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(54) Title: AN ARRANGEMENT AND A METHOD FOR ATTACHING AT LEAST ONE TEAT CUP TO A TEAT OF AN ANIMAL BY MEANS OF A ROBOT ARM

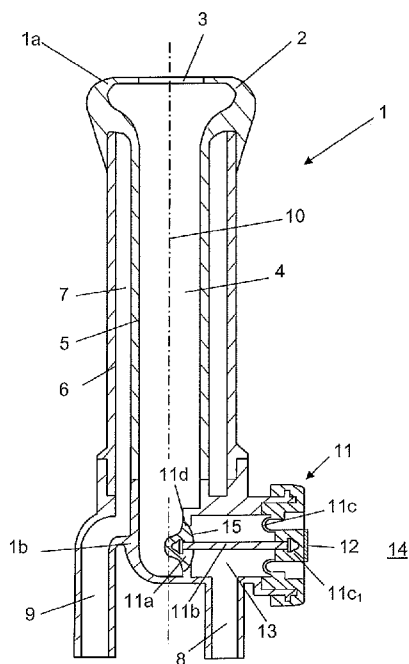


Fig 1

(57) Abstract: The invention relates to an arrangement and a method for attaching at least one teat cup (1) to a teat (23) of an animal by means of a robot arm (18). The arrangement comprises a control unit (24) adapted to control the robot arm (18), a vacuum valve (11) in the teat cup (1) adapted to be moved to an open position when a lower pressure than ambient pressure prevails in the teat cup (1) and detecting means (26, 27) adapted to detect if the vacuum valve (11) is in an open position. The control unit (24) is adapted to control the robot arm (18) such that it releases the grip of the teat cup (1) during an attaching process of the teat cup (1) to a teat (23) when the detecting means (26, 27) detects that the vacuum valve (11) is in the open position.

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5 An arrangement and a method for attaching at least one teat cup to a teat of an animal by means of a robot arm

THE BACKGROUND OF THE INVENTION AND PRIOR ART

10 The present invention relates to an arrangement and a method for attaching at least one teat cup to a teat of an animal by means of a robot arm, wherein the teat cup comprises an inner space adapted to receive a teat during a milking process and a vacuum valve arranged in a passage between the inner space of the teat cup and a vacuum system, wherein the robot arm
15 comprises a grip portion adapted to grip and move the teat cup to an attaching position in relation to the teat and wherein the arrangement comprises a control unit adapted to control the robot arm.

20 A milking robot is many times used to attach teat cups to milking animals in a milking stall. The milking robot is controlled by a control unit. Before a milking robot is allowed to release the grip of a teat cup during an attaching process, it has to be ascertained that the teat cup has been attached to a teat. Two
25 conditions have to be fulfilled before the milking robot is allowed to release the grip of a teat cup during an attaching process. The vacuum valve has to be in an open position such that a vacuum system applies a vacuum pressure to the inner space of the teat cup. Furthermore, the control unit has to have
30 information confirming that a teat is into the teat cup. In order to fulfil the first condition, the control unit opens the control valve when the teat cup reaches a predetermined position in relation to the teat during the attaching process. The vacuum valve may be opened when the teat cup reaches a position of about five
35 centimetres below the teat. In order to fulfil the second

condition, each teat cup comprises a sensor detecting when a teat has been introduced into the inner space of the teat cup.

5 However, it is an ambition to use a single milking robot for attaching teat cups to animals in several milking stalls. The milking robot may be used to attach teat cups to animals in a milking parlour in the form of a rotary platform with a large number of milking stalls. In this case, it is desired to use the same vacuum system for applying vacuum pressure to the teat
10 cups in several milking stalls. Relatively large amounts of air are sucked into the vacuum system during a conventional attaching process of a teat cup by means of a milking robot. This causes the vacuum pressure in the vacuum system to become temporarily reduced. If such a vacuum system is used for
15 several milking stalls, the reduced vacuum pressure in the vacuum system may disturb the transport of milk from the teat cups in milking stalls. Furthermore, the risk that an attached teat cup falls off from a teat during a milking process in a milking stall is considerably increased during periods when the vacuum
20 pressure is reduced in the vacuum system.

It is known to provide manually attachable teat cups with a vacuum valve which is controlled by the pressure in the inner space of the teat cup. This vacuum valve has a construction
25 such that it is automatically moved to a closed position when ambient pressure prevails in the inner space of the teat cup and to an open position when a lower pressure than ambient pressure prevails in the inner space of the teat cup. Ambient pressure prevails in the inner space of a teat cup until an upper
30 part of a teat closes an opening to the inner space during an attaching process. However, the vacuum valve is not completely air tight in the closed position. Therefore, the pressure in the inner space of the teat cup drops when the opening to the inner space of a teat cup is closed by the teat. The reduced pressure
35 in the inner space of the teat cup moves the vacuum valve to an

open position such that a vacuum pressure is applied to the inner space of the teat cup.

