

FIELD OF THE INVENTION

[0001]

The present invention relates to a syringe fixing mechanism for a syringe pump that uses a mounted syringe to discharge a variety of liquids such as a medicinal solution, blood, or the like.

BACKGROUND ART

[0002]

Conventionally, this type of invention, for example, as described in patent document 1, has a syringe pump that inserts a flange (SF) of a syringe (S) mounted on a support base (122) into a recessed portion (123) so as to position the syringe (S).

Also, with this conventional syringe pump, an appropriate gap is secured between the flange (SF) and the recessed portion (123) in order to easily attach and detach the syringe (S). Therefore, for example, when a syringe different from that specified is installed, and the thickness of the syringe flange is thinner than that specified, the syringe (S) may experience looseness in the forward and backward direction, and the stroke of a piston (SP) may vary.

For example, with the syringe pump described in patent document 2, a flange installation portion (6) is released by an operation that raises an operation knob (23), and a flange portion (53) is clamped in the thickness direction by the flange installation portion (6).

[0003]

However, in the latter conventional technique, because a structure is provided wherein the flange installation portion (6) is released by an operation that raises the operation knob (23), the syringe may inadvertently detach due to vertical vibration during the raising operation when raising the operation knob (23) to remove the installed syringe, thereby decreasing work efficiency during syringe replacement. Further, it is also difficult to intuitively understand when the flange installation portion (6) opens due to the raising movement, and an improvement in operability is required. Furthermore, waterproofing measures are necessary because a sensor or the like is disposed directly under the vicinity of an opening released by the flange installation portion (6).

PRIOR ART DOCUMENTS

Patent Documents

[0004]

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2011-200597

Patent Document 2: Japanese Unexamined Patent Application Publication No. 2010-29593

OVERVIEW OF THE INVENTION

Problems to be Solved by the Invention

[0005]

In light of the above, an object of the present invention is to provide a syringe fixing mechanism for a syringe pump that can prevent looseness in the forward and backward direction of a mounted syringe, wherein operability is favorable when attaching or

detaching an outer circumferential portion of a syringe and a flange portion.

Summary

[0006]

As a means for solving the above problems, the present disclosure is provided, in an aspect, a syringe fixing mechanism for a syringe pump, comprising: a mounting base having a receiving surface for receiving an outer circumferential portion of a syringe, a clamp that moves in a rotational motion along the receiving surface between a clamped position at which the outer circumferential portion of a syringe can be clamped against the receiving surface and an unclamped position at which the outer circumferential portion of the syringe cannot be clamped, a support shaft that supports the clamp; a rotating shaft that fixes the clamp to one end side while having the other end side inserted with the ability to rotate with respect to the support shaft; a rotating cam provided so as to move in association with rotation of the rotating shaft and rotate in two directions, and a clamping member that moves toward and away from the mounting base through engagement with the rotating cam, and the clamping member clamps a flange portion of the syringe in the thickness direction between the mounting base by moving toward the mounting base through engagement with the rotating cam moving in association with the rotation of the clamp toward the clamped position side, and releases the flange portion by moving away from the mounting base through engagement with the rotating cam moving in association with the rotation of the clamp toward the unclamped position side.

EFFECT OF THE INVENTION

[0007]

Because the present invention is configured as described above, it can prevent looseness in the forward and backward direction of a mounted syringe, and it has favorable operability because the outer circumferential portion of the syringe and the flange portion are fixed by an operation that rotates the clamp.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a perspective view illustrating one example of the syringe fixing mechanism according to the present invention. FIG. 1A illustrates a state where the clamp is in a clamped position, FIG. 1B illustrates a state where the clamp is raised, and FIG. 1C illustrates a state where the clamp is rotated and is in an unclamped position.

FIG. 2 is a cross-sectional view of main parts along the line II-II in FIG. 1A.

FIG. 3 is a cross-sectional view of main parts illustrating the raised state of the clamp in the cross-section of FIG. 2.

