Nov. 26, 1940. L. DINESEN 2,222,811

VACUUM PRESSURE PULSATOR

Filed Aug. 16, 1937

Fig 1

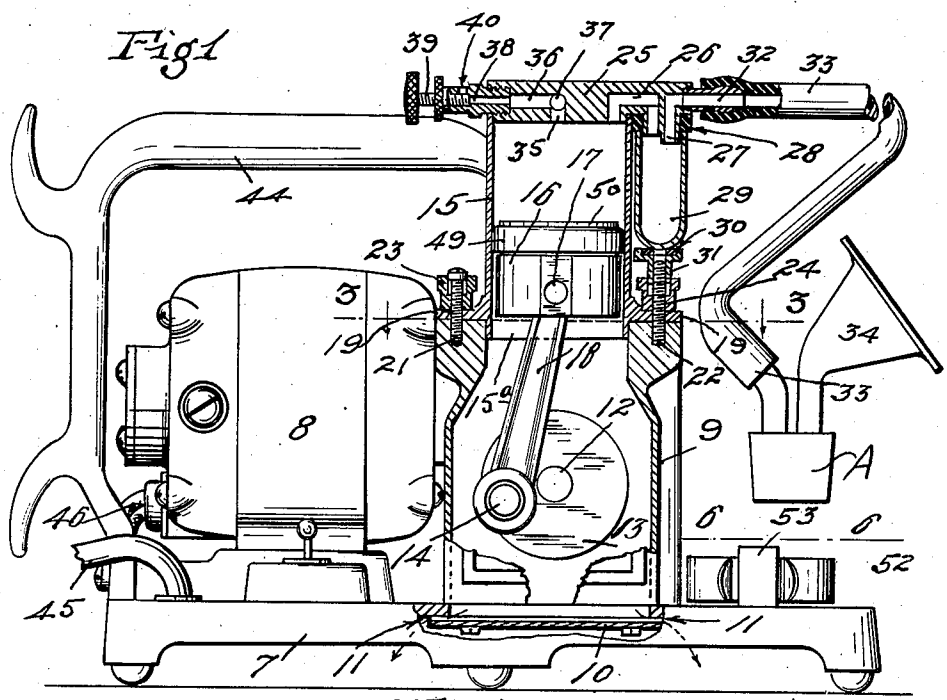


Fig 3

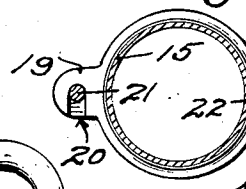


Fig 2

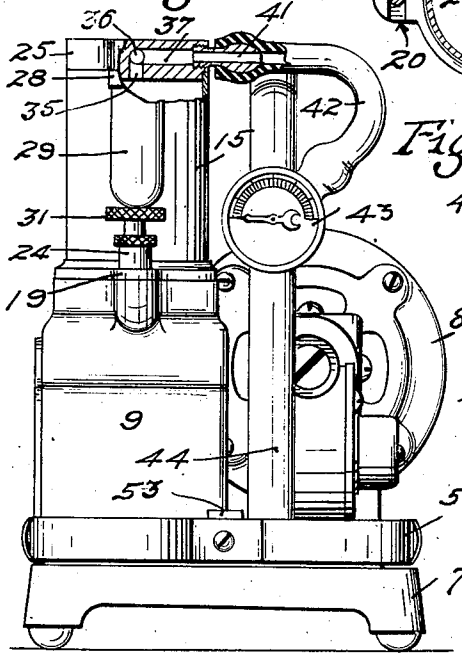


Fig 5

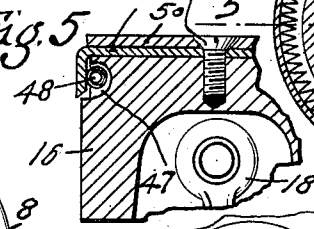


Fig 4

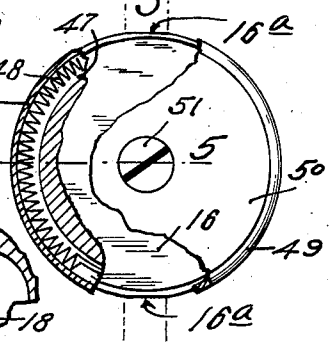
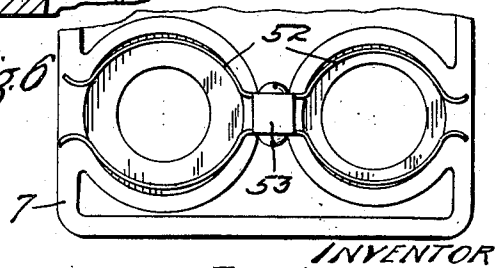


Fig 6



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2,222,811

VACUUM PRESSURE PULSATOR

Laurits Dinesen, Minneapolis, Minn.

Application August 16, 1937, Serial No. 159,227

8 Claims. (Cl. 230—190)

My invention provides what is herein designated as a vacuum pressure pulsator, in that it produces pressure pulsations that are below atmospheric pressure. Pressure pulsations of this kind are desirable for various different kinds of service, such, for example, as massage devices and breast pumps and milking apparatus.

In the use for massage purposes and for breast pumps light suction pulsations, or, in other words, pressure pulsations below atmospheric pressure and tending toward partial vacuum are required. Such pressure pulsations in massage treatments increase circulation of the blood with well known advantageous results. Breast pumps, as is well known, are quite generally used in hospitals for artifically extracting the human milk; and for that purpose the pulsations must be mild. For example, they may vary from approximate atmospheric pressure to a vacuum or low pressure, represented approximately by a six inch water column. For skin or scalp massage higher vacuum will be desired.

In adapting the device for a breast pump, a drip cup or vacuum receptacle is required to catch the milk and prevent flow thereof to the pump; and, moreover, such a drip cup is very desirable wherever there is a possible flow of liquid or floating solid material with the air drawn into the cylinder of the vacuum pump. My improved device meets all of the above requirements in an extremely simple and highly efficient self-contained device, wherein the customary