SUMMARY OF THE INVENTION

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The object of the present invention is to provide arrangement making it possible to attach teat cups in a very safe manner by means of a milking robot to teats of milking animals in several milking stalls using the same vacuum system for the teat cups.

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This object is achieved by the initially mentioned arrangement characterised in that the arrangement comprises a valve mechanism adapted to move the vacuum valve to a closed position when an ambient pressure prevails in the inner space and to an open position when a lower pressure than ambient pressure prevails in the inner space, and detecting means adapted to detect if the vacuum valve is in an open position or in a closed position, and that the control unit is adapted to receive information from said detecting means and to control the robot arm such that it releases the grip of the teat cup during an attaching process of the teat cup to a teat when the detecting means detects that the vacuum valve is in the open position. Thus, this vacuum valve is controlled by the pressure in the inner space of the teat cup. The vacuum valve is only moved to the open position during occasions when the pressure in the inner space of the teat cup is lower than ambient pressure. During an attaching process of a teat cup to a teat, an upper part of the teat closes the opening to the inner space when the teat has been introduced to an attaching position in the inner space. However, the vacuum valve is not completely air tight in the closed position. Thereby, a small amount of air flows from the inner space to the vacuum system when the vacuum valve is in the closed position. Due to the existence of that air flow, the pressure in the inner space will be reduced as soon as the opening to the inner space is closed. The reduced pressure in the inner space moves the vacuum valve to the open position. In

the open position, the vacuum system applies a vacuum pressure to the inner space of the teat cup. The applied vacuum pressure results in a force attaching the teat cup to the teat in a very safe manner.

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Since the upper part of the teat closes the opening to the inner space in the attaching position, substantially no ambient air will be sucked into the inner space after that the vacuum valve has been moved to the open position. Consequently, only already existing air in the inner space will be sucked from the teat cup to the vacuum system. The amount of air in the inner space is so small that it will not disturb the vacuum level in the vacuum system. If this vacuum system is used for teat cups in several milking stalls, the vacuum system will apply a substantially unchanged vacuum pressure to the teat cups in the other milking stalls during the attaching process of a teat cup. The risks of a disturbed milk flow from other milking stalls connected to the vacuum system or of already attached teat cups falling off from teats are substantially eliminated. In this case, the vacuum valve is only moved to the open position when a teat has been introduced to an attaching position in the teat. Consequently, when the control unit receives information confirming that the vacuum valve has been moved to the open position, this is an indication of a vacuum pressure having been applied to the inner space of the teat cup at the same time as it is an indication of a teat having been introduced into the teat cup. When the control unit receives this information, it is ascertained that the teat cup is attached to the teat by means of the vacuum pressure. The control unit is now allowed to control the robot arm such that it releases the grip of the teat cup.

According to an embodiment of the invention, the detecting means comprises a proximity sensor adapted to sense if the vacuum valve is in an open position or a closed position. A proximity sensor is a sensor able to detect an object without physical contact. The proximity sensor may be an inductive

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proximity sensor, a capacitive proximity sensor, a photoelectric proximity sensor, an infrared proximity sensor, an ultrasonic proximity sensor, an optical proximity sensor, a magnetic proximity sensor, a Hall effect sensor etc. A proximity sensor
5 may be adapted to detect the position of the vacuum valve by means of a target surface arranged on a movable part of the vacuum valve. The sensor may detect when the target surface reaches a position corresponding to an open position of the vacuum valve or a position corresponding to a closed position of
10 the vacuum valve. The target surface may be made of a special material such a metal for an inductive proximity sensor, a magnet for a magnetic proximity sensor and a Hall effect sensor.

According to an embodiment of the invention, the target surface
15 may be arranged on a part of the vacuum valve movably arranged in a direction perpendicular to a longitudinal axis through the teat cup. Such an arrangement of the target surface facilitates the positioning of the sensor. The target surface may be arranged on a part of the vacuum valve connected to ambient
20 air. Such a part of the vacuum valve may be a flexible membrane which moves the vacuum valve to an open position when the ambient air pressure is larger than the pressure in the inner space of the teat cup.

25 According to another embodiment of the invention, the detecting means comprises an acoustic sensor adapted to sense a sound indicating when the vacuum valve has been moved to an open position. When the vacuum valve is moved to the open position, a vacuum pressure is applied to the inner space of the teat cup.
30 The applied vacuum pressure results in a specific sound. When the sensor detects this specific sound, it is in indication of that the vacuum valve has been moved to the open position. The detecting means may of course comprise other kinds of sensors such as different kinds of touch sensors.