FIG. 4 is a bottom view of the same syringe fixing mechanism, FIG. 4A illustrates a state where the clamping member is closed, and FIG. 4B illustrates a state where the clamping member is open.

FIG. 5 illustrates a process in which a syringe is installed in a normal position, FIG. 5(a) illustrates a state before a flange portion is clamped between a mounting base and a clamping member, and FIG. (b) illustrates a state after the flange portion is clamped between the mounting base and the clamping member.

FIG. 6 illustrates a process in which the syringe is installed in an incorrect position, FIG. 6(a) illustrates a state where a long section of the flange portion is inserted between the mounting base and the clamping member and a protrusion of the clamping member is about to ride onto the long section, and FIG. 6(b) illustrates a state where the protrusion of the clamping member is on top of the long section.

FIG. 7 is a perspective view illustrating one example of a syringe pump that uses a syringe fixing mechanism according to the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0009]

A first feature of the present embodiment provides a mounting base having a receiving surface for receiving an outer circumferential portion of a syringe, a clamp that moves in a rotational motion along the receiving surface between a clamped position at which the outer circumferential portion of a syringe can be clamped against the receiving surface and an unclamped position at which the outer circumferential portion of the syringe cannot be clamped, a rotating cam provided to move in association with the clamp and rotate in two directions, and a clamping member that moves toward and away from the mounting base through engagement with the rotating cam, and the clamping member clamps a flange portion of the syringe in the thickness direction between the mounting base by moving toward the mounting base through engagement with the rotating cam moving in association with the rotation of the clamp toward the clamped position side, and releases the flange portion by moving away from the mounting base through engagement with the rotating cam moving in association with the rotation of the clamp toward the unclamped position side.

According to this configuration, by rotating the clamp in one direction and putting it in a clamped position at which the syringe can be clamped, the rotating cam moves in association with the rotation of the clamp, and the clamping member engages the rotating cam and clamps the syringe between the clamping member and the mounting base by moving toward the mounting base. Furthermore, by rotating the clamp in the other direction and putting it in an unclamped position at which the syringe cannot be clamped, the rotating cam moves in association with the rotation of the clamp, and the clamping member engages the rotating cam and releases the syringe clamped between the clamping member and the mounting base by moving away from the mounting base.

Therefore, looseness in the forward and backward direction of the syringe can be prevented by a configuration that clamps the flange of the syringe between the mounting base and the clamping member. Further, because the clamping member opens and closes by an operation that rotates the clamp, the conventional problem of the syringe suddenly detaching due to a vertical vibration during operation while in a mounted state can be prevented.

[0010]

As a second feature in addition to the first feature, in order to more surely clamp the outer circumferential portion of the syringe, a support shaft that supports the clamp, a guided portion provided on one of either the clamp or the support shaft, and a guide portion provided on the other that guides the guided portion in a direction to move toward or away from the receiving surface are provided, and when the clamp is moved a predetermined distance away from the receiving surface, the guided portion separates from the guide portion so that the clamp can rotate toward the unclamped position side.

[0011]

As a third feature in addition to the first and second features, in order to make the operability of the clamping member favorable, a biasing means is provided for biasing the clamping member in the clamping direction.

[0012]

As a fourth feature in addition to any of the first to third features, in order to be capable of arranging the clamp separate from a position for performing a rotating operation and from an operation position of the clamping member, a rotating shaft that fixes the clamp to one end side while having the other end side inserted with the ability to rotate with

respect to the support shaft, and gears provided on the other end side of the rotating shaft are provided, and the rotation of the clamp is transferred to the rotating cam via the rotating shaft and the gears.

[0013]

As a fifth feature in addition to any of the first to fourth features, in order to be able to confirm when the circumferential direction position of the syringe is different, a protrusion on a clamping surface on the clamping member is provided, and when a long section, longer in the radially outward direction than other portions on the flange portion of the syringe, is inserted between the protrusion and the mounting base, the protrusion rides up onto the long section.

