspective view of an accommodation portion that is a part of the drive mechanism 70 of FIG. 10. Fig 12 is a top view of a rotary drive device included in the drive mechanism 70 of FIG. 10. FIG. 13 is a side view of the rotary drive device of FIG. 12.

[0059]

The infusion pump 100 includes the drive mechanism 70. The drive mechanism 70 includes the liquid feeding device 80 that feeds the infusion solution in the infusion tube Q, the first accommodation portion 71 that accommodates the liquid feeding device 80, a rotary drive device 90, and a second accommodation portion 72 that accommodates the rotary drive device 90. The infusion pump 100 is a known peristaltic pump.

[0060]

The liquid feeding device 80 has a plurality of pressure fingers 81 that press the infusion tube Q, and a camshaft 82 that presses the pressure fingers 81 from the interior side of the main body 10. In the pressure finger 81, an end on one side of each pressure finger 81 is rotatably held, and an end on the other side is disposed in contact with the

inner side surface of the infusion tube Q mounted on the fifth side surface 50.

[0061]

The liquid feeding device 80 will be described with reference to FIGS. 10 and 13. The liquid feeding device 80 is a device that sends out the infusion solution in the infusion tube Q. The liquid feeding device 80 has the pressure fingers 81 and the camshaft 82. The camshaft 82 has a plurality of cams 84 which are disposed at positions corresponding to the pressure fingers 81 and is disposed inside the pressure fingers 81. Each cam 84 is provided on the camshaft such that the maximum protrusion portion of each cam 84 is shifted by a predetermined angle in the rotation direction of the camshaft 82. When the rotary drive device rotates the camshaft 82, each cam drives the pressure finger 81 which is in contact with the cam. Each pressure finger 81 presses the infusion tube Q so as to sequentially advance and retreat from the upstream side of the infusion tube Q to the downstream side. In this way, the infusion solution in the infusion tube Q flows from the upstream side of the infusion tube Q toward the downstream side.

[0062]

The rotary drive device 90 will be described with reference to FIGS. 12 and 13. The rotary drive device 90 is a device that generates a driving force and transmits it to the liquid feeding device 80. The rotary drive device 90 includes a motor 91 having a rotary shaft 91a, a first gear 92a fixed to the rotary shaft 91a, a second gear 93a and a third gear 93b fixed to a support shaft 93, a fourth gear 94a and a fifth gear 94b supported on a support shaft 94 so as to be relatively rotatable, and a sixth gear 83 fixed to the upper end portion of the camshaft 82. Each gear is connected in the above order, the driving force generated by the motor 91 is transmitted to the first gear 92a, and the fifth gear 94b drives the sixth gear 83.

[0063]

The rotary drive device 90 has six gears including the first gear 92a as an input gear and the sixth gear 83 as an output gear, and has a three-stage reduction ratio. The motor 91 is a stepping motor whose rotation angle can be accurately controlled, and can control the flow rate of the infusion solution with high accuracy. Further, as described above, the motor 91 is downsized by improving the output torque with a high reduction

ratio configuration using six gears.

[0064]

The infusion pump 100 has the plurality of gears 92a, 93a, 93b, 94a, 94b, and 83 disposed outside the motor 91 and above the liquid feeding device 80, which is the upper portion of the infusion pump 100. The gears for transmitting the driving force are not dispersedly disposed but intensively disposed above the liquid feeding device 80, which is the upper portion of the infusion pump 100, so that the accommodation space for the rotary drive device 90 is reduced.

[0065]

The first accommodation portion 71 that accommodates the liquid feeding device 80 and the second accommodation portion 72 that accommodates the rotary drive device 90 will be described with reference to FIGS. 11 to 13.

[0066]

The first accommodation portion 71 and the second accommodation portion 72 are illustrated in FIG. 11. The first accommodation portion 71 and the second accommodation portion 72 are integrally formed of metal, for example, aluminum die-cast ADC12. The first accommodation portion 71 and the second accommodation portion 72 are formed with a thinner plate thickness as compared with a case of being formed of resin. For example, the tensile strength of PBT resin is in a range of about 96 MPa to about 131 MPa, and the tensile strength of the aluminum die-cast ADC12 is about 310 MPa. Although it varies according to a shape, in a case where the first accommodation portion 71 and the second accommodation portion 72 are formed of resin, in order to maintain the desired strength and rigidity, it is necessary to form the accommodation portions with a wall thickness of generally three times to five times that in a case of being formed of metal.

[0067]

The liquid feeding device 80 is accommodated in a rectangular parallelepiped space whose longitudinal direction is the up-down direction inside the main body 10. As illustrated in FIG. 11, the first accommodation portion 71 has three surfaces among the surfaces that define the rectangular parallelepiped space. The three surfaces of the first

accommodation portion 71 are a first wall portion 73 that is the upper surface of the rectangular parallelepiped space, and a second wall portion 74 and a third wall portion 75 that are vertical surfaces of the rectangular parallelepiped space and are in contact with each other. The first wall portion 73, the second wall portion 74, and the third wall portion 75 are in contact with the same corner portion of the upper portion of the rectangular parallelepiped space. Further, a wall portion having a shorter length than the second wall portion 74 is disposed to be spaced apart from the first wall portion 73 at the position of the facing surface parallel to the second wall portion 74 of the rectangular parallelepiped space.

