TITLE

Device and method for expressing human breast milk

TECHNICAL FIELD

The present invention relates to a device for expressing human breast milk according to the preamble of patent claim 1, to a vacuum pump according to the preamble of patent claim 12, and to a method for operating a device for expressing human breast milk according to the preamble of patent claim 14.

PRIOR ART

Devices for expressing human breast milk are well known. In principle, there are two different types: the first device type is operated manually, *i.e.* the negative pressure required for the expressing operation is generated by manual actuation of the vacuum pump. In the devices of the second type, the vacuum pump is operated electrically, it being possible for the vacuum pump to be connected to the power supply network and/or to be operated via a battery or another energy accumulator. Examples for this include WO 96/22116, US 2009/0099511, US 2008/0287037, US 7 094 217 and US 2008/0039781.

Said vacuum pumps are connected to a breast shield either directly or via vacuum lines. The breast shield usually has a funnel-shaped part for receiving part of the mother's breast including the nipple. As a rule, said funnel-shaped part merges into a part, which is in the shape of a hollow cylinder and to which, firstly, either the vacuum pump is connected directly or via a suction line and which, secondly, is likewise connected directly or via a milk line to a milk collecting container. It is known to select breast shields in accordance with the size of the breast. In particular, breast shield sets are known, in which the size of the funnel-shaped part can be selected according to the mother.

PATENT CLAIMS

1. A device for expressing human breast milk, wherein the device has a breast shield (4) for bearing against a mother's breast, a vacuum pump (1, 9, 9') for generating a vacuum, a line (2) which connects the vacuum pump (1, 9, 9') to the breast shield (4) and is intended for transmitting the vacuum generated to the breast shield (4), and a chamber (133, 112; 8), the line (2) ending on the pump side in a first port (130, 130') of said chamber (133, 112; 8), characterized in that the chamber (133, 112; 8) has a second port (131, 131') for connection to a milk collecting container (7), in that the two ports (130, 130', 131, 131') in the chamber (133, 112; 8) are connected to each other in terms of fluid communication, and in that, during the expressing operation, the line (2) forms a milk line for transporting breast milk expressed in the breast shield (4) to the chamber (133, 112; 8) and from the chamber (133, 112; 8) to the milk collecting container (7).

2. The device as claimed in claim 1, wherein there is a partition wall (14, 14'), which separates the chamber (133, 112; 8) into a drive-side region (112, 80) and a breast-shield-side region (133, 81), and wherein the first and the second port (130, 130', 131, 131') are arranged in the breast-shield-side region (133, 81).

3. The device as claimed in claim 2, wherein the partition wall (14, 14') is a diaphragm, wherein the diaphragm (14, 14') is driven and is designed for conveying the expressed milk.

4. The device as claimed in claim 3, wherein the vacuum pump (1) is a diaphragm pump, the chamber (133, 112) is a pump chamber of the vacuum pump (1), and the diaphragm (14') divides the chamber (133, 112) into the two regions mentioned.

5. The device as claimed in either of claims 3 and 4, wherein the drive of the diaphragm (14) serves simultaneously to generate the vacuum in the pump chamber (133, 112) and to convey the flow of milk.

6. The device as claimed in one of claims 3 to 5, wherein the diaphragm (14, 14') has a substantially circular outline.

7. The device as claimed in one of claims 3 to 6, wherein the diaphragm (14, 14') is driven in the central region thereof, preferably in the center thereof.

8. The device as claimed in one of claims 1 to 7, wherein the second port (131, 131') is provided with a one-way valve (5), which prevents sucked off milk from flowing back from the milk collecting container (7) to the chamber (133, 112; 8).

9. The device as claimed in one of claims 1 to 8, wherein the breast shield (4) has a tubular connector (40) and a funnel (42), which is integrally formed thereon and is intended for resting on a mother's breast, wherein the funnel (42) widens toward the free side thereof that faces away from the connector (40), and wherein there is a passage (43), which extends continuously from a breast-side end of the funnel (42) as far as a pump-side end, being opposite said breast-side end, of the connector (40) and which serves to apply a vacuum to the mother's breast and for the flowing away of the expressed breast milk, wherein the funnel (42) is of more flexible design than the connector (40), wherein the funnel (42) has a main region (420) extending over a substantial part of the length thereof with a first opening angle (α_1) of the passage (43), and a breast-side end region (421) with a second opening angle (α_2) of the passage (43), and wherein, when not in use, the first opening angle (α_1) is smaller than the second opening angle (α_2), and wherein, in the use state, at least the first opening angle (α_1) can be enlarged by axial pressure on the breast shield (4).