[0014]

As a sixth feature in addition to any one of the first to fifth features, in order to detect that the syringe is installed in a normal position, that the syringe is not installed, or that it is not installed incorrectly, or the like, a position sensor is provided for detecting the position of the clamping member.

[0015]

Furthermore, another independent invention relating to the above features is provided with a mounting base having a receiving surface for receiving an outer circumferential portion of a syringe, a clamping member that clamps and releases a flange portion of the syringe mounted on the mounting base in the thickness direction, and a protrusion on a clamping surface on the clamping member, and when a long section, longer in the radially outward direction than other portions on the flange portion of the syringe, is clamped by the clamping member, the protrusion rides up onto the long section.

According to this configuration, if the circumferential direction position of the syringe is different than the normal position when the syringe is mounted on the mounting base and the flange portion of the syringe is clamped by the clamping member, the protrusion rides up onto a long section, longer in the radially outward direction than other portions on the flange portion of the syringe, and thus this state can be confirmed by detecting with a sensor, or confirmed visually.

[0016]

Next, particularly preferred embodiments will be described in detail with reference to the drawings.

EMBODIMENTS

[0017]

A syringe fixing mechanism 1, as illustrated in FIGS. 1 to 6, is provided with a mounting base 10 having a receiving surface 11 for receiving an outer circumferential portion of a syringe S, a clamp 20 that rotates in a rotational motion substantially parallel along the receiving surface 11 between a clamped position (position illustrated in FIG. 1A) at which the outer circumferential portion of the syringe S can be clamped against the receiving surface 11 and an unclamped position (position illustrated in FIG. 1C) at which the outer circumferential portion of the syringe S cannot be clamped, a rotating shaft 30 that fixes the clamp 20 to one end side while having the other end side inserted with the ability to rotate with respect to the mounting base 10, a plurality of gears 41, 42 and 43 provided on the other end side of the rotating shaft 30, a rotating cam 44 that rotates in both directions in accordance with the gears 41, 42, and 43, a clamping member 50 that moves toward and away from the end portion of the mounting base 10 through engagement with the rotating cam 44, and a position sensor 60 for detecting the position of the clamping member 50.

This syringe fixing mechanism 1, as illustrated in FIG. 7, is incorporated into a syringe installation site of a syringe pump A.

[0018]

Note that the syringe S installed to the syringe fixing mechanism 1 is provided with a tube shaped cylinder portion s1, a flange portion f extended in a radially outward direction from the rear end portion of the cylinder portion s1, and a piston portion p inserted into the cylinder portion s1 from the rear end side.

The flange portion f has a collar shaped clamped portion f1 that is formed in a substantially horizontally elliptical shape from a plane view (when viewed from the right side in FIG. 5) and clamped by the mounting base 10 and the clamping member 50, and a collar shaped long section f2 that is longer in the radially outward direction than the clamped portion f1, and in the normal position, the clamped portion f1 is clamped between the end portion of the mounting base 10 and the clamping member 50¹.

[0019]

The mounting base 10 is integrally provided with a substantially recess-shaped receiving surface 11 that continues in the longitudinal direction of the mounted syringe S and a support shaft 12 for supporting the clamp 20, and according to the example in the drawings, is formed in a substantially square shape in a planar view by a synthetic resin material formation, and the bottom surface side (bottom surface side in FIG. 2) is recessed in a substantial concave shape.

[0020]

The receiving surface 11 is formed in a recessed shape to partially receive the cylinder portion s1 on the syringe S in the circumferential direction. This receiving surface 11 is made to follow in the longitudinal direction of the mounted syringe S, and continues from one end portion of the mounting base 10 along the entire length to the other end on the opposite side.

[0021]

The support shaft 12 is disposed in the planar direction that crosses the continuation direction of the receiving surface 11, separated from the receiving surface 11.