[0068]

The second accommodation portion 72 is disposed on the first accommodation portion 71. The second accommodation portion 72 is a substantially rectangular parallelepiped-shaped member in which the upper surface thereof is open and a step is present on the bottom surface. The second accommodation portion 72 has a bottom surface 77 and a bottom surface 78 having different heights. The bottom surface 78 is formed integrally with the first wall portion 73 below the bottom surface 78. Further, the bottom surface 77 is connected to the bottom surface 78 via a step, and is provided parallel to the bottom surface 78 and higher than the bottom surface 78. As illustrated in FIG. 12, the motor 91 and the support shaft 93 are supported on the bottom surface 77. Further, the support shaft 94 is supported on the bottom surface 78.

[0069]

The rotary drive device 90 is three-dimensionally disposed with gears having different heights in the second accommodation portion 72 that includes the bottom surface 77 and the bottom surface 78 having different heights. Further, the rotary shaft 91a of the motor 91, the support shaft 93, the support shaft 94, and the camshaft 82 are not disposed linearly, and the rotary shaft 91a, the support shaft 93, the support shaft 94, and the camshaft 82 are disposed in a triangle connecting three points of the rotary shaft 91a, the support shaft 94, and the camshaft 82 when viewed from the above. The rotary shaft 91a, the support shaft 93, the support shaft 94, and the camshaft 82 are disposed in a triangle connecting three points of the rotary shaft 91a, the support shaft 94, and the

camshaft 82, so that the area occupied by the rotary drive device 90 is reduced when viewed from the above, and the height of the rotary drive device 90 is suppressed when viewed from the side. Therefore, the rotary drive device 90 contributes to downsizing of the infusion pump 100 with the above configuration.

[0070]

The second accommodation portion 72 has a plate-like upper plate 76 at the upper portion thereof. The upper plate 76 is made of metal, for example, stainless steel SUS304, and is provided so as to close the upper opening of the second accommodation portion 72. The upper plate 76 is formed thin by using metal having higher tensile strength than resin. Further, by closing the upper opening of the second accommodation portion 72 with the upper plate 76, a configuration is made in which the rigidity is increased and the upper opening of the second accommodation portion 72 is not easily opened even if the driving force is applied to the rotary drive device 90. That is, the first accommodation portion 71 and the second accommodation portion 72 are made of metal, so that it contributes to downsizing of the infusion pump 100 while obtaining the desired strength and rigidity.

[0071]

According to the present invention, it is possible to provide an infusion pump that is smaller than that in the related art.

Reference Signs List

[0072]

10: main body

11: first side surface

21: mounting portion

23: first recessed portion

30: fixing part

36: operating member

40: opening/closing part

41: outer hinge portion

44: second recessed portion

46: packing

48: packing groove

48a, 48b: ridge

60: tube pressing part

62: pressing member

71: first accommodation portion

72: second accommodation portion

91: motor

91a: rotary shaft

92a, 93a, 93b, 94a, 94b, 83: gear

WHAT IS CLAIMED IS:

1. An infusion pump comprising:

a main body; and

a fixing part for fixing the main body to a support member,

wherein the main body has a mounting portion which is formed on a first side surface provided to face the support member, and on which the fixing part is mounted, and

the mounting portion protrudes from the first side surface and is formed integrally with the first side surface.

2. The infusion pump according to claim 1, wherein the fixing part has an operating member for fixing the main body to the support member, and

the first side surface is formed with a first recessed portion corresponding to an outer shape of the operating member.

3. The infusion pump according to claim 1 or 2, wherein the main body includes an opening/closing part having an outer hinge portion and held to be capable of being opened and closed, and

a tube pressing part having an inner hinge portion and held to be capable of being opened and closed, inside the opening/closing part, and pressing an infusion tube in a closed state.

4. The infusion pump according to claim 3, wherein the main body has a liquid feeding device that sends out an infusion solution in the infusion tube mounted on the main body, and a first accommodation portion that accommodates the liquid feeding device,

the tube pressing part has a pressing member, and

the first accommodation portion and the pressing member are made of metal.

5. The infusion pump according to claim 4, further comprising:

a rotary drive device that includes a motor and a plurality of gears for transmitting rotation of a rotary shaft of the motor; and

a second accommodation portion that accommodates all gears of the rotary drive device,

wherein the second accommodation portion is made of metal and formed integrally with the first accommodation portion.

6. The infusion pump according to claim 3, wherein the opening/closing part has a packing at an upper portion of the opening/closing part,

the packing has a packing groove in which the infusion tube is fitted when the opening/closing part is closed, and which is provided with ridges, and

the ridges are formed to protrude over an entire periphery of an inner surface of the packing groove at an upper end portion and a lower end portion of the packing groove.

7. The infusion pump according to claim 6, wherein a second recessed portion is formed in the upper portion of the opening/closing part,

at least a part of an upper surface of the packing is exposed in the second recessed portion, and

the exposed upper surface of the packing and a surface forming the second recessed portion around the packing are connected without a step.