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(71) Applicant *(for all designated States except US)*: **DELAVAL HOLDING AB** [SE/SE]; P.O. Box 39, S-147 21 Tumba (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **HÄGGLUND, Christoffer** [SE/SE]; Grytstigen 12, S-147 52 Tumba (SE). **PETTERSON, Torbjörn** [SE/SE]; Rosenhed, S-646 32 Gnesta (SE). **SANDBERG, Ola** [SE/SE]; Norrtuna, S-646 91 Gnesta (SE). **PERSSON, Michael** [SE/SE]; Nejlikev. 5B, S-146 50 Tullinge (SE).

(74) Agent: **BERGLUND, Stefan**; Bjerkéns Patentbyrå KB, Östermalmsgatan 58, S-114 50 Stockholm (SE).

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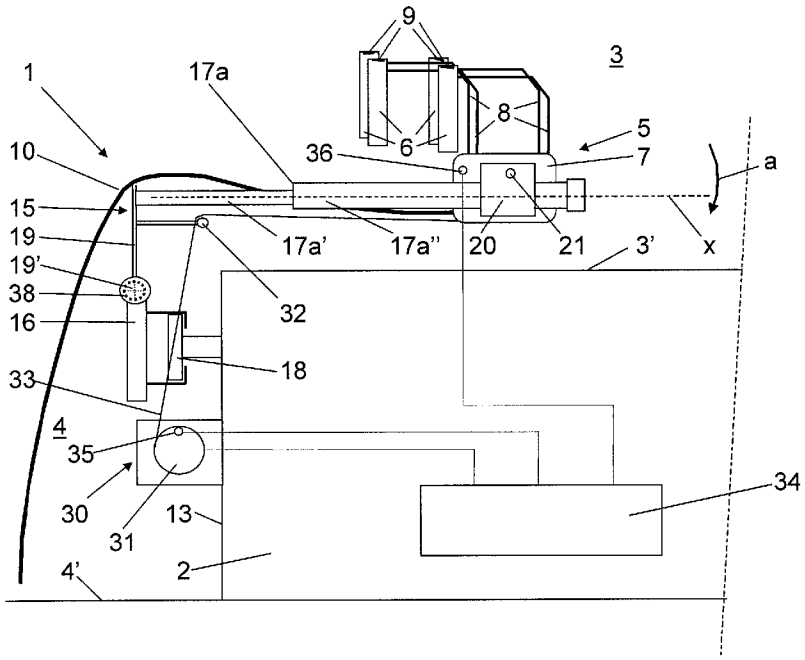
(54) **Title:** A MILKING DEVICE



(57) **Abstract:** The present invention refers to a milking device (1) for milking an animal during a milking operation A milking member (5) comprises at least one teatcup (6) to be attached to a teat of the animal to be milked. At least one long milk conduit (10) extends from the milking member and is connected to a milking machine for providing a milking vacuum in the teatcup. A removing device (30) is provided for removing the milking member from the animal during a removing operation when the milking operation is finished. The removing device is adapted to apply a variable force on the milking member for facilitating the removing of the milking member from the animal.

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A milking device

THE BACKGROUND OF THE INVENTION AND PRIOR ART

The present invention refers to a milking device for milking an animal during a milking operation, comprising a milking member comprising at least one teatcup to be attached to a teat of the animal to be milked, at least one long milk conduit extending from the milking member and adapted to be connected to a milking machine for providing a milking vacuum in the teatcup, and a removing device for removing the milking member from the animal during a removing operation when the milking operation is finished.

There are several different milking methods known today. One differs between manual milking, where the milking operation is performed by hand, and machine milking, where the milking is performed by a milking machine. Machine milking may be semi-automatic, i.e. the teatcups are still attached manually and may be automatically removed from the teats after the milking operation is finished. Such semi-automatic milking is the most frequent method today, especially in milking arrangements comprising a large number of animals. In recent time, fully automatic milking is also used, wherein the teatcups are attached in an automatic manner to the teats of the animal to be milked, which means that no manual operation is any longer needed.

This invention refers to a milking device comprising a removing device for removing the milking member from the animal during a removing operation when the milking operation is finished. One problem in connection with such an automatic removing is that the teatcups can not always be easily drawn off from the teats. The teat and/or udder shape is most often the reason for

teatcups remaining firmly attached when the milking operation has been finished. A rather high force is thus needed in order to remove the teatcups. Such a high force can hurt the animal and lead to injuries on the teats and the udder.

US-A-3,870,021 discloses a support device for supporting a milking member. The support device comprises a curved arm which is vertically displaceable upwardly and downwardly. By means of this vertical movement, vertically downward directed force can be applied to the teats during the milking of the animal. Moreover, the height of the milking member can be adjusted to different levels of the teats of different animals. The removing of the teatcups takes place by rotating the arm laterally outwardly.

EP-A-1 514 469 discloses a milking plant having automatic removing of the teatcups by means of a removing device. The removing takes place when the vacuum level in the milking space has decreased to a lower limit. The teatcups can be removed independently of each other. The removing force can be different for different teatcups.

DE-C-44 38 236 discloses an arm for supporting a milking member. The arm is vertically displaceable upwardly and downwardly. In such a way a downwardly directed force can be applied to the teats during the milking operation. The removing of the teatcups is performed by means of a laterally directed force.

SUMMARY OF THE INVENTION

The object of the present invention is to facilitate the removal of the milking member after the milking operation is finished.

This object is achieved with the milking device initially defined, which is characterized in that the removing device is adapted to

apply a variable force on the milking member for facilitating the removing of the milking member from the animal. By means of such a variable force, the removing of the teatcups is facilitated also in the cases when the teatcups for any reason are firmly stuck to the teats. By alternately varying the force applied, the removing of the teatcups is more gentle to the animal, and the risk for injuries is reduced.

According to an embodiment of the invention, the removing device is adapted to apply a primary force on the milking member before the variable force is applied. The removing of the teatcups may thus be initiated by the application of the primary force, which may be a constant or a substantially constant pulling force. The variable force may then be applied if the teatcups are not removed by the application of the primary force. Advantageously, the removing device may be adapted to reduce the primary force before the variable force is applied.

According to a further embodiment of the invention, the variable force is an alternately increasing and decreasing force. For instance, the variable force may be an alternately pulling and pushing force, or an alternately high and low pulling force. Alternatively, the variable force may involve an alternately changing of the direction of the force applied on the milking member.

According to a further embodiment of the invention, the milking device comprises a control unit adapted to control the removing device and the variable force.