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According to an embodiment of the invention, said detecting means comprises a sensor arranged on the robot arm. If the sensor is arranged on the robot arm, it is possible to use one sensor for all teat cups attached by the robot arm. Thus, the individual teat cups do not need any such sensor. In this case, the number of sensors is reduced to a minimum. The sensor may be arranged in a fixed position in relation to the grip portion of the robot arm. In this case, the sensor is attached on the robot arm at a predetermined distance from the grip portion such that the sensor obtains an optimal detecting position of the vacuum valve of a teat cup gripped by the grip portion. Alternatively, the sensor is movably arranged in relation to the grip portion of the robot arm. The sensor may be arranged on a portion of the robot arm movably arranged in relation to the grip portion. Thereby, it is possible to move the sensor to an optimal detecting position when the teat cup is to be attached to a teat.

According to an embodiment of the invention, the sensor is arranged on the robot arm in a position such that it is located at a smaller distance than 3 cm from a part of the vacuum valve during an attaching process of the teat cup to a teat. Preferably, the sensor is arranged in a position as close as possible to the vacuum valve in order to detect the position of the vacuum valve in a safe way. The sensor may be arranged on the robot arm in a position substantially vertically below the grip portion during an attaching process of the teat cup to a teat. The vacuum valve is usually arranged at the end portion of the teat cup forming a lower part of the teat cup during an attaching process. The grip portion usually grips teat cups at an area located above this end portion of the teat cup with the vacuum valve. Due to these facts, it is suitable to arrange the sensor vertical below the grip portion in order to arrange the sensor in a position just opposite to the vacuum valve during the attaching process.

According to an embodiment of the invention, the robot arm comprises at least a first grip portion and a second grip portion

each adapted to grip a teat cup and move it to an attaching position on a teat of an animal. In this case, it is possible to grip several teat cups simultaneously in a parked position in a teat cup storing device and to move them to a position in the vicinity of the teats of an animal to be milked. The detecting means may 5 comprise a sensor for each grip portion. Such sensors may be arranged in an optimal fixed detecting position of the vacuum valves in the respective teat cups. Alternatively, the detecting means comprises a common sensor for the at least two grip 10 portions. Such a common sensor may be movably arranged in order to be positioned in an optimal detecting position of the vacuum valves in the respective teat cup when they are attached to a teat. Alternatively, the common sensor has a fixed position on the robot arm from which it is possible to detect the 15 positions of the vacuum valves of the respective teat cups when they are attached to a teat.

According to an embodiment of the invention, the grip portion comprises an electromagnet adapted to grip a teat cup and the 20 control unit is adapted to control the activation of electromagnet such that it releases the grip of the teat cup when the detecting means detects that the vacuum valve is in the open position. A grip portion with an electromagnet does not need any movable parts for gripping and realising a teat cup. However, it is 25 possible to use grip portions of other kinds for gripping and releasing the teat cups.

This object is also achieved by a method comprising the step of using a control mechanism adapted to move the vacuum valve 30 to a closed position when an ambient air pressure prevails in the inner space and to an open position when a lower pressure than ambient pressure prevails in the inner space, detecting when the vacuum valve is in an open position or a in closed position and controlling the robot arm in a manner such that it releases the 35 grip of the teat cup during an attaching process of the teat cup to a teat when the vacuum valve is in the open position.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is now to be explained more closely by means of preferred embodiments, which are disclosed as examples, and with reference to the attached drawings.

- Fig. 1 shows a teat cup to be used with an arrangement according to the present invention,
10 Fig. 2 shows an arrangement according to a first embodiment of the invention and
Fig. 3 shows an arrangement according to a second embodiment of the invention.

15 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Fig. 1 shows a teat cup 1 adapted to be attached to a teat of a milking animal. The teat cup 1 comprises a mouthpiece 2 having an opening 3 to an inner space 4 for receiving a teat of an animal during a milking process. The inner space 4 is defined by an inner surface of a flexible liner 5. A rigid shell 6 is arranged around the flexible liner 5 such that a pulsation chamber 7 is created in the radial space between the flexible liner 5 and the shell 6. The mouthpiece 2 and the flexible liner 5 are, in this case, formed in one piece. A milk tube 8 is connected to the teat cup 1. A vacuum system is adapted to apply a vacuum pressure to the milk tube 8 for conducting milk from the teat cup 1 to a milk receiver. A pulse tube 9 is connected to the teat cup 1. The pulse tube 9 is adapted to transfer a pulsating vacuum pressure from a pulsator to the pulsation chamber 7. A centrally located longitudinal axis 10 of the teat cup has an extension through a first end portion 1a of the teat cup 1 comprising the opening 3 and an oppositely located second end portion 1b of the teat cup 1. The milk tube 8 and the pulse tube 9 are connected to the second end portion 1b of the teat cup 1.