check valve or valves in the ordinary sense are eliminated and wherein the piston of the air pump is equipped with a sealing ring, which, under outward movements of the piston, formed an air-tight joint between the piston and cylinder but under inward movements of the piston, releases at least in part from the cylinder wall to permit relatively free movement of the air out of the cylinder and past the piston.

The invention also involves important mechanical features which make assembling and disassembling of the parts an easy matter and which, therefore, permits frequent, thorough and easy sterilizing of the parts. A commercial form of the device is illustrated in the accompanying drawing, wherein like characters indicate like parts throughout the several views.

Referring to the drawing:

Fig. 1 is a view partly in side elevation and partly in vertical section illustrating the invention, some parts being broken away;

Fig. 2 is a front elevation of the device, some parts being sectioned;

Fig. 3 is a detail in section on the line 3—3 of Fig. 1, some parts being removed;

Fig. 4 is a detail looking at the top or inner end of the piston removed from the cylinder and with some parts broken away and other parts sectioned;

Fig. 5 is a fragmentary section taken on the line 5—5 of Fig. 4; and

Fig. 6 is a fragmentary plan view showing certain parts found immediately below the line marked 6—6 of Fig. 1.

All of the parts of the device are supported directly or indirectly from a portable supporting base 7, on which is mounted a small electric motor 8. Rigidly secured on the base 7 adjacent one end of the frame of the motor 8 is a box-like crank casing 9, the lower end of which is partly but not completely closed by a plate 10, between which and the walls of the lower portion of the casing 9 are free air discharge passages 11. Mounted in the crank casing 9 and extending at right angles to the axis of the rotor of the motor 8 is a crank shaft 12 shown as provided with a disc-like crank head 13 that carries a crank pin 14.