According to a further embodiment of the invention, the removing device comprises a first sensor connected to the control unit and adapted to sense a value of a parameter related to the force applied on the milking member. The control unit may then be adapted to control the removing device to initiate the

application of the variable force when the primary force reaches an upper level.

According to a further embodiment of the invention, the removing device comprises a second sensor connected to the control unit and adapted to sense a value of a parameter related to a pressure in the teatcup. The control unit may then be adapted to control the removing device to initiate the application of the variable force a predetermined time period after the application of the primary force if the pressure in the teatcup is below or significantly below the atmospheric pressure. Furthermore, the control unit may also be adapted to terminate the application of the variable force if the pressure in the teatcup is equal to or substantially equal to the atmospheric pressure.

According to a further embodiment of the invention, the removing device is arranged in such a way that at least the variable force, and preferably also the primary force, applied to the milking member is directed downwards during the removing operation, and more precisely substantially vertically downwards.

According to a further embodiment of the invention, the milking device comprises a support device comprising a support arm to which the milking member is attached during the removing operation, wherein the removing device is adapted to co-operate with the support device during the removing operation for providing the downwards directed force. By means of such a support arm the force for removing the teatcups can easily be applied in a desired and suitable direction. Advantageously, the support arm may be provided to be rotatable in a substantially vertical plane, wherein the removing device is adapted to co-operate with the support device during the removing operation to rotate the support arm downwards in order to provide the downwards directed force. Furthermore, the support device may

comprise a mounting device, adapted to be mounted to a structure, wherein the support arm is mounted to the mounting device to be rotatable in the substantially vertical plane.

According to a further embodiment of the invention, the support arm provides a first inner position relatively close to the mounting device and a second outer position relatively far away from the mounting device, wherein the milking member is freely movable between the first inner position and the second outer position. Advantageously, the removing device is adapted to move the milking member from the second outer position to the first inner position during an end phase of the removing operation.

According to a further embodiment of the invention, the removing device comprises a line element connected to the milking member and a removing member connected to the line element. By such removing equipment, the application of the primary, substantially constant force and of the variable force may be easily accomplished. Advantageously, the removing member may be adapted to apply said downwards directed force and to apply an opposite upwards directed force.

According to a further embodiment of the invention, the removing device comprises a force-generating member adapted to apply an upwards directed force to the milking member.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is now to be explained more closely by means of a description of various preferred embodiments and with reference to the drawings attached hereto.

Fig 1 discloses schematically a side view of a first embodiment of a milking device according to the invention in an active milking position.

Fig 2 discloses a view from above of the milking device in Fig 1 in an intermediate position.

Fig 3 discloses schematically a side view of the milking device in Fig 1 in an intermediate position.

Fig 4 discloses schematically a side view of the milking device in Fig 1 in a rest position.

Fig 5 discloses schematically a side view of a second embodiment of a milking device according to the present invention in a position where the removing of the teatcups has been initiated.

Fig 6 discloses schematically a side view of the milking device in Fig 5 in an intermediate position.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

Figs 1 to 4 disclose a first embodiment of a milking arrangement comprising a milking device 1 for milking an animal during a milking operation. The milking device 1 is provided in a structure 2 in the form of a milking stall. The milking stall comprises at least one milking place 3 for receiving at least one animal to be milked. The milking stall may comprise a large number of milking places 3 or milking boxes arranged in any preferred configuration. Each milking place 3 is adapted to house one animal at a first level on a substantially horizontal animal floor 3' for milking of the respective animal during a respective milking operation. The structure 2 also comprises a pit area 4 having a substantially horizontal pit floor 4' at a third level, and a substantially vertical wall 13 extending at least substantially between the animal floor 3' and the pit floor 4'.

The milking device 1 comprises a milking member 5 comprising at least one teatcup 6 to be attached to a teat of the animal to be milked. In the embodiments disclosed, the milking member 5 comprises a claw 7 and four teatcups 6. Each teatcup 6 is connected to the claw 7 via a respective short milk conduit 8.

Each teatcup 6 defines an inner space for receiving a respective teat and has an upper opening 9 permitting the introduction of the teat into the inner space of the teatcup 6. Each short milk conduit 8 has such a stiffness that the teatcups 6 are maintained in a position with the openings 9 turned substantially upwards also when the teatcups 6 are not attached to the teats of the animal and the claw is in a substantially horizontal position as shown in Fig 1. As can be seen in Fig 1, each short milk conduit 8 is attached to the respective teatcup 6 at an upper part of an outer side surface of the teatcup 6. Each short milk conduit 8 has a first substantially straight portion connected to the claw 7 and a second substantially straight portion connected to the respective teatcup 6. The first straight portion is approximately perpendicular to the second straight portion. In the position disclosed in Fig 1, the first straight portion extends substantially vertically and the second straight portion extends substantially horizontally. A long milk conduit 10 extends from the milking member 5. In the embodiment disclosed in Figs 1-4, the long milk conduit 10 is attached to and extends from the claw 7. The long milk conduit 10 is adapted to be connected to a milking machine (not disclosed) in a manner known per se. It should also be noted that each teatcup 6, in a conventional manner, comprises a pulsation chamber (not disclosed) connected to a pulsator (not disclosed) via pulse conduit (not disclosed), which could be a separate conduit or a conduit integrated in the short milk conduit 8 and/or the long milk conduit 10.

The milking device 1 also comprises a support device 15. The support device 15 comprises a mounting device 16 and a support arm 17a, 17b. The support arm 17a, 17b has an elongated shape and extends in parallel to an arm axis x. The mounting device 16 is adapted to be mounted to the structure 2. In the embodiments disclosed, the structure 2 comprises a rail element 18 provided outside the milking place 3 and mounted to the substantially vertical wall 13 next to and beneath the milking place 3 and the first level of the animal floor 3'. The rail element

18 extends in parallel to or along a horizontal or substantially horizontal rail axis r at a second level between the first level and third level. It should be noted that the rail axis r could be inclined with respect to a horizontal line. The mounting device 16 is mounted to the rail element 18 to be freely movable on the rail element 18 along the rail axis r at least during the milking operation.

The support arm 17a, 17b is connected to the mounting device 16 via a connecting member 19. The support arm 17a, 17b is movable with respect to the mounting device 16. In the embodiments disclosed, the support arm 17a, 17b is rotatable in a vertical plane with respect to the mounting device 16. This possibility of rotation of the support arm 17a, 17b is accomplished by means of a rotary joint 19' of the connecting member 19. The connecting member 19 is thus mounted to the mounting device 16 by means of the rotary joint 19'.