10. The device as claimed in one of claims 1 to 9, wherein the breast shield (4) has a tubular connecter (40) and a funnel (42) that is integrally formed thereon and is intended for resting against a mother's breast, wherein the funnel (42) has a breast-side diameter (D) of 5 mm to 40 mm and a length (L) of 10 mm to 40 mm, such that, in the use state, the nipple, and at maximum the areola, is surrounded by the breast shield (4).

11. The device as claimed in one of claims 1 to 10, wherein the breast shield (4) is

arranged in a coupling part (3), the upper region of which, in the use position, has a port (31) for the connection of the line (2).

12. A vacuum pump (1) for expressing human breast milk by means of a breast shield (4), the vacuum pump (1) having a drive (11, 12) and a diaphragm (14) that can be driven cyclically by the drive (11, 12), the diaphragm (14) being arranged in a chamber (133, 112), the diaphragm (14) separating the chamber (133, 112) into a drive-side part (112) and a breast-shield-side part (133), and the breast-shield-side part (133) having a vacuum port (130) for producing a connection to the breast shield (4), wherein the breast-shield-side part (133) of the chamber (133, 112) furthermore has a milk port (131) for producing a connection to a milk collecting container (7), and wherein the vacuum port (130) and the milk port (131) are connected to each other in terms of fluid communication via the breast-shield-side part (133) of the chamber (133, 112).

13. The vacuum pump as claimed in claim 12, wherein it is a diaphragm pump (1), and the chamber (133, 112) is the pump chamber of the diaphragm pump (1) used for generating the vacuum, and the diaphragm (14) is the diaphragm used for generating the vacuum.

14. A method for operating a device for expressing human breast milk, a vacuum being generated in a breast shield (4) by means of a vacuum pump (1, 9, 9'), the vacuum generated being conducted from a chamber (133, 112; 8) via a line (2) to the breast shield (4), and expressed milk being collected via the breast shield (4) in a milk collecting container (7), wherein, during the expressing operation, the same line (2), which is used for transmitting the vacuum, conducts the milk expressed in the breast shield (4) to the chamber (133, 112; 8), and wherein, during the expressing operation, the milk is conducted further from the chamber (133, 112; 8) into the milk collecting container (7).

15. The method as claimed in claim 14, wherein use is made of a nonreturn valve (5), which, when there is sufficient pressure in the chamber (133, 112; 8), creates a connection between the chamber (133, 112; 8) and the milk collecting container (7).

TITLE

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PRIOR ART

Devices for expressing human breast milk are well known. In principle, there are two different types: the first device type is operated manually, *i.e.* the negative pressure required for the expressing operation is generated by manual actuation of the vacuum pump. In the devices of the second type, the vacuum pump is operated electrically, it being possible for the vacuum pump to be connected to the power supply network and/or to be operated via a battery or another energy accumulator. Examples for this include WO 96/22116, US 2009/0099511, US 2008/0287037, US 7 094 217 and US 2008/0039781.

Said vacuum pumps are connected to a breast shield either directly or via vacuum lines. The breast shield usually has a funnel-shaped part for receiving part of the mother's breast including the nipple. As a rule, said funnel-shaped part merges into a part, which is in the shape of a hollow cylinder and to which, firstly, either the vacuum pump is connected directly or via a suction line and which, secondly, is likewise connected directly or via a milk line to a milk collecting container. It is known to select breast shields in accordance with the size of the breast. In particular, breast shield sets are known, in which the size of the funnel-shaped part can be selected according to the mother.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A device for expressing human breast milk, wherein the device has a breast shield for bearing against a mother's breast, a vacuum pump for generating a vacuum, a line which connects the vacuum pump to the breast shield and is intended for transmitting the vacuum generated to the breast shield, and a chamber, the line ending on the pump side in a first port of said chamber, wherein the chamber has a second port for connection to a milk collecting container, wherein the two ports in the chamber are connected to each other in terms of fluid communication, and wherein, during the expressing operation, the line forms a milk line for transporting breast milk expressed in the breast shield to the chamber.