The second end portion 1b of the teat cup 1 also comprises a vacuum valve 11. The vacuum valve 11 comprises a valve body 11a, a rigid pin 11b, and a flexible membrane 11c. The rigid pin 11b connects the valve body 11a and a centre part 11c₁ of the membrane 11c such that these parts form a connected unit. In this case, a thin plate 12 is arranged on an outer surface of the centre part 11c₁ of the membrane 11c. The plate 12 is together with the flexible membrane 11c movably arranged in a direction perpendicular to the longitudinal axis 10 through the teat cup 1. The milk tube 8 is connected to a vacuum space 13 arranged between valve body 11a and the membrane 11c in the second end part 1b of the teat cup 1. Fig 1 shows the vacuum valve 11 in a closed position, in which the valve body 11a is in contact with a valve seat 11d forming an opening 15 between the inner space 4 and the vacuum space 13. However, the valve body 11a and the valve seat 11d do not form a completely air tight connection. A small air flow is present through the opening 15 when the vacuum valve is in the closed position.

The pressure in the inner space 4 of the teat cup 1 acts on a surface of the valve body 11a. Ambient air pressure acts on an outer surface of the membrane 11c. However, the active surface of the valve body 11a is larger than the active surface of the membrane 11c. Thus, when ambient pressure prevails in both the inner space 4 of the teat cup 1 and in the area 14, the vacuum valve 11 is moved to the right in Fig. 1 to a position in which the valve body 11a comes in contact with the valve seat 11c and closes the opening 15. This is the case when the teat cup 1 is not attached to a teat of an animal. If instead the pressure in the inner space 4 of the teat cup 1 is lower than ambient pressure, the pressure force acting on the active surface of the membrane 11c will be larger than the pressure force acting on the active surface of the valve body 11a. In this case, the valve body 11a is moved to the left in Fig. 1 such that

the valve body 11a is moved from the valve seat 11d to an open position in which it uncovers the opening 15.

5 Fig. 2 shows an outer end of a robot arm 18. The outer end of the robot arm 18 comprises a grip portion 19 adapted to grip and attach a teat cup 1 to a teat 23 of a milking animal. In this case, the grip portion 19 comprises an electromagnet 21 arranged between two side walls 20. An outer surface of the teat cup 1 is made of a magnetic material. Thereby, it is possible to grip the
10 teat cup 1 by means of the electromagnet 21 of the grip portion 19. The side walls 20 of the grip portion 19 may be provided with contact surfaces having a complementary shape to the outer surface of the teat cup 1. A camera 22 is mounted on the robot arm 18. The camera 22 is adapted to detect the position of
15 a teat 23 of a milking animal during an attachment process of a teat cup 1. A control unit 24 is adapted to control the robot arm 18 during the attaching process. The robot arm 18 comprises a supporting portion 25. The supporting portion 25 supports the grip portion 19 and a proximity sensor 26, which is a sensor able
20 to detect an object without physical contact. The proximity sensor 26 may, for example, be an inductive sensor, a capacitive sensor, a photoelectric sensor, a magnetic sensor, a Hall effect sensor etc. The thin plate 12 may constitute a target surface for the sensor 26. Usually, the target surface has to be
25 made of a special material such a metal material, a magnetic material, a plastic material etc. depending on the kind of proximity sensor 26 used.

30 When a milking process of an animal is to be performed, the robot arm 18 moves the grip portion 19 to a position in which the electromagnet 21 comes in contact with an outer surface of a teat cup 1 parked in the teat cup storing device. The control unit 24 activates the electromagnet 21 such that it grips the teat cup
35 1. In this case, ambient pressure prevails in the inner space 4 of the teat cup 1 and the vacuum valve 11 is in a closed position. The robot arm 18 moves the gripped teat cup 1 to a position

substantially vertically below a teat 23 of the animal. The control unit 24 controls the robot arm 18 by means of information from the camera 22 about the position of the teat 23. Finally, the robot arm 18 moves the teat cup 1 upwardly such that the teat
5 23 will be introduced into the inner space 4 of the teat cup 1.