The milking member 5 is attached to the support arm 17a, 17b and at the same time freely movable along the arm axis x. This movability is accomplished in two ways. The milking member 5 is displaceable on the support arm 17a, 17b along the arm axis x. The milking device 1 may then comprise a slide member 20, which holds the milking member 5 and is slidably attached to the support arm 17a, 17b to be displaceable along the arm axis x. More specifically, as can be seen from the figures, the slide member 20 holds the claw 7 via two pins 21 attached to the claw 7 and extending through corresponding holes extending through two flange members 22 provided on the slide member 20. The claw 7 is pivotal with respect to the slide member 22 by means of the pins 21. More specifically, the claw 7 is pivotal around a pivot axis p extending in parallel to the pins 21. In the embodiments disclosed, the pivot axis p extends at a substantially right angle in relation to the arm axis x. The flange members 22 are elastically flexible so that the claw 7 and the

milking member 5 can be easily detached from the slide member 20 by bending the flange members 22 outwardly.

The support arm 17a, 17b comprises a primary arm element 17a', 17b' connected to the mounting device and a secondary arm element 17a'', 17b'' holding the milking member 5. The movability of the milking member 5 is also accomplished by the feature that the primary arm element 17a', 17b' is telescopically introduceable into the secondary arm element 17a'', 17b'' so that the secondary arm element 17a'', 17b'' is displaceable and freely movable on the primary arm element 17a', 17b' along the arm axis x. The support arm 17a, 17b has an inner end connected to the mounting device 16 and an opposite outer end. The milking member 5 is thus displaceable on the support arm 17a, 17b between a first inner position in the proximity of the inner end, see Fig 4, and a second outer position in the proximity of the outer end, see Fig 1. Furthermore, the support arm 17a, 17b is, as mentioned above, connected to the mounting device 16 to be movable with respect to the mounting device 16 in order to be positionable in at least a rest position shown in Fig 4 and an active milking position shown in Fig 1.

As can be seen from Fig 2, the support arm 17a, 17b may comprise a first arm 17a and a second arm 17b. The teatcups 6 and the short milk conduits 8 are not disclosed in Fig 2. Both the first arm 17a and the second arm 17b extend in parallel to each other and to the arm axis x. Both the first arm 17a and the second arm 17b are at the inner ends connected to the mounting device 16 via the connecting element 19. At the outer ends the first arm 17a and the second arm 17b are connected to each other via a connecting rod 25. The long milk conduit 10 extends beside the support arm 17a, 17b and in the first embodiment, the long milk conduit 10 extends between the first arm 17a and the second arm 17b. The slide member 20 is mounted to the first arm 17a and the second arm 17b to be displaceable along the arm axis x. Both the first arm 17a and the second arm 17b

comprise a respective primary arm element 17a', 17b' connected to the mounting device 19 and a respective secondary arm element 17a'', 17b'' holding the milking member 5. The primary arm elements 17a', 17b' are telescopically introduceable into the secondary arm elements 17a'', 17b'' in such a way that the secondary arm elements 17a'', 17b'' are displaceable on the respective primary arm element 17a', 17b' in parallel to the arm axis x.

The milking device 1 also comprises a removing device 30 provided to remove the milking member during a removing operation after the milking operation has been finished. The removing device 30 comprises a removing member 31 attached to the structure 2, and more specifically to the wall 13. It is to be noted that the removing member 31 could also be attached to for instance the mounting device 16. In the embodiments disclosed in Figs 1 to 4, the removing member 31 comprises a rotary motor. The removing member 31 may also as an alternative comprise a linear motor, such as a pneumatic or hydraulic cylinder.

Furthermore, the removing device 30 comprises a guide member 32 and a line element 33, such as a wire, a chain etc. The line element 33 extends between and is connected to the removing member 31 and the milking member 5. The guide member 32 is attached to the connecting member 19 and fixed in relation to the support arm 17a, 17b. In the first embodiment, the guide member 32 is located at a horizontal position lying between a horizontal position of a connection point of the line element 33 to the removing member 31 and a horizontal position of a connection point of the line element 33 to the milking member 5.

The milking device 1 also comprises a schematically indicated control unit 34, which may form a part of a control system for the milking device 1 and which is adapted to control the removing operation to be performed by the removing device 30 and the

removing member 31. A first sensor 35 is connected to or form a part of the control unit 34 and adapted to sense a value of a parameter related to the force applied on the milking member 5. A second sensor 36 is connected to or form a part of the control unit 34 and adapted to sense a value of a parameter related to a pressure in the teatcups 6. It should be noted that the sensors 35, 36 may be included in the control unit 34 for permitting sensing of an electric current or electric power.

In the embodiment disclosed in Figs 1 – 4, the milking device also comprises a force-generating member 38 exerting a force acting on the support arm 17a, 17b to rotate, around the rotary joint 19', the support arm 17a, 17b upwards in the vertical plane. The force-generating member 38 may comprises any suitable force-exerting member, such as an electrical motor, a pneumatic or hydraulic cylinder or a spring. The spring may, for instance, be a spiral spring incorporated in the rotary joint 19', as indicated in Fig 1, or a helical spring acting on the support arm 17a, 17b.

The removing device 30 is adapted, by means of the removing member 31 and via the line element 33 and the guide member 32, to apply a primary force on the milking member 5. The primary force is directed downwards and may be constant or substantially constant. If the milking member 5 is not removed from the teats by means of the primary force, the removing device 30 is then adapted to apply variable force on the milking member 5 for facilitating the removing of the milking member 5 from the teats of the animal. The removing device 30 may be adapted to reduce significantly the primary force before the variable force is applied.

The variable force may be an alternately increasing and decreasing force. The variable force could e.g. be an alternately relatively high pulling force and a relatively low pulling force, or an alternately pulling force and a pushing force. The pushing

force may for instance be provided by the force-generating member 38 acting on the support arm 17a, 17b to rotate the arm upwards around the rotary joint 19'.

The variable force may also involve an alternately changing of the direction of the force applied on the milking member 5, not only in a substantially vertical direction towards and away from the teats, but also in a lateral direction with respect to the teats, e.g. back and forth in a substantially horizontal direction along the arm axis x. Furthermore, a drive member (not disclosed) may be provided, for instance, for moving the mounting device 16 back and forth along the rail element 18 to provide the variable force on the milking member 5.

The control unit 34 is adapted to control the removing device 30 to initiate the application of the variable force, e.g. after a predetermined time period, when the primary force, sensed by the first sensor 35, reaches an upper level, or a predetermined time period after the application of the primary force if the pressure, sensed by the second sensor 36, in the teatcup 6 is below the atmospheric pressure.

