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J. W. MATTINGLY

3,453,969

LIQUID PUMP FOR ORAL HYGIENE APPARATUS AND THE LIKE

Filed Dec. 13, 1967

Sheet 1 of 2

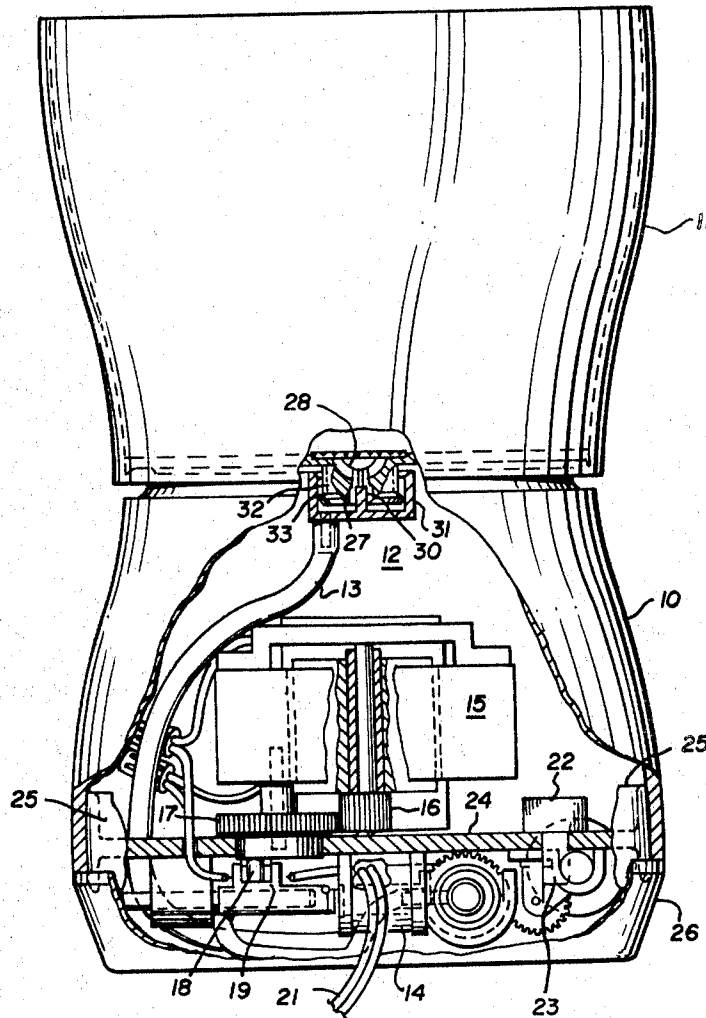


FIG. 1

INVENTOR.

John W. Mattingly

BY

McGraw-Hill

ATTORNEYS

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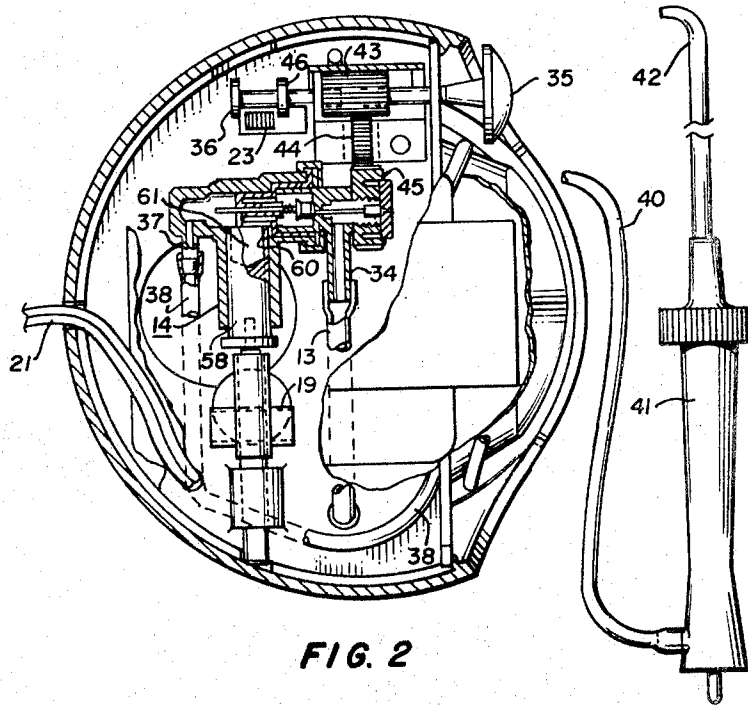