When the teat 1 has been introduced a certain distance into the inner space 4 of the teat cup 1, the opening 3 to the inner space 4 is closed by an upper part of the teat 23. Since the contact
10 surface between the valve body 11a and the valve seat 11c is not completely air tight, a small air flow is sucked from the inner space 4 to the vacuum space 13. Since the upper part of the teat 23 prevents air from flowing into the inner space 4 of the teat cup 1 at the same time as a small air flow leaves the inner
15 space 4, the air pressure in the inner space 4 drops. When the air pressure has dropped to a predetermined level, the pressure force acting on the valve body 11a will be lower than the pressure force acting on the membrane 11c. As a result, the vacuum valve 11 is moved from the closed position to the open
20 position. The valve body 11a uncovers the opening 15 and a vacuum pressure is applied from the vacuum system, via the vacuum space 13, to the inner space 4 of the teat cup 1.

The sensor 26 detects that the plate 12 has been moved from a
25 first position in which the vacuum valve 11 is in a closed position to a second position in which the vacuum valve 11 is in an open position. The sensor 26 sends a signal to the control unit 24 informing that the vacuum valve 11 is now in an open position. As soon as the control unit 24 receives this information
30 confirming that the vacuum valve 11 is in the open position, it establishes the fact that the teat 23 is located into the inner space 4 of the teat cup 1 and that a vacuum pressure has been applied to the inner space 4 of the teat cup 1. Thus, the teat cup 1 is attached to the teat 23 in a very safe manner by means of
35 the applied vacuum pressure. The control unit 24 deactivates the electromagnet 21 and the teat cup 1 is released from the

grip portion 19 of the robot arm 18. Thereafter, the robot arm 18 is used for attaching the remaining teat cups to the teats of the animal in a corresponding manner.

- 5 In the event that a teat cup 1 accidentally comes loose from a teat 23 during a milking process, ambient air will flow into the inner space 4. Since the active surface of the valve body 11a is larger than the active surface of the membrane 11c, the valve body 11 is automatically displaced to the closed position as soon as ambient air flows into the inner space 4 of the teat cup 1. This automatic shut off of the vacuum supply to the inner space 4 prevents dirt and particles from being sucked into the teat cup 1 and the connected milk tube 8.
- 10
- 15 Since the opening 3 to the inner space 4 already is closed by an upper part of the teat 23 when the vacuum pressure is applied to the inner space 4, the air flow from the teat cup 1 to the vacuum system will be low. Such a small flow of air to the vacuum system during an attaching process of a teat cup does not disturb the vacuum level in the vacuum system. Due to the low consumption of air of the above mentioned arrangement, it is possible to use the same vacuum system for applying a vacuum pressure to the teat cups in several milking stalls. The same robot arm 18 may be used to attach the teat cups 1 to the animals in the different milking stalls. In a conventional attaching process of teat cups by means of a robot arm, each teat cup has to be provided with a sensor detecting when a teat has been introduced into the inner space of the teat cup. In this case, only one sensor 26 on the robot arm 18 may be used for detecting when each of the vacuum valves 11 in a large number of teat cups 1 has been moved to an open position which confirms that a teat has been introduced into the inner space 4 of the teat cup 1.
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- 35 Fig. 3 shows an alternative embodiment of the arrangement. In this case, the robot arm 18 is provided with a first grip portion

19a and a second grip portion 19b. It is thereby possible to grip two teat cups simultaneously in a parked position in a teat cup storing device and move them to a position in the vicinity of the teats of an animal to be milked. A common sensor 27 is in this case used for the both grip portions 19a, 19b. The common sensor 27 is movable between a first position p_1 located vertically below the first grip portion 19a and a second position p_2 located vertically below the second grip portion 19a. The sensor 27 is movable along a rail 28 or the like in a supporting portion 29 of the robot arm 18 between the first position p_1 and the second position p_2 . However, the sensor 27 may be movable in other manners between different positions on the robot arm 18. The sensor 27 is in this case an acoustic sensor 27 detecting the sound emitted from the vacuum valve 11. When the vacuum valve 11 is moved from the closed position to the open position, a specific sound is created, which occurs when the vacuum pressure is applied to the inner space 4 of a teat cup 1. When such a sound is detected by the sound sensor 27, it is an indication of that the vacuum valve 11 has been moved to the open position.

When a first teat cup gripped by the first grip portion 19a is to be attached to a teat of the animal, the sensor 27 is placed in the first position p_1 on the supporting portion 29 of the robot arm 18. The sensor 27 is here located just in front of a vacuum valve 11 of the teat cup 1 gripped by the first grip portion 19a. The sensor 27 detects when the vacuum valve 11 in the teat cup 1 is moved to the open position. The sensor 27 sends a signal to the control unit 24 when this occurs. The control unit 24 establishes that the teat cup 1 has been attached to the teat 23. The control unit 24 deactivates the electromagnet 21 of the first grip portion 19a such that it releases the grip of the teat cup 1. The sensor 27 is thereafter moved to the second position p_2 just in front of a vacuum valve 11 of the teat cup 1 gripped by the second grip portion 19b. In this position p_2 , the sensor 27 is able to detect when the vacuum valve 11 in the teat cup 1 is moved to an open