The control unit 34 may also be adapted to control the variable force, and more precisely to control the removing member 31 and possibly the force-generating member 38 to shift from the increasing force to the decreasing force after a predetermined time period, and to shift from the decreasing force to the increasing force after another predetermined time period. Moreover, the control unit 34 may be adapted to control the removing member 31 and possibly the force-generating member 38 to shift from the increasing force to the decreasing force when the increasing force, sensed by the first sensor 35, reaches a predetermined upper level, and to shift from the decreasing force to the increasing force when the decreasing force, sensed by the first sensor 35, reaches a predetermined lower level. Furthermore, the control unit 34 may be adapted to

control the removing member 31 and possibly force-generating member 38 to shift from the increasing force to the decreasing force in response to the pressure sensed by the second sensor 36, and to shift from the decreasing force to the increasing force in response to the pressure sensed by the second sensor 36.

Furthermore, the control unit 34 may be adapted to terminate the application of the variable force if the pressure, sensed by the second sensor 36, is equal to the atmospheric pressure.

The removing device 30 is arranged in such a way that at least the force applied to the milking member 5 is directed downwards during the removing operation. Especially, the removing device will co-operate with the support device 15 during the removing operation so that the milking member 5 and the teatcups 6 are pulled downwards. The support arm 17a, 17b is rotated around downwards around the rotary joint 19' in order to provide the downwards directed force.

As indicated above, Fig 1 discloses the milking device 1 in an active milking position in which the milking member is located at an outer end of the support arm and the teatcups 6 may be attached to the teats of the animal (not disclosed). Fig 3 discloses the milking device 1 in an intermediate position in which the removing of the milking member 5 from the teats has been initiated by means of the removing device 30. The removing member 31 has pulled the line element 33 over the guide member 32. Due to the position of the guide member 32 and removing member 31, the support arm 17 will be rotated downwards in the direction of the arrow a. The pulling of the line element 33 also result in the milking member 5 being displaced on the support arm 17a, 17b, i.e. on the secondary arm element 17a'', 17b'', away from the outer end and towards an inner end of the support arm 17a, 17b. In the intermediate position disclosed in Fig 3, also the secondary arm element 17a'', 17b''

has been displaced on the primary support element towards the inner end of the support arm 17a, 17b.

Fig 4 discloses the milking device 1 in a rest position, in which the milking member 5 has been further pulled by means of the line element 33 and the removing member 31 and is located at the inner end of the support arm 17a, 17b. In the rest position the support arm 17a, 17b has been rotated upwards in a vertical plane with respect to the mounting device 16 so that the support arm 17a, 17b is located completely outside the milking place 3, or at least substantially completely outside the milking place 3. This rotation of the support arm 17a, 17b is accomplished by means of the gravity force, since the centre of gravity of the milking member 5 and the long milk conduit 10 will be located horizontally outside the point of rotation defined by the rotary joint 19'. Alternatively or additionally, the rotation of the support arm 17a, 17b is accomplished by the above-mentioned force-generating member 38 exerting a force acting on the support arm 17a, 17b to facilitate the moving of the support arm 17a, 17b from the active milking position to the rest position. Consequently, in this case the force-generating member 38 may, when the milking member 5 has been moved from the second outer position to the first inner position, overcome the weight of the support arm 17a, 17b, the milking member 5, the slide member 20 and the long milk conduit 10, and rotate the support arm from the active milking position shown in Fig 1 to the rest position shown in Fig 4.

The teatcups 6 can be easily attached to the teats of an animal by a milker when the milking device 1 is in the rest position. The milker can then grip two of the teatcups 6 and move them forwardly, i.e. from the position outside the milking place 3 to a position beneath the udder and the teats of the animal. This movement is permitted by the rotation of the support arm 17a, 17b around the connecting joint 19' and by the movement of the milking member 5 along the arm axis x. At this position, the

teatcups 6 can be slightly lifted onto the respective teats. The animal may then be milked during the milking operation. When the milking operation is finished, the removing device 30 is activated as explained above, wherein the milking member 5 is withdrawn from the teats and moved rearwardly and to the first inner position during an end phase of the removing operation. At this position the centre of gravity of the milking member 5 and the long milk conduit will be outside the rotary joint 19' so that the support arm will be rotated back to the rest position shown in Fig 4, possibly assisted by the force-generating member 38.

Figs 5 and 6 disclose a second embodiment of the milking device. It is to be noted that elements having a corresponding function have been denoted with the same reference signs in all embodiments. In the second embodiment, the removing member 31 comprises a reversible rotary motor having a rotary drum 39 on which the line element 33 is wound. The removing member 31 is connected to the milking member 5 via the line element 33 and the guide member 32. The support arm 17a, 17b is freely rotatable around the rotary joint 19, with respect to the mounting device 16. Also in the second embodiment, the guide member 32 is attached to the movable part of the support device 15, and more specifically to the connecting member 19. It should be noted that the guide member 32 in the second embodiment as well as in the first embodiment could be attached to the support arm 17a, 17b. The guide member 32, seen along a vertical plane, is positioned between a left point of contact between the line element 33 and the rotary drum 39 and a right point of contact between the line element 33 and the rotary drum 39. In Fig 5, the rotary drum 39 of the removing member 31 is rotated to the right, which means that the support arm 17a, 17b and the milking member 5 will be forced downwards by the removing member 31 via the line element 33. The milking member 5 will also be forced to the left, i.e. towards the first inner position. In Fig 6, the rotary drum 39 of the removing member 31 is rotated to the left, which means that the support arm 17a, 17b and the

milking member 5 will be forced upwards by the removing member 31 via the line element 33. The force-generating member of the first embodiment can thus be dispensed with in the second embodiment. The rotary motor of the removing member 31 of the second embodiment can be employed for producing the substantially constant primary force, and also the varying force by rotating the rotary drum 39 alternately to the left and to the right. The rotary motor of the removing member 31 of the second embodiment can also be employed for moving the support arm to the rest position, compare Fig 4.

It is to be noted that the support arm 17a, 17b may be arranged to extend between the rear legs of the animal to be milked. The milking member 5 will then follow any lateral movement of the animal during the milking operation thanks to the feature that the mounting device 16 may move freely on the rail element 18. The milking member 5 will also follow any longitudinal forward or backward movement of the animal during the milking operation thanks to the feature that the milking member 5 may move freely along the support arm 17a, 17b. The latter movement is permitted by means of the slide member being slidable on the second arm element 17a'', 17b'' and/or the second arm element 17a'', 17b'' being slidable on the primary arm element 17a', 17b'. The rail element 18 may be mounted in relation to the milking place 3 in such way that the rail element 18 extends behind the animal to be milked or beside the animal to be milked. In both case lateral and/or longitudinal movements of the milking member 5 in relation to the animal are permitted.