FIG. 2

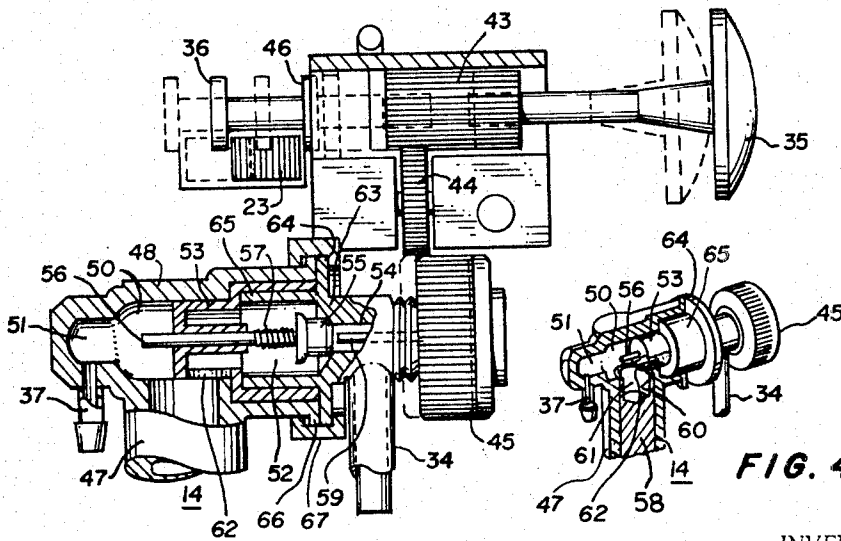


FIG. 3

FIG. 4

INVENTOR.

John W. Mattingly

BY

McBrew & Edwards

ATTORNEYS

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LIQUID PUMP FOR ORAL HYGIENE APPARATUS AND THE LIKE

John W. Mattingly, Fort Collins, Colo., assignor to Aqua
Tec Corporation, Fort Collins, Colo., a corporation of
California

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4 Claims

ABSTRACT OF THE DISCLOSURE

A liquid pump of the reciprocating type having a piston with a skirted end forming a pocket opening into the cylinder is provided with an arrangement for preventing the accumulation of a gas bubble in the skirt pocket. By directing liquid from the intake axially into the pocket gas bubbles are removed on each stroke of the piston.

This invention relates to reciprocating liquid pumps of the intermittent pulse type suitable for oral hygiene appliances and particularly to an improved construction of such pumps for preventing interference with the pulse discharge due to an accumulation of gas in the cylinder.

The use of a water jet of small cross section and comprising intermittent pulses has been found effective for dislodging accumulated particles from the teeth and subgingival margins, and for manipulating the gum tissue. Oral hygiene apparatus for producing an intermittent pulse of this type is disclosed and claimed in my United States Patent No. 3,227,158 granted Jan. 4, 1966, and assigned to the same assignee as the present invention. It has been found desirable to provide a sealing skirt on the piston used with small liquid pumps of the type employed in such apparatus. Under some conditions of operation, for example, when the piston and cylinder are horizontal, there may be a tendency for the pump to accumulate an air bubble in the piston skirt pocket; such bubble impairs the effectiveness of the pump because of the compressibility of the gas, accordingly, it is an object of the invention to provide a liquid pump for oral hygiene apparatus and the like which is not subject to an accumulation of gas in the pump cylinder chamber.

It is another object of this invention to provide an improved reciprocating liquid pump of the intermittent pulse type.