This support shaft 12 is formed in a substantially tubular shape protruding upward from the mounting base 10, and a groove shaped guide portion 12a is provided on the outer circumferential portion continuing in a direction to move toward or separate from (in other words, the vertical direction) the receiving surface 11. Further, an annular recessed portion 12b that continues only to a prescribed length in a substantial C-shape in the circumferential direction is formed on the upper end portion of the outer circumferential portion of the support shaft 12. This annular recessed portion 12b connects to the upper end portion of the recessed groove shaped guide portion 12a, and guides and rotates the clamp 20 in the circumferential direction.

[0022]

The clamp 20 is provided with a clamp main body portion 21 that sandwiches the cylinder portion s1 of the syringe S between the receiving surface 11, and a substantially column shaped operating portion 22 for performing a rotation operation on the clamp main body portion 21, and these are integrally provided so that they can be rotated.

This clamp 20 can be moved vertically with regards to the support shaft 12 by the interior of the operating portion 22 being supported by the support shaft 12, and when moved upward, can rotate about 90 degrees between the clamped position (see FIG. 1A)

¹ Japanese states "clamping member 60", but this is a typographical error for clamping member 50.

and the unclamped position (see FIG. 1C) by fitting into the annular recessed portion 12b and rotating.

[0023]

The clamp main body 21 is provided in a bar shape opposing the receiving surface 11 substantially perpendicular to the continuation direction of the receiving surface 11 in the clamp position, and has a recessed section 21a which fits the outer circumferential portion of the syringe S from the upper side on the lower end portion. The base end side of this clamp main body portion 21 is connected to the outer circumferential portion of the operating portion 22.

[0024]

The operating portion 22 is formed in a substantially tube shape having a protrusion and a recession to stop slipping on the outer circumferential portion, and has in its interior a fitting hole 22a that fits the upper end side of the support shaft 12 so that it can rotate, and a protruding guided portion 22b that protrudes from the interior circumferential surface of the fitting hole 22a and fits the guide portion 12a of the outer circumference of the support shaft 12 and the recessed annular portion 12b.

The fitting hole 22a is a hole shape with a bottom in which the support shaft 12 is inserted from the bottom, and is formed with an inner diameter slightly larger than the outer diameter of the support shaft 12.

The guided portion 22b is formed to move in the vertical direction to fit the guide portion 12a of the outer circumference of the support shaft 12 in the clamped position, and to fit the annular recessed portion 12b on the upper end side of the support shaft 12 and to rotate a predetermined amount in the circumferential direction.

[0025]

Furthermore, the rotating shaft 30 is a tube shaped or column shaped shaft body that fixes the clamp 20 at one end thereof so as to be capable of integral rotation, while have the other end side inserted with the ability to rotate with respect to a center portion of the support shaft 12, and protrudes downward of the mounting base 10.

This rotating shaft 30 can slide vertically via an O-ring, a shaft receiving member, or the like with regards to the inner circumferential surface of the support shaft 12, and fits so as to be capable of rotating in the circumferential direction.

Furthermore, a gear 41 is fixed in an annular shape further on the lower side than the mounting base 10 on the rotating shaft 30, a biasing member 31 is installed even further on the lower side than the gear 41, and a receiving member 32 is fixed even further on the lower side than the biasing member 31 such that it can receive the lower end of the biasing member 31.

[0026]

The gear 41 is a gear fixed on the outer circumferential portion of the rotating shaft 30 so that it can rotate integrally with the rotating shaft 30, and is pressed against the bottom surface of the mounting base 10 by being pressed from the lower side by the biasing member 31 via a spring receiver 31a.

[0027]

The biasing member 31 is a compression coil spring according to the example in the drawings, and is installed in an annular shape in a state having play with respect to the outer circumferential portion of the rotating shaft 30. This biasing member 31 accumulates elastic force by being compressed between the gear 41 and the receiving member 32 when the clamp 20 and the receiving member 32 move upward relative to the mounting base 10.