The present invention is not limited to the embodiments disclosed but may be varied and modified within the scope of the following claims. The support arm 17a, 17b may, instead of having two parallel arms 17a, 17b as shown in Fig 2, be provided with only one arm. In the embodiments disclosed, the milking member 5 comprises a claw 7. It should be noted that the milking member 5 also may comprise the teatcups 6 and a

respective long milk conduit 10 for each teatcup 6, wherein the long milk conduits 10 are directly connected to the respective teatcup 6 permitting so called quarter milking.

Claims

1. A milking device (1) for milking an animal during a milking operation, comprising
a milking member (5) comprising at least one teatcup (6) to be attached to a teat of the animal to be milked,
at least one long milk conduit (10) extending from the milking member (5) and adapted to be connected to a milking machine for providing a milking vacuum in the teatcup (6), and
a removing device (30) for removing the milking member (5) from the animal during a removing operation when the milking operation is finished,
characterized in that the removing device (30) is adapted to apply a variable force on the milking member (5) for facilitating the removing of the milking member from the animal.

2. A milking device according to claim 1, wherein the removing device (30) is adapted to apply a primary force on the milking member (5) before the variable force is applied.

3. A milking device according to claim 2, wherein the removing device (30) is adapted to reduce the primary force before the variable force is applied.

4. A milking device according to any one of the preceding claims, wherein the variable force is an alternately increasing and decreasing force.

5. A milking device according to any one of the preceding claims, wherein the variable force involves an alternately changing of the direction of the force applied on the milking member.

6. A milking device according to any one of the preceding claims, wherein the milking device (1) comprises a control unit

(34) adapted to control the removing device (30) and the variable force.

7. A milking device according to claim 6, wherein the removing device (30) comprises a first sensor (35) connected to the control unit (34) and adapted to sense a value of a parameter related to the force applied on the milking member (5).

8. A milking device according to claims 2 and 7, wherein the control unit (34) is adapted to control the removing device (30) to initiate the application of the variable force when the primary force reaches an upper level.

9. A milking device according to any one of claims 6 to 8, wherein the removing device (30) comprises a second sensor (36) connected to the control unit (30) and adapted to sense a value of a parameter related to a pressure in the teatcup (6).

10. A milking device according to claims 2 and 9, wherein the control unit (34) is adapted to control the removing device (30) to initiate the application of the variable force a predetermined time period after the application of the primary force if the pressure in the teatcup (6) is below the atmospheric pressure.

11. A milking device according to any one of claims 9 and 10, wherein the control unit (34) is adapted to terminate the application of the variable force if the pressure in the teatcup (6) is equal to the atmospheric pressure.

12. A milking device according to any one of the preceding claims, wherein the removing device (30) is arranged in such a way that at least the variable force applied to the milking member (5) is directed downwards during the removing operation.

13. A milking device according to claim 12, wherein the milking device (1) comprises a support device (15) comprising a support arm (17a, 17b) to which the milking member (5) is attached during the removing operation, wherein the removing device is adapted to co-operate with the support device (15) during the removing operation for providing the downwards directed force.

14. A milking device according to claim 13, wherein the support arm (17a, 17b) is provided to be rotatable in a substantially vertical plane, wherein the removing device (30) is adapted to co-operate with the support device (15) during the removing operation to rotate the support arm (17a, 17b) downwards in order to provide the downwards directed force.

15. A milking device according to claim 14, wherein the support device (15) comprises a mounting device (16), adapted to be mounted to a structure (2), wherein the support arm (17a, 17b) is mounted to the mounting device (16) to be rotatable in the substantially vertical plane.

16. A milking device according to claim 15, wherein the support arm (17a, 17b) provides a first inner position relatively close to the mounting device (16) and a second outer position relatively far away from the mounting device (16), wherein the milking member (5) is freely movable between the first inner position and the second outer position.

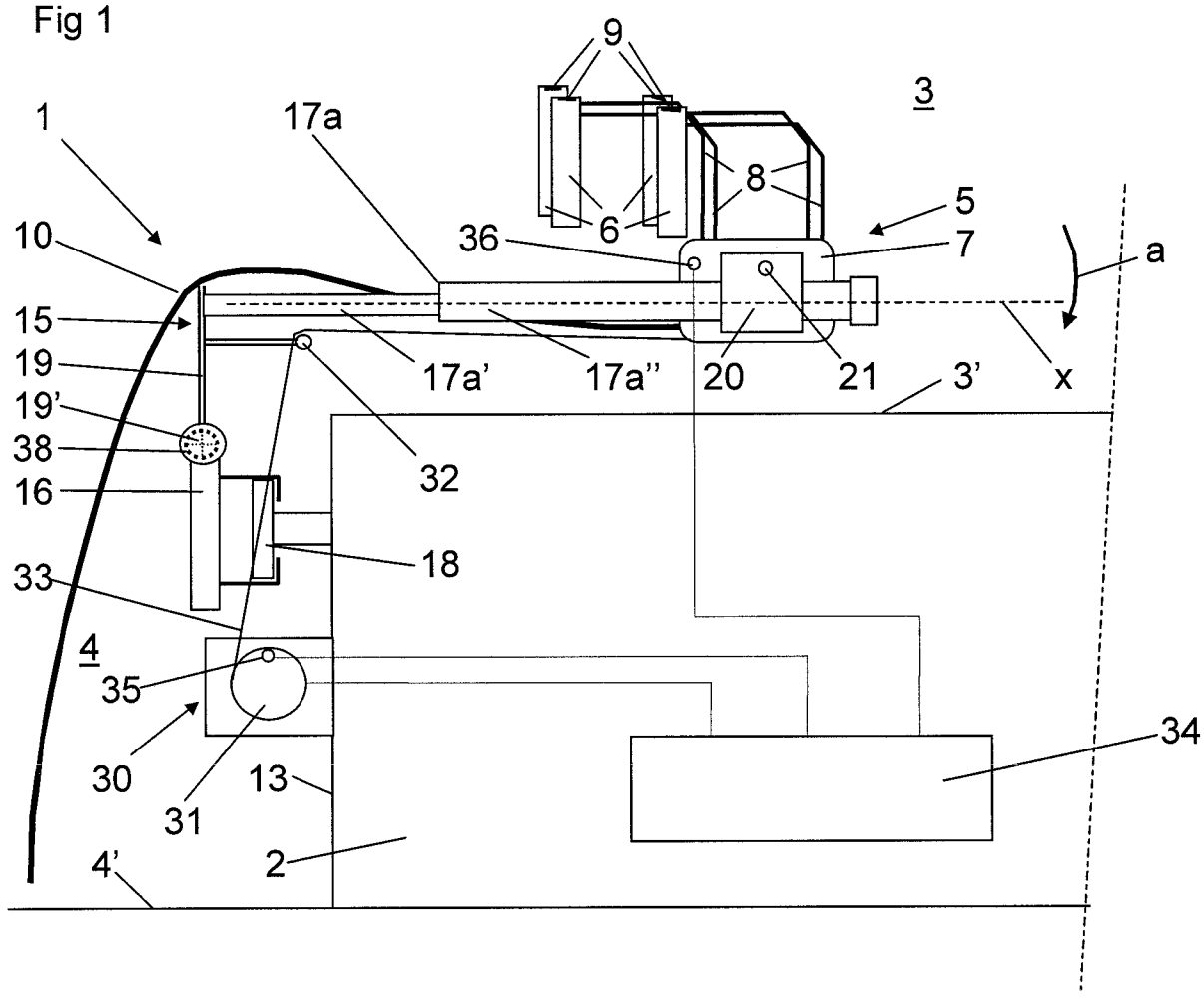
17. A milking device according to claim 16, wherein the removing device (30) is adapted to move the milking member (5) from the second outer position to the first inner position during an end phase of the removing operation.

