

PATENT SPECIFICATION

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(54) A HYGIENE APPLIANCE FOR DELIVERING AN INTERMITTENT LIQUID JET

(71) We, 4 P LIMITED, a British Company of La Chasse Court, La Chasse, St. Helier, Jersey, Channel Islands, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to hygiene appliances for discharging an intermittent jet of liquid via a hand-held spray nozzle, especially for massaging the gums and cleaning the teeth.

As is known, such appliances may comprise: a liquid pump including a working chamber connected to an outlet pipe, a motor-driven piston reciprocally axially within the working chamber, an inlet chamber connected to an inlet pipe, and an inlet valve located in a connecting aperture between the inlet chamber and the working chamber which inlet valve, in use, is closed during a working stroke of the piston and opened during a suction stroke of the piston; a liquid reservoir connected to the inlet pipe; and a spray nozzle connected to the outlet pipe, said nozzle having a passage leading to an outlet aperture and a stop valve actuatable by the user for opening and closing said passage.

In a known appliance of this type, there is provided a liquid return pipe leading from the spray nozzle to the liquid reservoir, enabling the liquid circuit of the pump to be short-circuited by the stop valve when there is an interruption in the supply of liquid to the spray nozzle such that the pump idles. In this known appliance, the stop valve is constructed as a multi-way valve, which either blocks the liquid return pipe while connecting the pipe leading to the nozzle aperture or connects the liquid return pipe to the outlet pipe, the pipe leading to the nozzle aperture then being blocked. However, the necessity of provid-

ing a separate liquid return pipe increases the production costs of the appliance. Furthermore, since the spray nozzle must be connected to the pump by two flexible liquid pipes, light and convenient handling of the spray nozzle is somewhat impaired, since the connecting hose enclosing the two separate liquid pipes is thicker and more rigid than in the case of a single connecting pipe.

Appliances operating without a separate return pipe and which are therefore constructed more simply and more economically in this respect, are already known but these have two main problems requiring solution. These problems are connected with the fact that in the pump the inlet valve is subject to the action of a closing spring, so that this inlet valve is biased closed and is open only during operation of the pump, during each suction stroke of the piston, against the action of the closing spring. Therefore, when the appliance is not in use and the stop valve is closed, the hydraulic system between the closed inlet and stop valves is completely sealed, this part of the hydraulic system either being filled completely with liquid or, owing to air pockets, being only partly filled, or may even contain no liquid.

The first problem occurs when the hydraulic system is full of liquid so that the motor may be unable to start when switched on due to the stop valve being closed. Starting the liquid pump at the time of switching the motor on when the stop valve is still closed is all the more difficult as the starting torque of the motor is less than its operating torque and for reasons of cost, space and weight, motors of relatively low power must necessarily be used.

In order to solve this first problem it is known to mechanically interconnect the electric switch for the pump motor and a pressure regulating device of the pump and

to actuate them by means of a common control member such that at the time of switching on the motor the minimum pressure is necessarily set before the pressure is subsequently increased, when required, by further actuation of the control member. This pressure regulation takes place due to the fact that a secondary pipe between the working chamber and inlet chamber of the pump or inlet valve is open to a greater or lesser extent, so that a greater or lesser part of the liquid expelled by the piston is not conveyed to the spray nozzle, but may escape into the pump inlet chamber connected to the reservoir. Therefore, if at the time of switching the motor on, the secondary pipe is simultaneously fully open, a relatively low starting torque of the motor is sufficient to produce the force necessary for expelling the liquid out of the working chamber of the pump. Such a connection between the electric switch and the pressure regulating device nevertheless represents a relatively complicated and troublesome mechanical arrangement and furthermore the starting of the pump is not guaranteed when, after previous use, the electric plug has been removed from the socket for the purpose of switching off the appliance and has been re-inserted in the socket for re-starting the appliance, since in this case, the pressure-regulating device is generally in an intermediate position and not in the position corresponding to minimum pressure. The same is true in the case of a power failure.

In another known appliance working without a liquid return pipe, the hydraulic system is provided with an additional spring-loaded auxiliary piston, which may yield under the pressure of the liquid, in the manner of a damper, when the liquid pump is switched on and the stop valve is closed. However, in this instance, the dimensions of the spring acting on the auxiliary piston are very critical, since in the untensioned condition, i.e. at the time of starting the pump, the spring should exert virtually no force on the auxiliary piston so that the latter may immediately yield under the slightest increase of pressure. On the other hand, while the stop valve is closed, the spring must damp relatively high pressure surges. In addition, on opening the stop valve, the auxiliary piston must be short-circuited by rotating a corresponding valve member. Furthermore, the provision of the auxiliary piston increases the production costs of the hand-operated appliance.