Mounted directly on the open upper end of the crank casing 9 is the cylinder 15 of an air pump, herein designated as a vacuum pump. Working in the cylinder 15 is a piston 16, the lower end of which is open and is provided with a wrist pin 17. A crank rod 18 is connected to the wrist pin 17 with its lower end mounted on the crank pin 14 of the disc 13. The lower end of the crank rod 18 is freely slipped laterally onto the crank pin 14 and is capable of being applied thereto or removed therefrom when the cylinder is shifted laterally from its fixed position, all as will presently more fully appear.

The cylinder 15 at its lower end is provided with outstanding anchoring ears 19 formed with open slots 20 which, in the two ears, are extended circumferentially in opposite directions. By oscillatory movements of the cylinder the slots 20 of the ears 19 are adapted to be simultaneously engaged astraddle of screw-threaded studs 21 and 22 that are screwed into the top of the crankcase 9 at diametrically opposite points. On the threaded upper ends of the studs 21 and 22 are applied clamping nuts 23 and 24, respectively, which nuts, as shown are recessed in their tops. The cylinder 15 has a depending annular centering flange 15a that is seated in the axially aligned opening in the top of the crank casing 9. Stud 21 at its upper end has a head that keeps the nut 23 from being accidentally entirely re-

moved from the stud; and the nut 24 is similarly formed for another purpose, which will presently be described. Rigidly secured to the upper end of the cylinder 15 is a cylinder head 25 that projects from the cylinder at one side and is there formed with an inverted U-shaped air port 26 and with an inverted L-shaped air port 27. The depending portions of the air ports 26 and 27 that are just outside of the cylinder are formed in a depending boss, which, as shown, is surrounded by a pliable gasket 28 of rubber, leather or the like.

Seated at its upper end against the gasket 28, by an air-tight joint, is a receptacle that constitutes a drip receptacle or vacuum cup 29. This drip cup 29 may be of any suitable material but will usually be made of glass which is transparent, so that the contents of the cup may be observed. The closed lower end of the cup 29 rests upon a pliable disc 30 that is held by the flanged and recessed upper end of a nut 31 that works with threaded engagement on the extreme upper end of the stud 22, and the sleeve-like portion of which is adapted to enter the recess of the lower nut 24.

From the port 27 a tubular nipple 32 projects and is engaged by the delivery end of a rubber tube 33, to the extended end of which is usually applied a bell-shaped suction head or breast cup 34. When the device is to be used as a breast pump, the cup 34 will be used in connection with an applied receptacle such as a jar, not shown, but which is adapted to be held in the holder 52. However, even when the device is used as a breast pump with the attached jar at the extended end of the flexible tube 33, the drip cup 29 is important because it will then function to catch any milk that should be drawn after the jar has been filled and, in any event, will catch any condensed vapors or solid matter that may be carried by the air drawn to the cylinder.

In Fig. 1 the receptacle marked "A" may serve as or be treated as the primary milk receptacle or the milk receptacle proper. This element "A" may be considered either the jar or a cap or plug to the jar where a larger jar is used.

In the cylinder head 25 there is another port 35 that has two branches 36 and 37. The branch 36 leads to a tubular nipple 38 that is equipped with a needle valve 39 and is provided with a lateral atmospheric port 40. The branch 37 leads to a projecting nipple 41 that is connected by a tube 42 to a vacuum gauge 43. This vacuum gauge may be supported in any suitable manner but, as shown in Fig. 2, is supported by a yoke-like handle bar 44 that is rigidly secured to the base and extends upward therefrom above the motor. The numeral 45 indicates a rubber tube that leads to the base 7 and is adapted to carry wire cables 46 to the motor.