position. The sensor 27 sends a signal to the control unit 24 when this occurs. When it has received this signal, the control unit 24 deactivates the electromagnet 21b of the second grip portion 19b such that the teat cup 1 will be released from the
5 second grip portion 19b. Alternatively, two fixed sensors 27 may be used in the positions p_1 , p_2 for detecting when the vacuum valves 11 in the respective teat cups 1 are moved to an open position during an attaching process. It is also possible to use one sensor 27 arranged in a fixed position from which it is able
10 to detect the position of vacuum valves in the teat cups gripped by the first grip portion 19a and the second grip portion 19b.

The invention is not restricted to the described embodiments of
15 the invention but may be varied freely within the scope of the claims.

Claims

1. An arrangement for attaching at least one teat cup (1) to a teat (23) of an animal by means of a robot arm (18), wherein the teat cup (1) comprises an inner space (4) adapted to receive a teat (23) during a milking process and a vacuum valve (11) arranged in a passage between the inner space (4) of the teat cup (1) and a vacuum system (13), wherein the robot arm (18) comprises a grip portion (19) adapted to grip and move the teat cup (1) to an attaching position in relation to the teat (23) and wherein the arrangement comprises a control unit (24) adapted to control the robot arm (18), characterised in that the arrangement comprises a valve mechanism (11a-11d) adapted to move the vacuum valve (11) to a closed position when an ambient pressure prevails in the inner space (4) and to an open position when a lower pressure than ambient pressure prevails in the inner space (4), and detecting means (26, 27) adapted to detect if the vacuum valve (11) is in an open position or a in closed position, and that the control unit (24) is adapted to receive information from said detecting means (26, 27) and to control the robot arm (18) such that it releases the grip of the teat cup (1) during an attaching process of the teat cup to a teat when the detecting means detects that the vacuum valve (11) is in the open position.

2. An arrangement according to claim 1, characterised in that said detecting means comprises a proximity sensor (26) adapted to sense if the vacuum valve (11) is in an open position or in a closed position.

3. An arrangement according to claim 2, characterised in that the said proximity sensor (26, 27) is adapted to detect the position of the vacuum valve (11) by means of a target surface (12) arranged on a movable part (11c₁) of the vacuum valve.

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4. An arrangement according to claim 3, characterised in that the target surface (12) is arranged on a part (11c₁) of the vacuum valve (11c) movably arranged in a direction perpendicular to a longitudinal axis (10) through the teat cup (1).
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5. An arrangement according to claim 3 or 4, characterised in that the target surface is arranged on a part (11c₁) of the vacuum valve (11c) connected to ambient air.
- 10
6. An arrangement according to claim 1, characterised in that said detecting means comprises an acoustic sensor (27) adapted to sense a sound indicating when the vacuum valve (11) has been moved to an open position.
- 15
7. An arrangement according to any of the preceding claims, characterised in that said detecting means comprises a sensor (26, 27) arranged on the robot arm (18).
- 20
8. An arrangement according to claim 7, characterised in that the sensor (26) is arranged in a fixed position in relation to the grip portion (19) of the robot arm (18).
- 25
9. An arrangement according to claim 7, characterised in that the sensor (27) is movably arranged in relation to the grip portion (19) of the robot arm (18).
- 30
10. An arrangement according to anyone of the claims 7-9, characterised in that the sensor (26, 27) is arranged on the robot arm (18) in a position such that it is located at a smaller distance than 3 cm from a part (11c₁) of the vacuum valve (11) during an attaching process of the teat cup (1) to a teat (23).
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11. An arrangement according to anyone of the claims 7-10, characterised in that the sensor (26, 27) is arranged on the robot arm (18) in a position substantially vertically below the

grip portion (19) during an attaching process of the teat cup (1) to a teat (23).

- 5 12. An arrangement according to any one of the preceding claims, characterised in that the robot arm (18) comprises at least a first grip portion (19a) and a second grip portion (19b) each adapted to grip a teat cup (1) and move it to an attaching position on a teat (23) of an animal.
- 10 13. An arrangement according to claim 12, characterised in that the detecting means comprises a sensor for each of the two grip portions (19a, 19b).
- 15 14. An arrangement according to claim 12, characterised in that the detecting means comprises a common sensor (27) for the two grip portions (19a, 19b).
- 20 15. An arrangement according to anyone of the preceding claims, characterised in that grip portion (19) comprises an electromagnet (21) adapted to grip a teat cup and that the control unit (24) is adapted to control the activation of electromagnet (21) such that it releases the grip of the teat cup (1) when the detecting means (26, 27) detects that the vacuum valve is in the open position.
- 25 16. A method for attaching at least one teat cup (1) to a teat of an animal by means of a robot arm (18), wherein the teat cup (1) comprises an inner space (4) adapted to receive a teat (1) during a milking process and a vacuum valve (11) arranged in a passage between the inner space (4) and a vacuum system (13), wherein the robot arm comprises a grip portion (2) adapted to grip and move the teat cup to an attaching position in relation to the teat (23), characterised by the step of using a control mechanism adapted to move the vacuum valve to a closed position when an ambient air pressure prevails in the inner space and to an open position when a lower pressure than
- 30
- 35