[0028]

Further, the receiving member 32, according to the example in the drawings, is formed in a substantially tube shape with a bottom covering the biasing member 31 from the lower side, and receives a seat surface of the lower end side of the biasing member 31.
[0029]

Further, the gears 42 and 43 that engage with the gear 41, as illustrated in FIG. 4, are each supported to rotate in both directions with respect to the lower end surface of the mounting base 10.

More specifically, the gear 42 engages with the gear 41, and the gear 43 engages with the gear 42.

These gears 41, 42, and 43 are for disposing the below-described rotating cam 44 substantially directly below the receiving surface 11, and engage each other with a gear ratio of 1 to 1. Note that as another example, it is possible to change the gear ratio.
[0030]

The rotating cam 44 is fixed in the same shaft shape to the gear 43 so as to be capable of integrally rotating with the gear 43, and is positioned between the gear 43 and the lower surface of the mounting base 10 as shown with a dotted line in FIG. 4.

This rotating cam 44 is formed in a substantially disk shape, and has a roughly recessed shaped cam surface 44a on the outer circumferential portion. This cam surface 44a is formed in a substantially fan shaped recessed shape whose dimensions in the circumferential direction gradually expand towards the centrifugal direction. According to this shape, a slanted surface is formed on both end sides of the circumferential direction of the cam surface 44a, and this slanted surface causes the clamping member 50 to advance and retract by slide-contacting an engaging protrusion 51a of the clamping member 50 in accordance with the rotation of the rotating cam 44.
[0031]

The clamping member 50 is formed integrally by an engaged portion 51 that is engaged by the cam surface 44a of the rotating cam 44, a rod portion 52 that extends in one direction of the continuation direction of the receiving surface 11 from the engaged portion 51 and is inserted into a side wall portion 10a of the mounting base 10, and a clamping piece 53 that is connected to the outer side of the mounting base 10 on the rod portion 52.
[0032]

The engaged portion 51 is a member positioned between the rotating cam 44 and the side wall portion 10a of the mounting base 10, and has an engaging portion 51a to oppose the cam surface 44a. This engaging portion 51a advances and retreats by slide-contacting the slanted surface of both ends of the cam surface 44a.
[0033]

A plurality of rod portions 52 (two in the example in the drawings) are provided with spacing there between in a direction substantially parallel with the receiving surface 11. Each rod portion 52 is formed in a substantially column shape, is inserted into the side wall portion 10a and protrudes towards both sides of the side wall portion 10a. A biasing member 54 (a compression coil spring in the example of the drawings) is installed in an annular shape between the engaged portion 51 on the outer circumferential portion of the rod portions 52 and the side wall portions 10a. This biasing member 54 biases the entire clamping member 50 to the rotating cam 44 side.
[0034]

Furthermore, the clamping piece 53 is formed in a substantially plate-shape that is substantially parallel to the end face of the mounting base 10. A long protrusion 53a is provided in the width direction of the receiving surface 11 (the vertical direction on the

bottom surface of the mounting base 10 of FIG. 4) in the clamping surface of the clamping piece 53 (in other words, the surface of the mounting base 10 side).

This protrusion 53a has an inclined surface 53a1 to slide and push it up to the end of the long section f2 when the long section f2 of the flange f in the syringe S is inserted between the clamping piece 53 and the mounting base 10. This inclined surface 53a1 is inclined such that it gets closer to the mounting base 10 facing the downward direction, as illustrated in FIG. 5 and FIG. 6.

[0035]

Furthermore, a non-sensing unit 51b is provided in the clamping member 50 to integrally retreat with the clamping member 50.

This non-sensing unit 51b is configured so as to sense from the position sensor 60 when the clamping member 50 is in a regular clamping state (the state illustrated in FIG. 5(b)) clamping the flange portion f of the syringe S. To describe more specifically, the non-sensing unit 51b is formed in a protruding shape that protrudes from the end of one rod piece 52 to the other clamping piece 53, and has a slit 51b1 that passes through in the direction that intersects the retreating direction of the clamping member 50 into a portion having a protruding shape.