Briefly, in carrying out the objects of this invention, in one embodiment thereof, an oral hygiene appliance is provided with a motor driven reciprocating pump unit for producing intermittent liquid pulses at a rate of the order of 1200 pulses per minute and with sufficient Kinetic energy of each pulse to depress a discrete area of gum tissue and with a spacing of the pulses to provide rebound time for the tissue. The pulses are formed to have a substantially circular cross section with a diameter of the order of .035 inch. To secure effective sealing of the reciprocating piston of the pump the piston head is provided with a skirt providing a thin annular sealing ring adjacent the cylinder wall. In order to prevent the accumulation of air bubbles or the like in the skirt pocket an arrangement is provided for injecting liquid into the pocket during operation of the pump and thereby forcing out bubbles which may tend to collect in the pocket.

The features of novelty which characterize this invention are pointed out with particularity in the claim annexed to and forming a part of this specification. The invention itself, however, both as to its organization and manner of operation, together with further objects and advantages thereof may best be understood from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is an elevation view partly broken away to show the motor pump mechanism embodying the invention;

FIG. 2 is a bottom plan view of the unit of FIG. 1 with the base cover removed and partly in section to show the construction of the pump;

FIG. 3 is an enlarged view of the pump assembly broken away to show the internal construction; and

FIG. 4 is a bottom perspective view of a portion of the pump unit broken away to show the internal construction.

Referring now to the drawings, FIG. 1 illustrates an oral hygiene appliance including a pump embodying the invention and comprising a bottom or base section 10 containing the motor pump unit and an upper water reservoir 11 which is removably attached to the top wall of the base 10. The reservoir 11 is provided to supply water through a valve assembly 12 and through an intake tube or conduit 13 to a pump indicated generally at 14; the pump is driven by an electric motor 15 through a pinion gear 16 and a spur gear 17 which carries an eccentric pin 18 and drives the pump 14 through a Scotch yoke connection 19. Electric energy for the motor is supplied through lines 21 and is controlled by an "on-off" switch 22 actuated by a slide member 23. The motor pump assembly is mounted on a main supporting plate 24 having a flange 25 about its periphery which engages the open bottom wall of the base housing 10. The bottom closure of the housing indicated at 26 is secured to the base by a press fit and suitably retaining screws (not shown).

Water to be pumped by the pump 14 flows from the reservoir 11 and enters a duct 27 in the reservoir portion of the valve assembly 12, a gravity biased valve 28 being held away from its seating position at the entrance of the duct 27 by a post 30 integrally formed with the housing member 31 of the portion of the valve assembly 12 mounted on the base 10. The duct 27 and valve 28 are mounted in a boss 32 mounted on the bottom of the container 11 and which fits within the housing 31 and is sealed about its periphery by an O-ring or gasket 33 to prevent leakage of water from the valve assembly. The water then flows through the tube 13 down to the pump, the tube 13 passing through an opening in the base plate 24. As shown in FIG. 2 the tube 13 communicates with an intake connection 34 of the pump assembly 14. The pump motor is started by moving a knob 35 to the right as viewed in FIG. 2 so that a disc 36 on the knob engages the switch actuator 23 and moves it to the right thereby energizing the motor. During operation of the pump a pulsating stream of water is produced which is discharged from the pump through a connection 37 to a tube 38 and thence to a coiled tube 40 on the outside of the unit which terminates in a handle 41 holding a pivoted nozzle 42 from which the pulsed stream of water is ejected. In addition to controlling the motor switch the knob 35 performs a second function of controlling the effective pressure of the pulses discharge from the appliance. In order to con-

trol the pressure a knob shaft is provided with an elongated gear 43 which engages an idler pinion 44 and a gear 45 rotatably mounted on the pump housing. Rotation of the gear 45 controls a bypassing of fluid in the pump and thereby controls pressure; the manner in which this operates will be pointed out further below. This arrangement for controlling the operation of the motor and of the intensity of the pressure of the liquid pulse is disclosed in a copending application of Michael A. Cammack, Ser. No. 577,913 filed Sept. 8, 1966, and assigned to the same assignee as the present invention. The motor is de-energized by pressing the knob 35 to the left whereupon a disc 46 on the shaft of the knob engages the switch actuator 23 and moves it to the left to its shut off position.