18. A milking device according to any one of the preceding claims, wherein the removing device (30) comprises a line element (33) connected to the milking member (5) and a removing member (31) connected to the line element (33).

19. A milking device according to claims 12 and 18, wherein the removing member (31) is adapted to apply said downwards directed force and to apply an opposite upwards directed force.

20. A milking device according to any one of the preceding claims, wherein the removing device comprises a force-generating member (38) adapted to apply an upwards directed force to the milking member (5).

Fig 1


9
3
1
17a
8
5
10
36
6
7
a
15
17a'
17a''
20
21
3'
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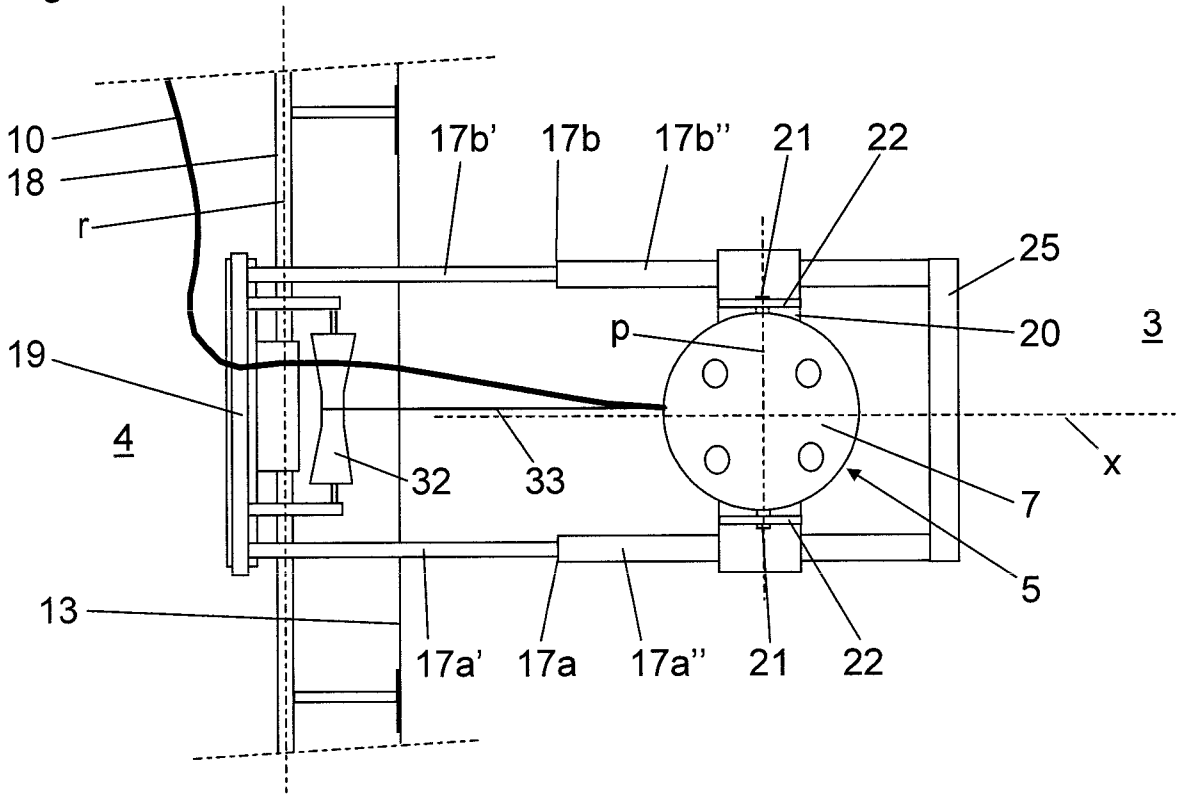
19
19'
38
32
16
18
33
4
35
34
30
13
31
2
4'