Attention is now called to one of the highly important features of the invention above briefly indicated and which makes unnecessary and eliminates the use of check valves in the air intake to the cylinder of the pump. The body of the piston 16 may be made of various different materials, but, in practice, I have found it advisable to use oil-treated wood. The body of this piston, near its upper end, is formed with a quite deep annular groove 47, in which is placed an endless coiled spring 48 which, under normal expansion, will have greater diameter than the bottom of the groove in which it is placed, so that there will always be some clearance between the spring and the bottom of the groove.

The element which in this piston acts as or as a substitute for a piston ring is a flanged sealing ring 49 of flexible material such as leather, frequently designated as a sealing cup. As shown, this element 49 is formed by a leather disc having an outturned flange that surrounds the endless spiral spring 48 and, by the natural expansion of the latter, is yieldingly held in contact with the walls of the cylinder. The disc-like body of this element 49 is clamped to the piston head by a metallic disc 50, which in turn is detachably but firmly held to the piston by a screw 51.

At one or more points, to wit: as shown at diametrically opposite points, the piston 16 below the groove 47 is formed with longitudinally flattened or reduced portions 16*a*, the transverse medial portions of which are in the axial plane that includes the axis of the wrist pin 17. These flattened or grooved portions form an important function that will appear in the description of the operation.

In the drawing there is shown a forked spring clamp 52 applied to a lug 53 on one end of the base 7 for holding jars or the like. This last noted element is adapted to hold jars or similar receptacles that are in connection with the device and has been found serviceable, especially when the device has been used as a breast pump for containing milk transferred from the drip cup 29.

The crank shaft 12 may be driven from the rotor of the motor 8 in any suitable way, but, in practice, it is driven from the rotor of the motor through the customary speed-reducing worm and gear driving of the worm on the shaft of the rotor and of the gear on the shaft 12.

When the device is in action, under downward or outward movements of the piston, the flexible flange of the ring-acting element 49 will, by air pressure, be completely seated against the walls of the cylinder, thereby insuring the suction or partial vacuum-producing action in the piston, and such sucking action will produce the required partial vacuum in the drip cup 29 and in the air tube 33 and nozzle cup 34.

Under the upward or inward movement of the piston the air caged in the cylinder will find relatively free escape therefrom past the flexible flange of the piston ring 49, especially at or in line with the flattened portion 16*a*. Under the said inward movement of the piston there will be a tendency of the air to press in the flange of the element 49 all the way around, but if the main body of the piston fits the cylinder quite closely, the free passage of air through the channels will be afforded by the flattened or grooved surfaces 16*a*. In actual practice this device is found to work with complete satisfaction without the use of any check valve in any of the air passages to or from the cylinder.

The intensity of the vacuum producing pulsations can be varied by adjustments of the needle valvet 31 so as to either cut off entirely or to reduce to any desired extent the passage of air through the air ports 38—40. The intensity of these pulsations will, of course, be shown on the vacuum gauge 43. The air discharged from the cylinder past the piston will find free escape out through the bottom of the crank casing 9.

In assembling the device the cylinder will be placed on the top of the crank casing 9 and turned so that its notched ears 19 will brace the studs 21 and 22 while the nuts 23 and 24 are loosened. Then when said nuts are tightened, the cylinder will be anchored in proper alignment with the cranks 9 and crank shaft 12. The removal of the

cylinder from the crank-case will, of course, be performed by a reverse operation. When the cylinder is thus loosened it can be lifted and drawn off from the piston; and then the piston and connecting rod can be moved laterally so as to slip the lower end of said rod off from the crank pin 14.

When the nut 31 is screwed on the stud 22 the drip cup 29 may be either applied in working position or removed therefrom; and when the said nut is screwed upward on the said stud, said drip cup will be anchored in working position, as already indicated.

The device, as illustrated in the drawings, is a compact complete operating unit which is adapted to be carried from place to place. As already indicated, the various parts thereof are capable of being readily separated for the purposes of cleaning, and, hence, it is easily kept in a sanitary condition.