[0036]

The position sensor 60 is configured so as to output an on or an off signal while the optical path formed between the light emitting element and the light receiving element turns on and off by obstructing and un-obstructing with an object.

The syringe fixing mechanism 1 of the present embodiment is composed such that, in the regular clamped state that the clamping member 50 clamps the clamped portion f1 of the flange f (the position illustrated in FIG. 5(b)), when the optical path of the position sensor 60 passes the slit 51b1 of the non-sensing unit 51b, a sensing signal from the position sensor 60 is output, and in the other positions, the optical path is obstructed by a portion other than the slit 51b1 of the non-sensing unit, and the output of the sensing signal is stopped. Note that, as another example, when the optical path is obstructed, the sensing signal is output, and when the optical path passes through the slit 51b1, the output of the sensing signal may also be stopped.

[0037]

Further, when the clamping member 50 is in the regular clamped state (the position illustrated in FIG. 5(b)), the information signal from the light and/or the sound from the information device (for example an LED, speaker, or the like) not illustrated is output from the perception of the position sensor 60. Note that, as another example, when the clamping member 50 is in not in the regular clamped state, for example, when it is in the state that the clamping piece 53 is closed (the state illustrated in FIG. 5(a)) or in an erroneous mounted state with the long section f2 of the flange portion f inserted between the protrusion 53a of the clamping piece 53 and the mounting base 10 (the state illustrated in FIG. 6(b)), the information signal may also be output.

[0038]

Next, a characteristic operational effect concerning the syringe fixing mechanism 1 of the configuration above is described in detail.

The state illustrated in FIG. 1(a) is in an initial position where the syringe fixing mechanism 1 does not clamp the syringe S.

When the syringe S clamps the syringe fixing mechanism 1 in the initial position, first, the clamp 20 is raised upward relative to the mounting base 10 into the state illustrated in FIG. 1(b). When raising, the clamp 20 slides upward without rotating as is it guided by the guided portion 22b of the inner peripheral portion to the guide portion 12a of the outer

perimeter of the support shaft 12.

[0039]

In the state with the clamp 20 raised as described above, in the clamp 20, because the guided portion 22b deviates from the vertically directed guide portion 12a, the clamp 20 is in a state capable of rotating in the circumferential direction along an annular recessed portion 12b.

In this state, if a rotating operation is applied to the clamp 20, the clamp 20 is rotated a predetermined amount in one circumferential direction (90° according to the illustrated example) to reach a non-clamped position (the position illustrated in FIG. 1) while the raised state is maintained by mating the guided portion 22b on the inside with the annular recessed portion 12b.

[0040]

During the rotation, gears 41, 42, 43, and the rotating cam 44 move and rotate in conjunction with the rotation of the rotation shaft 30 together with the clamp 20 at a location further downward than the mounting base 10.

Accordingly, the engaging projection 51a of the clamping member 50 is pushed upward, the clamping piece 53 of the clamping member 50 is separated from the end of the mounting base 10, and a gap W is formed between the clamping piece 53 and the mounting base 10 by the cam surface 44a of the rotating cam 44 that rotates (more specifically, the inclined surface of both sides of the cam surface 44a).

[0041]

Next, as illustrated in FIG. 5(a) and (b), the clamped portion f1 of the flange portion f is inserted between the clamping piece 53 and the mounting base 10 while the syringe S is mounted to the receiving surface 11 of the mounting base 10.

Further, in this state, when the clamp 20 is rotated and operated in the reverse direction (clockwise according to FIG. 1), the clamp main body 21 is in the clamp position facing the receiving surface 11, the entire clamp 20 slightly descends according to the biasing force of a biasing member 31, the cylinder portion s1 is clamped between the clamp main body 21 and the receiving surface 11, and at substantially the same time, the clamping piece 53 approaches the end of the mounting base 10 due to the biasing force of the biasing member 54 and the clamped portion f1 of the flange portion f is clamped between the ends while the engaging portion 51a of the clamping member 50 is mated to the rotation cam 44. This regular clamped state can be recognized from the outside based on the sensing signal of the position sensor 60.