Fig 2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17b
17b''
21
22
18
r
25
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19
4
32
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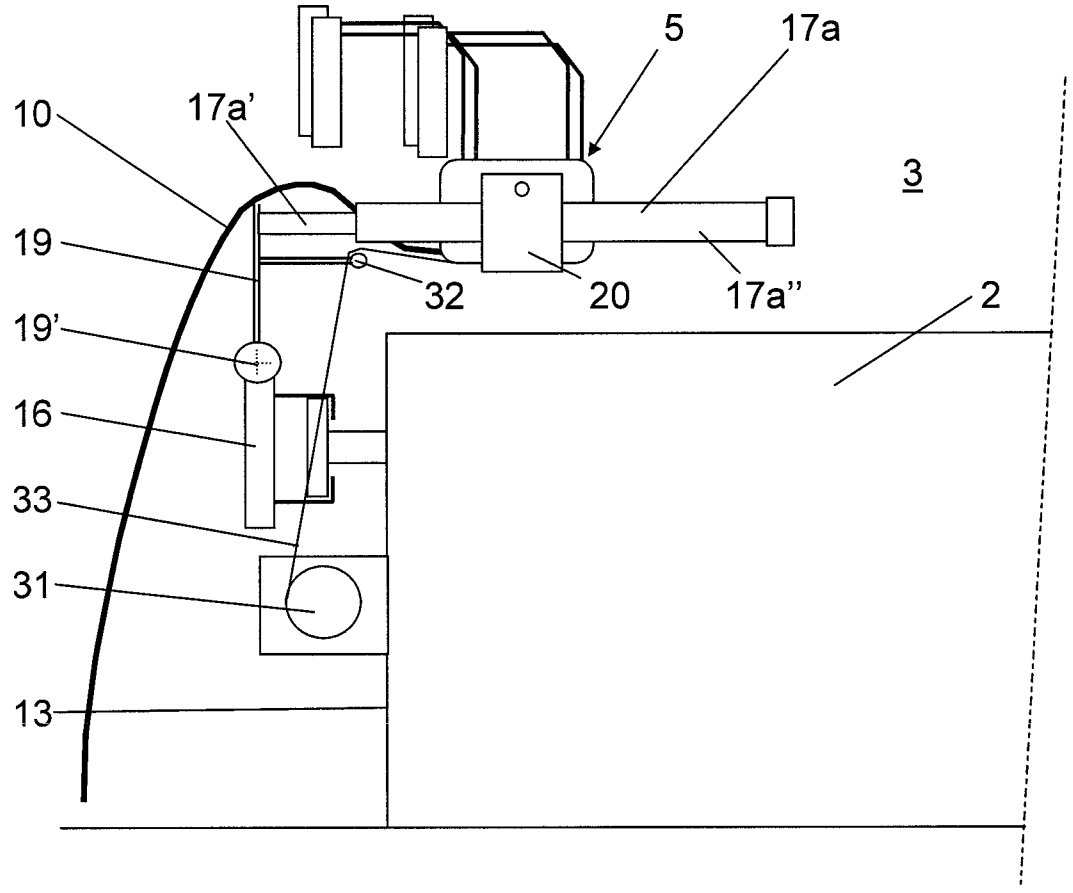
x
7
5
13
17a'
17a
17a''
21
22

Fig 3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3
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17a''
2
19'
16
33
31
13