The second problem is concerned with adequately venting the appliance such that, after connecting a full reservoir to the pump and after switching on the motor, the pump begins to pump as soon as possible. If, upon switching on the pump, the inlet

chamber is not completely full of liquid, then firstly the air present in the hydraulic system must be expelled after opening the stop valve so that after switching on of the pump, no liquid is conveyed or only a weak irregular liquid jet is produced until the pump and outlet pipe are completely full of liquid. If the appliance is to be used after an interval of time since its last use, then generally it is practically empty of liquid. If, for the purpose of setting the appliance in operation, a full liquid reservoir is connected to the pump, then generally liquid cannot flow into the inlet chamber of the pump, because the latter is practically full of air and is closed by the spring-loaded inlet valve so that there is no possibility of the air escaping from the inlet chamber. Under these circumstances of inadequate venting of the hydraulic system, when the stop valve is opened the user must generally wait for a period of time until the appliance works normally.

It is an object of the invention to provide a hygiene appliance of the aforementioned type which does not have a liquid return pipe, and in which the problem of reliable starting of the pump when the motor is switched on and the stop valve closed is solved by simple and economic means.

According to the invention there is provided a hygiene appliance for discharging an intermittent jet of liquid via a hand-held spray nozzle, especially for massaging the gums and cleaning the teeth, said appliance comprising: a liquid pump including a working chamber connected to an outlet pipe, a motor-driven piston reciprocable axially within the working chamber, an inlet chamber connected to an inlet pipe, and an inlet valve located in a connecting aperture between the inlet chamber and the working chamber which the inlet valve, in use, is closed during a working state of the piston and opened during a suction stroke of the piston; a liquid reservoir connected to the inlet pipe; a spray nozzle connected to the outlet pipe, said nozzle leading to an outlet aperture, and a stop valve actuable by the user to open and close said passage; and a spring biasing the inlet valve toward the open position to hold the inlet valve in the open position when the appliance is in an inoperative state with the pump switched off, the force of the spring being less than the closing force exerted on the inlet valve by liquid in the working chamber during the working stroke of the piston.

In the inoperative state of the appliance, the hydraulic system including the working chamber of the pump is not closed, but connected by way of the open inlet valve and the inlet chamber to the open liquid reservoir. Therefore, when the pump is switched on, during the first part of the working

stroke of the pump piston, liquid may escape from the working chamber through the inlet valve which is still open, the inlet valve then being closed under the action of liquid pressure. The motor is thus prevented from having to start under load and a motor with a relatively low starting torque is able to accelerate quickly to its operating speed. Then, when the pump is completely full of liquid, i.e. when it is operating at maximum pressure, tests have shown that the inlet valve operates in a manner which is as troublefree as the hitherto known inlet valves operated by a closing spring. This means that during each suction stroke of the piston, the inlet valve is opened and during each working stroke, the latter is closed. The open position of the inlet valve is preferably determined by stop means limiting the movement of the valve such that the displacement time of the valve is as short as possible. The strength of the valve spring should be as low as possible in order that its compression during the closing movement of the valve, under the action of the liquid pressure, requires only a very small force.

In addition, in order to solve the second problem, i.e. to guarantee an immediate delivery of liquid by the liquid pump, as soon as the stop valve is opened, in a preferred embodiment the liquid reservoir is connected by the inlet chamber of the pump to a vertical ascending pipe with an aperture at its upper end, which pipe branches off from the pump inlet chamber and acts as an air-vent pipe. In this manner, the reservoir connected to the pump, the pump inlet chamber and the ascending pipe form a communicating system which guarantees complete filling of the inlet chamber when the reservoir full of liquid is connected to the inlet pipe of the pump. Air may thus escape completely from the inlet chamber through the ascending pipe, the liquid level in the ascending pipe then assuming the same height as in the reservoir. The inlet chamber may be appropriately constructed, for example by the provision of suitable baffles, such that during filling of the inlet chamber when the pump is inoperative, the liquid circulates around the inlet valve and some liquid reaches the working chamber of the pump through the open inlet valve. For reasons of space, the height of the ascending pipe may be less than that of the reservoir, a float provided with openings for the passage of air being located in the ascending pipe, which float in its raised position, i.e. when the ascending pipe is full, closes off the upper opening of the latter.

Two embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic view, partly in section, of a hygiene appliance according to the invention;

Fig. 2 is a cross-section on line II-II of Fig. 1;

Fig. 3 is a fragmentary sectional view similar to Fig. 2 of another embodiment, in which the upright pipe is constructed in a different manner; and

Fig. 4 is a cross-section on line IV-IV of Fig. 3.