[0042]

Furthermore, when the syringe S is mounted to the mounting base 10, for example, when it is in the irregular clamped state illustrated in FIG. 6, that is, when the long section f2 of the flange portion f is inserted between the mounting base 10 and the clamping piece 53, the long section f2 pushes the protrusion 53a upward, and because the space between the mounting base 10 and the clamping piece 53 is larger than when in the regular clamped state (see FIG. 5(b)), the optical path of the position sensor 60 is obstructed at the bottom side of the mounting base 10 and does not traverse the slit 51b1 of the non-sensing unit 51b. Accordingly, this irregular clamped state can be recognized from the outside based on the sensing signal of the position sensor 60.

[0043]

Furthermore, when removing the syringe S in the installed state, the operation may be performed in reverse of the above, that is, first, pull the clamp 20 up in a slightly upward direction and remove the concave portion 21a of the clamp main body 21 lower surface from the syringe S outer circumferential portion. In this case, the syringe S will not be

removed inadvertently due to vertical vibration because the clamping member 50 has not yet opened.

For the next operation, when the operation portion 22 raised in the slightly upward direction is rotated in the reverse direction (counter-clockwise according to FIG. 1), the clamp main body 21 reaches the clamp position, and at substantially the same time, the syringe S may be removed in the upward direction because the clamping member 50 releases the clamped state.

[0044]

Therefore, according to the above-described syringe fixing mechanism 1, the installed syringe S can be prevented from loosening in the forward and backward direction because the flange portion f of the syringe S is clamped between the end of the mounting base 10 and the clamping piece 53 of the clamping member 50.

Furthermore, because the structure is such that the clamping member 50 opens and closes through an operation of rotating the clamp 20, the operation of opening and closing the clamping member 50 is intuitive and easy to understand, vertical vibration accompanying the opening and closing of the clamping member 50 is relatively small, and consequently, for example, when the syringe S in the installed state is removed, the syringe S can be prevented from being removed inadvertently due to a vertical vibration during operation.

Furthermore, the regular clamped state of the syringe S (see FIG. 5(b)) and a state other than that may be easily understood by the signal based on the sensing of the position sensor 60.

Furthermore, even if by chance liquid leaks from the syringe S, interference from the liquid hindering the syringe fixing mechanism 1 can be prevented because the position sensor 60, the gears 41, 42, and 43, the rotation cam 44, and the like are in a configuration not disposed below the gap W between the end of the mounting base 10 and the clamping piece 53.

[0045]

Note that according to the above-described embodiment, a protruding guided portion 22b is provided in the clamp 20, and the recessed shaped guide portion 12a and the annular recessed portion 12b are provided on the outer circumferential portion of the support shaft 12, but alternative examples that reverse the protruding and recessed relationship may also be used.

The same is true for the engaged portion 51 and the rotating cam 44 in that the protruding and recessed relationship may be reversed.

[0046]

Further, in the above embodiment, a normally clamped state of the syringe S (see FIG. 5(b)) and a state other than that is recognized using one position sensor 60, but an alternate example may provide a plurality of position sensors in the advancing and retracting direction of the non-sensing unit 51b, and a configuration may be provided to distinguish a closed state between the clamping piece 53 and the mounting base 10 (see FIG. 1(a) and FIG. 4(a)) and an open state between the clamping piece 53 and the mounting base 10 so that the flange portion f can be inserted (see FIG. 1(c) and FIG. 4(b)), a normally clamped state with respect to the syringe S (see FIG. 5(b)), an abnormally clamped state with respect to the syringe S (see FIG. 6(b)), and the like using the plurality of position sensors.