ambient pressure prevails in the inner space, detecting when the vacuum valve (11) is in an open position or a in closed position and controlling the robot arm (18) in a manner such that it releases the grip of the teat cup (23) during an attaching
5 process of the teat cup (1) to a teat when the vacuum valve (11) is in the open position.

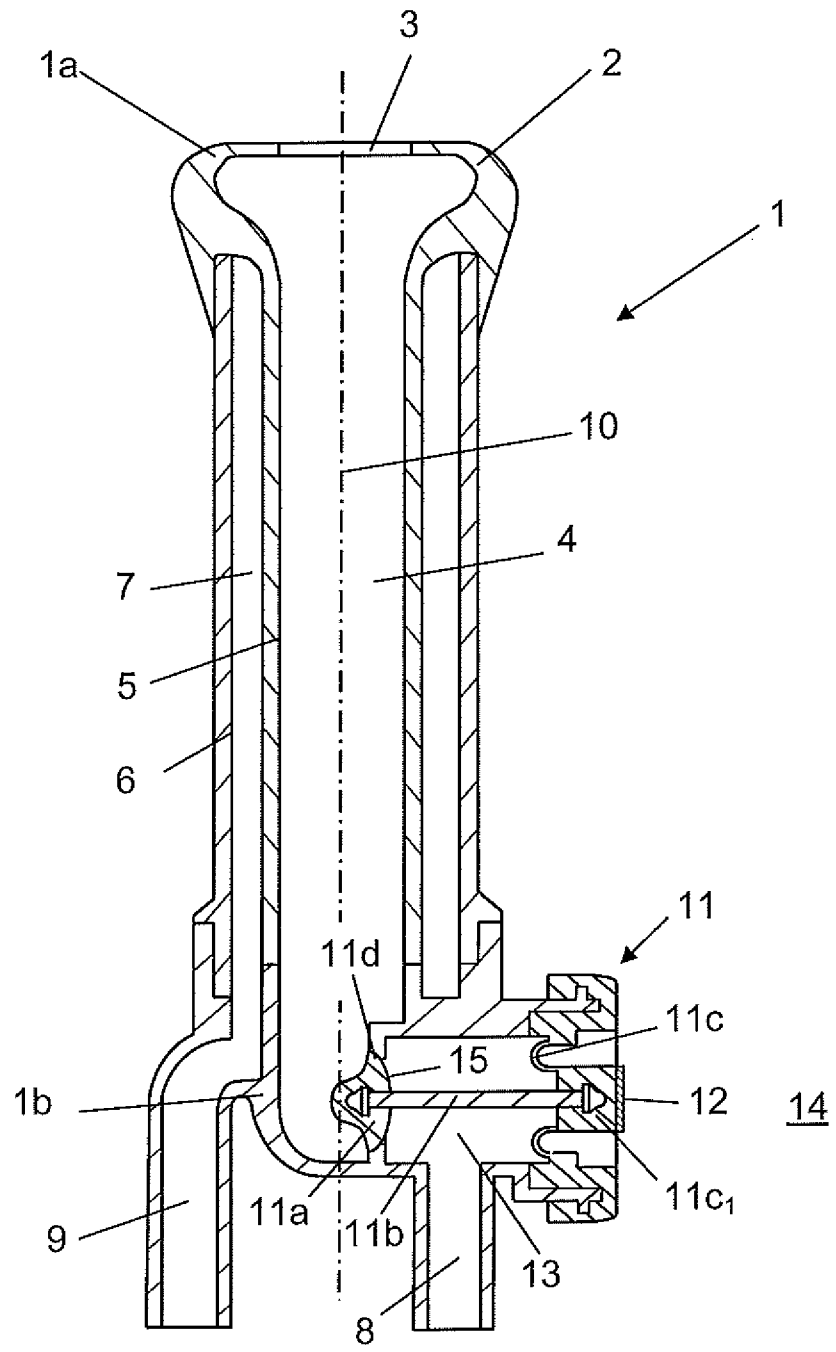


Fig 1

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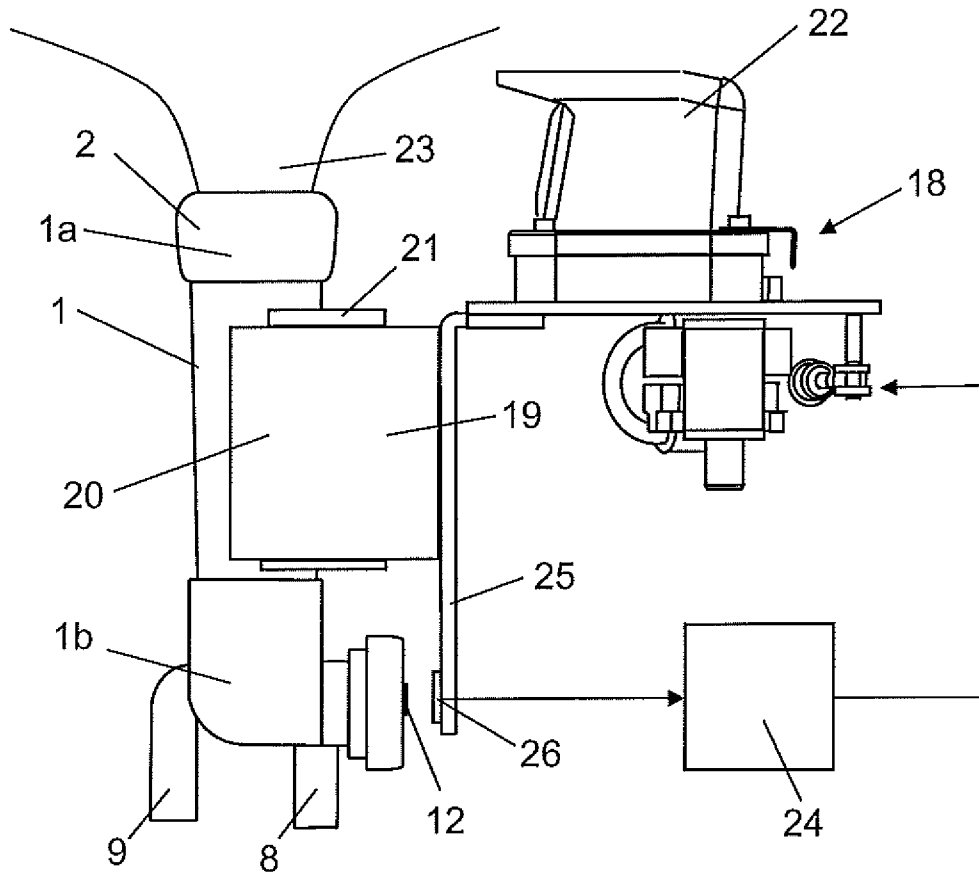


Fig 2

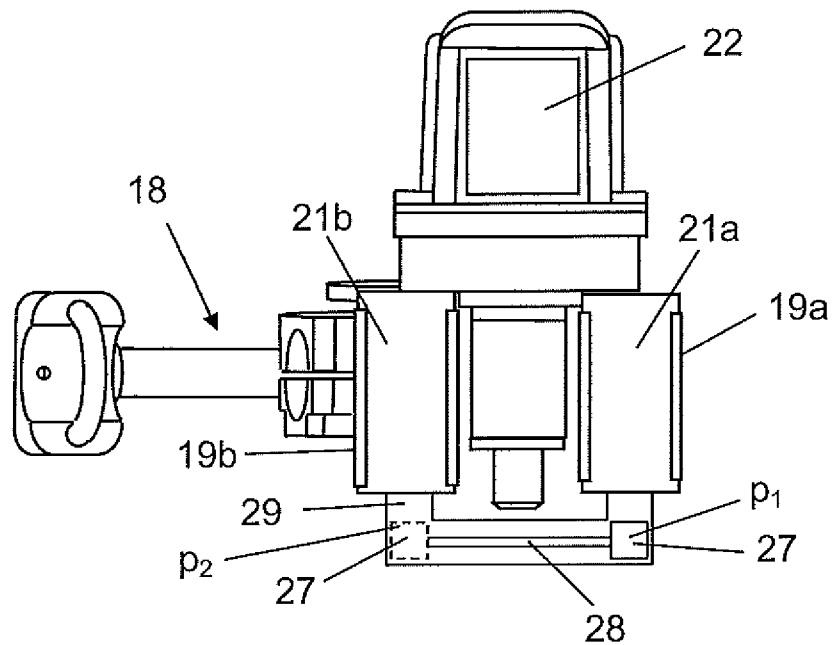


Fig 3