As shown in Figs. 1 and 2, the hygiene appliance comprises a liquid pump with a pump housing 1, in which are provided an inlet chamber 2 connected to a liquid inlet pipe 3 and a cylindrical working chamber 4 connected to a liquid outlet pipe 5. The working chamber 4 is coaxial with an extension of the inlet chamber 2. Located in the working chamber 4 is an axially reciprocating piston 6, which is driven by a drive pin 7 engaging through a slot in an enlarged rear part of the piston. The drive pin 7 is attached to the shaft of an electric motor not shown, eccentric to the axis of the shaft, and when the motor is running, moves along the circle shown in a dot-dash line in Fig. 2.

An inlet valve arranged axially of the pump chambers is located with a valve rod 8 in the inlet chamber 2 and with a frusto-conical closure member 9 projecting into the working chamber 4. When the appliance is in an inoperative state, the inlet valve is kept in an open position (shown in Fig. 2) by a helical compression spring 11 surrounding the valve rod 8, this open position being defined by stops 10 on the inner wall of the working chamber 4. In this open position, the inlet chamber 2 and working chamber 4 are in flow communication. The displacement of the inlet valve between the open position determined by the stops 10 and a closed position (not shown) in which its frusto-conical closure member 9 comes to bear against a seat and closes off communication between the chambers 2 and 4, is so small that the time for displacement of the inlet valve between these positions during operation of the appliance is as short as possible.

Located adjacent the pump housing 1 is a hollow support 14, on which is placed an open-topped liquid reservoir 12. The reservoir 12 has a bottom opening 13 which is closed by known means (not shown) when the reservoir is removed from the support 14 and which is automatically opened when placing the reservoir on the support 14, the reservoir thereby being connected to the interior of the hollow support 14. The outlet aperture of the hollow support 14 is connected to the inlet pipe 3 of the pump by a connecting pipe 15.

The outlet pipe 5 of the pump is con-

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 5 nected by a flexible hose 16 to a spray nozzle 17 having an outlet aperture and mounted on a handle which comprises a stop valve 18 on the periphery of the nozzle handle for operation by the user. In the closed position of the stop valve 18, the supply of liquid to the nozzle aperture is prevented, whereas in the open position of the stop valve 18, the liquid supplied by the pump
 10 egresses through the nozzle aperture.

Branching from the inlet chamber 2 of the pump is a vertical ascending pipe 19, mounted on a tubular connection 20. The pipe 19 is open at its top and, together with the inlet chamber 2 of the pump, the connecting pipe 15 and the reservoir 12, forms a communicating system. Ribs 21 provided in the pump inlet chamber 2 form baffles which ensure that the liquid reaching the
 15 pipe 19 through the inlet chamber 2, after connecting the reservoir 12 full of liquid to the support 14, circulates around the inlet valve 8, 9 and also that some of the liquid passes through the open inlet valve into the
 20 working chamber 4. The arrangement and dimensions of the pipe 19 and of the inlet chamber 2 are such that the liquid levels in the reservoir 12 and in the pipe 19 may equalize in an unhindered manner during
 25 operation without the formation of air pockets.

When the appliance which is empty or only partly filled with liquid is to be used again after an interval of time since its last
 30 use, the reservoir 12 full of liquid is placed on the support 14 while the stop valve 18 is closed. The inlet chamber 2 of the pump rapidly fills with liquid, since the liquid flowing into the inlet chamber 2 expels substantially all the air through the pipe 19
 35 and rises in the latter until the liquid head in the pipe 19 has reached the same level as in the reservoir 12. During filling of the chamber 2 and pipe 18, liquid circulates
 40 around the inlet valve 8, 9, which is open so that some of the liquid will also pass into the pump working chamber 4. When the pump motor is switched on, the pump starts up immediately, since the inlet valve
 45 8, 9 is at first open and during the first part of the working stroke of the piston 6, allows the escape of liquid from the working chamber into the inlet chamber 2, which is connected to the pipe 19 and the reservoir 12.
 50 As the pressure in the working chamber increases during the working stroke, the inlet valve closes against the action of the valve spring 11, whose strength is chosen to be as low as possible but sufficient to reliably
 55 open the inlet valve when the appliance is in an inoperative state. At the end of the working stroke of the piston, when the pressure in the working chamber 4 has dropped, the inlet valve opens once more,
 60 the following suction stroke of the piston

promoting and accelerating this opening movement, particularly at full speed operation of the pump.

Thus, since the closing of the inlet valve takes place in a somewhat delayed manner
 70 with respect to the beginning of a working stroke of the piston, the pump may start up virtually without load and reach its operating speed quickly, even when the stop valve is closed and the working chamber 4 and out-
 75 let hose 16 are filled with liquid as far as the stop valve 18. When the stop valve 18 is then opened, the supply of liquid to the spray nozzle 17 begins rapidly since on account of the vertically ascending pipe 19,
 80 at least in the region of the inlet chamber of the pump, the hydraulic system is satisfactorily vented and completely filled with liquid and it is not necessary, first of all, to remove pockets of air from the pump inlet
 85 chamber. It has been shown in tests that during normal operation of the appliance, the delayed closure of the inlet valve has no adverse function, i.e. the appliance operates just as well as appliances with an inlet
 90 valve actuated by a closing spring.