Fig 4

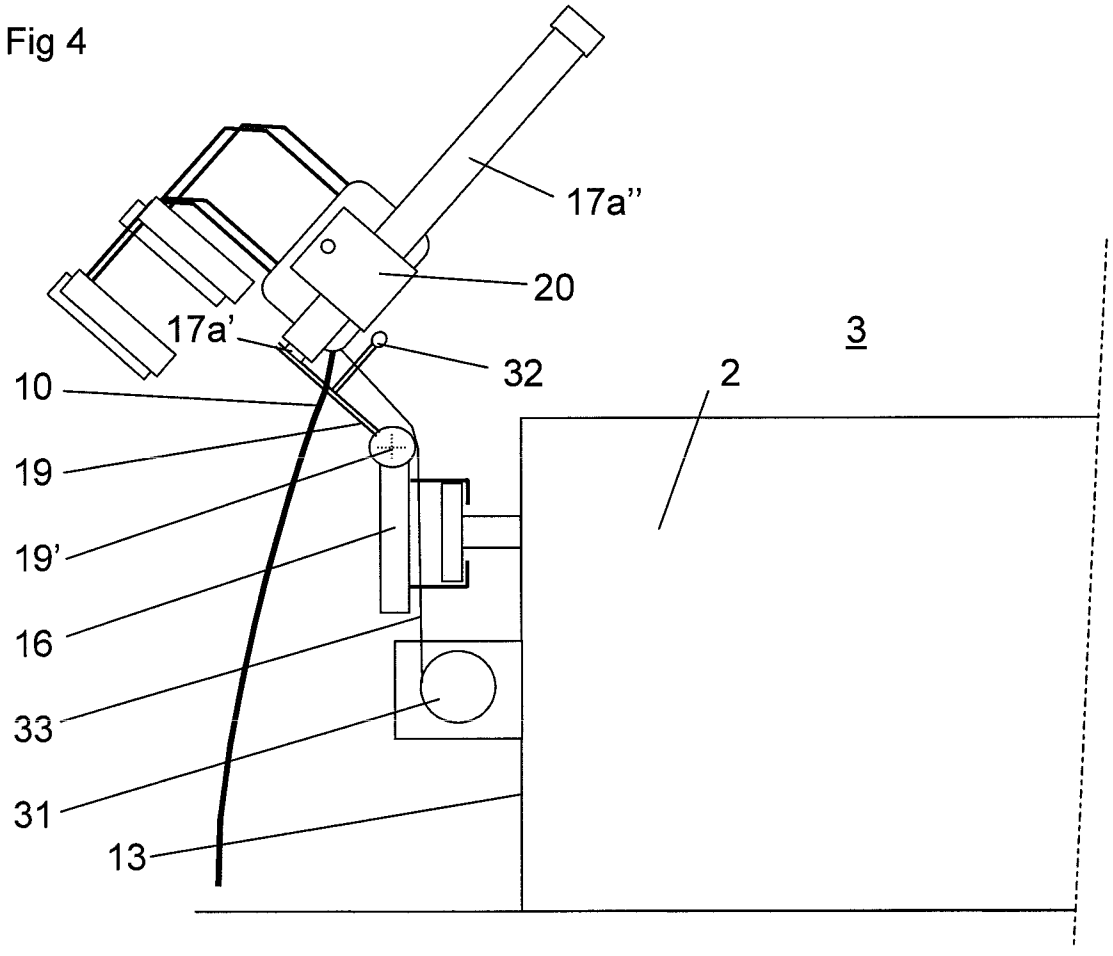
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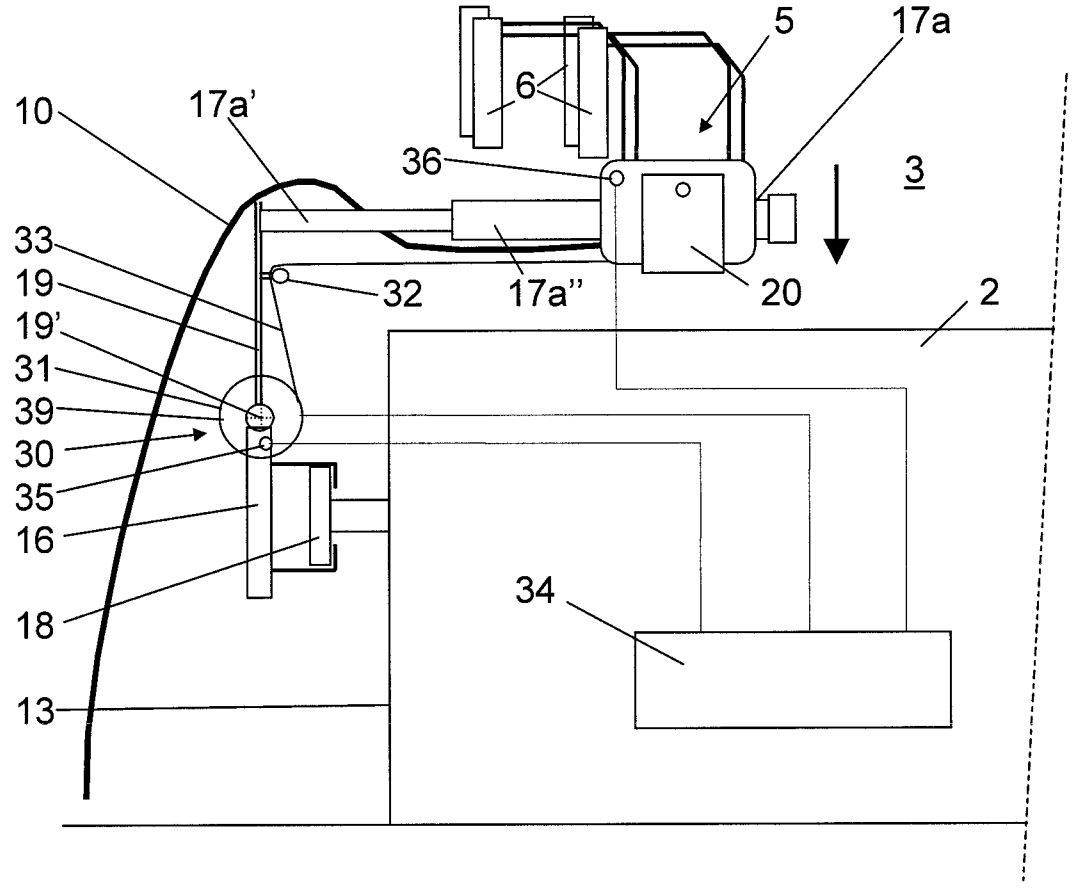
Fig 5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34
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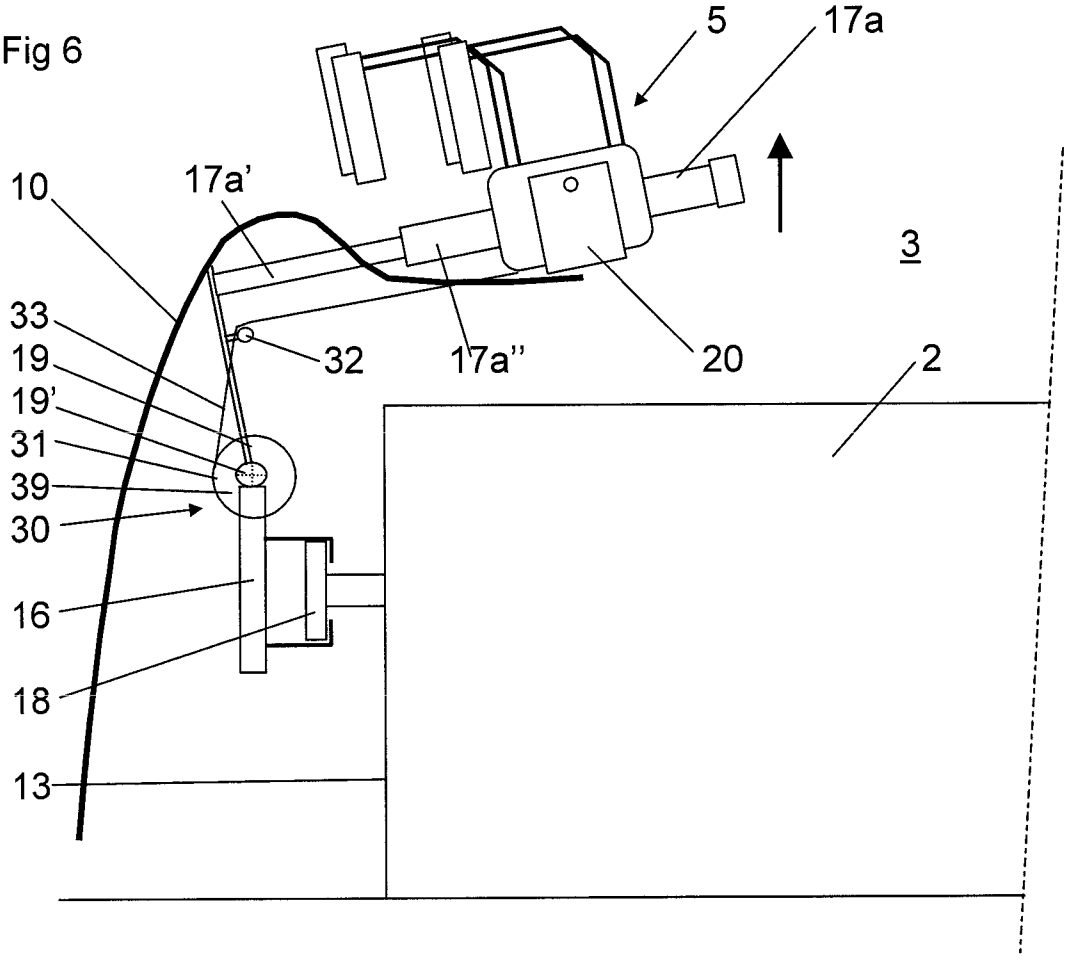
Fig 6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17a
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17a'
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19'
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30
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18
13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/050498

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0945055 A1 (MAASLAND N V), 29 Sept 1999 (29.09.1999), column 3, line 40 - line 47, claims 19-22	1,2,6,12-14, 18
A	WO 2006073370 A1 (DELAVAL HOLDING AB), 13 July 2006 (13.07.2006), figures 3-5, abstract	1,6,14-18
A	WO 2006073368 A1 (DELAVAL HOLDING AB), 13 July 2006 (13.07.2006), figures 1-4, abstract	1,6,14-18

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
15 October 2007	16 -10- 2007
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Magnus Thorén / JA A Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/050498

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0951820 A2 (MAASLAND N V), 27 October 1999 (27.10.1999), column 8, line 15 - line 38; column 9, line 5 - line 42, figures 5-7, claims 6, 7 ---	2,4-6,15-17, 19,20
A	US 3870021 A (NEDERBRAGT), 11 March 1975 (11.03.1975), abstract ---	1,7
A	EP 1514469 A1 (LELY ENTERPRISES AG), 16 March 2005 (16.03.2005), abstract --- ---	1,9

International patent classification (IPC)

A01J 5/017 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

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				SE	0500043	D	00/00/0000
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				WO	2006073369	A	13/07/2006
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				DK	1514469	T	27/12/2006
				EP	1668980	A	14/06/2006
				NL	1024295	C	16/03/2005
				US	20050056224	A	17/03/2005