[0047]

Further, in the above embodiment, an example is given of using a photosensor as the position sensor 60, but alternate examples of the position sensor 60 may include using a

noncontact type sensor (for example a magnetic proximity sensor and the like), a contact type sensor (for example a limit switch and the like), and the like in place of the photosensor.

[0048]

Further, in the above embodiment, the rotational motion of the clamp 20 is transmitted to the rotating cam 44 via a plurality of gears 41, 42, and 43, but an alternate example may transmit the rotational motion of the clamp 20 to the rotating cam 44 via a single gear, the gear may be omitted by providing a direct rotating cam 44 to the lower end of the rotating shaft, or the rotational motion of the clamp 20 may be transmitted to the rotating cam 44 by another power transmitting means such as a chain and sprocket, belt and pulley, or the like.

[0049]

Further, in the above embodiment, a structure is provided in which the clamp 20 slides upward and then rotates, but an alternate example may provide a structure in which the clamp 20 rotates without vertically sliding, and the clamping member 50 advances and retracts by moving in association with the rotation. When structured in such manner, the recessed section 21a is omitted from the clamp main body 21 to facilitate rotation of the clamp 20, and the structures for sliding the clamp 20 vertically, namely the guide portion 12a, the guided portion 22b, the biasing member 31, the receiving member 32, and the like, are not required.

[Reference Numerals]

[0050]

1: syringe fixing mechanism	10: mounting base
11: receiving surface	12: support shaft
12a: guide portion	20: clamp
22b: guided portion	30: rotating shaft
31: biasing member	41, 42, 43: gear
44: rotating cam	50: clamping member
53: clamping piece	53a: protrusion
54: biasing member	S: syringe
s1: cylinder portion	f: flange portion
f1: clamped portion	f2: long section

What is Claimed is:

1. A syringe fixing mechanism for a syringe pump, comprising:
 - a mounting base having a receiving surface for receiving an outer circumferential portion of a syringe;
 - a clamp that moves in a rotational motion along the receiving surface between a clamped position at which the outer circumferential portion of a syringe can be clamped against the receiving surface and an unclamped position at which the outer circumferential portion of the syringe cannot be clamped;
 - a support shaft that supports the clamp;
 - a rotating shaft that fixes the clamp to one end side while having the other end side inserted with the ability to rotate with respect to the support shaft;
 - a rotating cam provided so as to move in association with rotation of the rotating shaft and rotate in two directions; and
 - a clamping member that moves toward and away from the mounting base through engagement with the rotating cam; wherein
 - the clamping member clamps a flange portion of the syringe in the thickness direction between the mounting base by moving toward the mounting base through engagement with the rotating cam moving in association with the rotation of the clamp toward the clamped position side, and releases the flange portion by moving away from the mounting base through engagement with the rotating cam moving in association with the rotation of the clamp toward the unclamped position side.
2. The syringe fixing mechanism for a syringe pump according to claim 1, comprising a guided portion provided on one of either the clamp or the support shaft; and a guide portion provided on the other to guide the guided portion in a direction to move toward or away from the receiving surface; wherein when the clamp is moved a predetermined distance away from the receiving surface, the guided portion separates from the guide portion so that the clamp can rotate toward the unclamped position side.
3. The syringe fixing mechanism for a syringe pump according to claim 2, comprising biasing means for biasing the clamping member in the clamping direction.
4. The syringe fixing mechanism for a syringe pump according to claim 3, comprising gears provided on the other end side of the rotating shaft; wherein the rotation of the clamp is transferred to the rotating cam via the rotating shaft and the gears.
5. The syringe fixing mechanism for a syringe pump according to claim 4, comprising a protrusion on a clamping surface on the clamping member, wherein, when a long section, longer in the radially outward direction than other portions on the flange portion of the syringe, is inserted between the protrusion and the mounting base, the protrusion rides up onto the long section.
6. The syringe fixing mechanism for a syringe pump according to claim 5, comprising a position sensor for detecting the position of the clamping member.