2. The device as claimed in claim 1, wherein there is a partition wall, which separates the chamber into a drive-side region and a breast-shield-side region, and wherein the first and the second port are arranged in the breast-shield-side region.

3. The device as claimed in claim 2, wherein the partition wall is a diaphragm, wherein the diaphragm is driven and is designed for conveying the expressed milk.

4. The device as claimed in claim 3, wherein the vacuum pump is a diaphragm pump, the chamber is a pump chamber of the vacuum pump, and the diaphragm divides the chamber into the two regions mentioned.

5. The device as claimed in either of claims 3 and 4, wherein the drive of the diaphragm serves simultaneously to generate the vacuum in the pump chamber and to convey the flow of milk.

6. The device as claimed in any one of claims 3 to 5, wherein the diaphragm has a substantially circular outline.

7. The device as claimed in any one of claims 3 to 6, wherein the diaphragm is driven in the central region thereof, preferably in the center thereof.

8. The device as claimed in any one of claims 1 to 7, wherein the second port is provided with a one-way valve, which prevents sucked off milk from flowing back

from the milk collecting container to the chamber.

9. The device as claimed in any one of claims 1 to 8, wherein the breast shield has a tubular connector and a funnel, which is integrally formed thereon and is intended for resting on a mother's breast, wherein the funnel widens toward the free side thereof that faces away from the connector, and wherein there is a passage, which extends continuously from a breast-side end of the funnel as far as a pump-side end, being opposite said breast-side end, of the connector and which serves to apply a vacuum to the mother's breast and for the flowing away of the expressed breast milk, wherein the funnel is of more flexible design than the connector, wherein the funnel has a main region extending over a substantial part of the length thereof with a first opening angle of the passage, and a breast-side end region with a second opening angle of the passage, and wherein, when not in use, the first opening angle is smaller than the second opening angle, and wherein, in the use state, at least the first opening angle can be enlarged by axial pressure on the breast shield.

10. The device as claimed in any one of claims 1 to 9, wherein the breast shield has a tubular connecter and a funnel that is integrally formed thereon and is intended for resting against a mother's breast, wherein the funnel has a breast-side diameter of 5 mm to 40 mm and a length of 10 mm to 40 mm, such that, in the use state, the nipple, and at maximum the areola, is surrounded by the breast shield.

11. The device as claimed in any one of claims 1 to 10, wherein the breast shield is arranged in a coupling part, the upper region of which, in the use position, has a port for the connection of the line.

12. A vacuum pump for expressing human breast milk by means of a breast shield, the vacuum pump having a drive and a diaphragm that can be driven cyclically by the drive, the diaphragm being arranged in a chamber, the diaphragm separating the chamber into a drive-side part and a breast-shield-side part, and the breast-shield-side part having a vacuum port serving as a port for a line for producing a connection to the breast shield, wherein the breast-shield-side part of the chamber furthermore has a milk port for producing a connection to a milk collecting container, and wherein the vacuum port and the milk port are connected to each other in terms of fluid communication via the breast-shield-side part of the chamber.

13. The vacuum pump as claimed in claim 12, wherein it is a diaphragm pump, and the chamber is the pump chamber of the diaphragm pump used for generating the vacuum, and the diaphragm is the diaphragm used for generating the vacuum.

14. A method for operating a device according to any one of claims 1 to 11 for expressing human breast milk, the method comprising the following steps: a vacuum being generated in a breast shield by means of a vacuum pump, the vacuum generated being conducted from a chamber via a line to the breast shield, and expressed milk being collected via the breast shield in a milk collecting container, wherein, during the expressing operation, the same line, which is used for transmitting the vacuum, conducts the milk expressed in the breast shield to the chamber, and wherein, during the expressing operation, the milk is conducted further from the chamber into the milk collecting container.

15. The method as claimed in claim 14, wherein use is made of a non-return valve, which, when there is sufficient pressure in the chamber, creates a connection between the chamber and the milk collecting container.

16. A coupling part for use in a device according to any one of claims 1 to 11, wherein the coupling part connects a breast shield with a line, wherein the line connects the breast shield with a vacuum pump and wherein the line forms a milk line for transporting expressed breast milk, wherein the coupling part comprises a port for connection of the line.

17. A breast shield unit, comprising:
a breast shield; and
a coupling part according to claim 16.

18. A device according to any one of claims 1 to 11, wherein the line is flexible.