As regards the inlet valve 8, 9, the appliance according to the invention thus requires no additional expenditure, compared with appliances known hitherto. Also, the
 95 provision of a vertically ascending pipe does not cause any constructional difficulties and represents a measure which only marginally makes the appliance more expensive, but which solves the problem of venting in an
 100 optimum manner.

The embodiment according to Figs. 3 and 4, has a vertically ascending pipe 19' the height of which is less than that of the reservoir 12, which is advantageous for reasons of space. The open upper end of the
 105 pipe 19' has a cover 24 with a central opening and a float 22 is provided in the pipe 19', the float 22 having a central part and peripheral openings 23 (Fig. 4) for the passage
 110 of air. The arrangement is such that when the ascending pipe 19' is completely filled with liquid, the central part of the float 22 closes the central opening in the
 115 cover 24.

The use of a vertically ascending pipe 19 which is permanently open (as in Figs. 1 and 2) has the advantage that when the appliance is not in use, the inside of the pump is connected to the atmosphere by this
 120 pipe, so that liquid contained in the pump may evaporate, which is desirable for reasons of hygiene. Stagnating liquid is thus prevented from remaining in the pump over a prolonged period. A further advantage
 125 of such a pipe 19 is that it is located in the immediate vicinity of the connecting opening between the inlet chamber and working chamber, which facilitates the expulsion of liquid from the working chamber into the
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full inlet chamber during starting of the pump, when the stop valve is closed, since the liquid in the inlet chamber may escape directly into the ascending pipe 19. The liquid in the ascending pipe has a slight inertia compared with the mass of liquid located in the reservoir 12, in the pipes 15 and 3 as well as in the pump inlet chamber 2 and may therefore move virtually without delay under the action of the pressure produced by the piston 6, the friction of the moving mass of liquid on the walls of the ascending pipe being only slight. For the same reason, during normal operation the delivery of liquid is facilitated and improved, since the ascending pipe 19 acts as a small, virtually inertia-free liquid reservoir in the immediate vicinity of the inlet valve, which supplies the pump immediately and without delay, whereas the liquid flows only relatively slowly out of the reservoir 12.

The herein described and illustrated hygiene appliances are also described and claimed in copending patent application No. 55312/74 (Serial No. 1487640).

WHAT WE CLAIM IS:—

1. A hygiene appliance for discharging an intermittent jet of liquid via a hand-held spray nozzle, especially for massaging the gums and cleaning the teeth, said appliance comprising: a liquid pump including a working chamber connected to an outlet pipe, a motor-driven piston reciprocable axially

within the working chamber, an inlet chamber connected to an inlet pipe, and an inlet valve located in a connecting aperture between the inlet chamber and the working chamber which inlet valve, in use, is closed during a working stroke of the piston and opened during a suction stroke of the piston; a liquid reservoir connected to the inlet pipe; a spray nozzle connected to the outlet pipe, said nozzle having a passage leading to an outlet aperture, and a stop valve actuatable by the user for opening and closing said passage; and a spring biasing the inlet valve toward the open position to hold the inlet valve in the open position when the appliance is in an inoperative state with the pump switched off, the force of the spring being less than the closing force exerted on the inlet valve by liquid in the working chamber during the working stroke of the piston.

2. An appliance according to claim 1, in which the inlet valve has a valve rod located in the inlet chamber and a closure member projecting into the working chamber, the spring being a helical spring surrounding the valve rod.

3. A appliance according to claim 1 or 2, in which the open position of the inlet valve is determined by stops which limit the valve movement.

MARKS & CLERK.



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WHAT WE CLAIM IS:—

1. A hygiene appliance for discharging an intermittent jet of liquid via a hand-held spray nozzle, especially for massaging the gums and cleaning the teeth, said appliance comprising: a liquid pump including a working chamber connected to an outlet pipe, a motor-driven piston reciprocable axially

within the working chamber, an inlet chamber connected to an inlet pipe, and an inlet valve located in a connecting aperture between the inlet chamber and the working chamber which inlet valve, in use, is closed during a working stroke of the piston and opened during a suction stroke of the piston; a liquid reservoir connected to the inlet pipe; a spray nozzle connected to the outlet pipe, said nozzle having a passage leading to an outlet aperture, and a stop valve actuable by the user for opening and closing said passage; and a spring biasing the inlet valve toward the open position to hold the inlet valve in the open position when the appliance is in an inoperative state with the pump switched off, the force of the spring being less than the closing force exerted on the inlet valve by liquid in the working chamber during the working stroke of the piston.

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