By the statements herein made that the cylinder has a free and unobstructed air intake passage for the movement of air therethrough is means that there is no such a device as a check valve or the like that will open to admit air to pass in one direction and close to prevent passage of air in the opposite direction. In this invention the sealing ring of the piston, under suction stroke, engages the cylinder wall to prevent passage of air between the cylinder and piston but under inward or compression stroke, yields to permit a relatively free passage of air out of the cylinder by movement of the air between the cylinder and piston.

It will be understood that while I have shown a commercial form of the device, that various modifications may be made thereof within the spirit of the invention herein disclosed and claimed.

One of the main objects of the present invention is the provision of a device, the parts of which may be quickly assembled and disassembled, thereby making it an easy matter to effectually sterilize all of those parts with which the milk or other liquid operated upon by the pump may be kept in sanitary condition.

What I claim is:

1. In a device of the kind described, a cylinder having a free and unobstructed air intake passage for the movement of air therethrough in both directions, a piston working in said cylinder, and means for reciprocating said piston, the latter having a ring-acting element which, under outward stroke, is automatically seated against the walls of the cylinder but under inward stroke releases from the walls of the cylinder to permit the movement of air past the same and out of the cylinder.

2. The structure defined in claim 1 in which said ring-acting element is of a flexible material with a cylindrical flange engaging the cylinder, the body of the piston having a groove, and yielding means in said groove exerting outward force tending to seat the cylindrical flange of said ring-acting element against the walls of the cylinder.

3. The structure defined in claim 1 in which said ring-acting element is of a flexible material with a cylindrical flange engaging the cylinder, the body of the piston having a groove, and yielding means in said groove exerting outward force tending to seat the cylindrical flange of said ring-acting element against the walls of the cylinder, said piston at at least one side having a longitudinally reduced portion affording a channel for the passage of air out of the cylinder, under inward stroke of the piston.

4. In a device of the kind described, a cylinder having a free and unobstructed air intake passage for the movement of air therethrough in both directions, a piston working in said cylinder, means for reciprocating said piston, said piston having a sealing ring formed with a pliable annular flange for direct engagement with the cylinder wall, said piston having at least one reduced surface that leads from said flexible annular sealing flange to the discharge end of the piston.

5. In a device of the kind described, a cylinder having a free and unobstructed air intake passage for the movement of air therethrough in both directions, a piston working in said cylinder, means for reciprocating said piston, said piston having a sealing ring formed with a pliable annular flange for direct engagement with the cylinder wall, said piston having at least one reduced surface that leads from said flexible annular sealing flange to the discharge end of the piston, said piston further having an annular groove and in said groove an endless coiled spring, under expansion tending to press said sealing flange against the wall of the cylinder.

6. In a device of the kind described, a crank casing, a rotary crank shaft having a crank equipped head working in said casing, a cylinder mounted on said crank casing for lateral shifting movements, means for clamping said cylinder to said casing and for releasing the same, said cylinder having an air intake passage, a piston working in said cylinder and having a wrist pin, and a connecting rod pivoted on said wrist pin at its inner end and at its outer end terminating in a sleeve adapted to be slid axially onto and off from the crank pin of said crank head, when said cylinder is loose and capable of lateral movements.

7. In a device of the kind described, a crank casing, a crank shaft having an eccentric crank-pin working within said casing, a cylinder detachably mounted on said crank casing, a piston working in said cylinder, and a connecting rod pivoted to said piston at one end and at its other end having a slip connection with said crank-pin and adapted to be slipped onto and off from said crank-pin when said cylinder is moved from said crank casing.

8. The structure defined in claim 7 in which said crank casing is provided with projecting diametrically opposite studs, and said cylinder is provided with diametrically opposite anchoring ears formed with open notches adapting the cylinder for quick engagement and disengagement with said nut-equipped studs, by rotation of said cylinder.

LAURITS DINESEN.