The manner in which the intensity of the discharge jet is controlled will be understood upon reference to the enlarged view FIG. 3. The pump assembly 14 comprises a cylinder block including a cylinder 47 and an integral cylinder head member 48. Within the member 48 there is provided a pump chamber 50 comprising an exhaust portion 51 and an intake portion 52 separated by a liner 53 slidably mounted within the chamber 50. An inlet port 54 is provided along the central axis of the chamber 50 at the right hand end and in communication with the inlet connection 34, an inlet valve 55 having a step 56 is mounted in the liner 53 and is biased toward the port 54 by a spring 57. The gear 45 is threaded on the cylinder block and when it is turned by the gear 44 moves toward and away from the block. The gear carries a stem 59 which extends centrally of the port 54 and when moved toward the left engages the valve 55 and acts as a stop so that the valve may be held away from its seating position on the port and thus allow liquid to be returned to the intake on the forward stroke of the piston 58. The degree of opening of the valve determines the intensity of the liquid stream discharged through the outlet 37, maximum intensity being effected when the valve 55 is allowed to seat on the port 54.

During the operation of the pump a piston 58 mounted in the cylinder 47 is reciprocated by operation of the motor 15 through the Scotch yoke mechanism 19. The piston is provided with a sealing skirt 60 on its inner end. The piston in the illustrated embodiment of the invention is constructed of plastic and the wall of the skirt 60 is very thin and presses lightly against the cylinder wall, thereby providing a seal which increases in effect on the forward stroke of the piston. A piston constructed in this manner is thus provided with a pocket indicated at 61 in the forward or cylinder end thereof. It has been found that during operation of the pump under some conditions, for example, when it is horizontal, bubbles tend to collect or form and remain in the pocket 61 and upon the accumulation of a bubble of sufficient size the effectiveness of the pumping action is substantially decreased.

In this embodiment of the invention, the normal position of the cylinder 47 and piston 58 is horizontal as illustrated. During use of the device, air is frequently drawn into the pumping system and in addition gases in solution in the water are extracted to a degree by cavitation tendencies of the pumping action. When, from whatever cause, a bubble becomes trapped in the pocket 61 of the piston, it is compressed on the pressure stroke of the piston which decreases the displacement of liquid and it expands on the intake stroke of the piston which decreases the efficiency of intake flow of the liquid. Under certain conditions of operation, an air bubble trapped in this manner renders the pump ineffective. In order to prevent the accumulation of air in the pocket 61, the intake water after passing through the chamber 52 enters the reduced portion 53 of the liner and is discharged through an elongated orifice 62 and is directed as a jet axially into the right-hand side of the cylinder 47 as viewed in FIG. 3. The arrangement of this orifice is also shown in FIG. 4 in the broken away portion of the liner 53. FIG. 4 is a perspective view from substantially the same

bottom position as FIG. 3 in which the cylinder 47 extends horizontally. Any bubbles discharged tending to accumulate in the pocket 61 or in the cylinder 47 are forced out by the flow of water axially of the piston and cylinder. Bubbles are thus removed from the pocket as they occur and are not allowed to accumulate but instead are directed into the chamber 51 and discharged through the output 37.

The liner 53 fits closely within the complementary recess in the head 48 and its edge terminates flush with the edge of the cylinder head. The cylinder head is closed by a cap 63 which has a flange 64 facing and in engagement with the ends of the cylinder head and liner. The cap 63 also is provided with an inwardly extending cylindrical flange 65 which fits within the enlarged cylindrical portion of the liner and acts as a further seal between the pump chamber and the outside. The flange 64 and a flange 66 on the cylinder head are held together by a clamping ring 67. The liner 53 and the cap 63 may be rotated with respect to one another and with respect to the cylinder head so that when placing these components of the pump together, the position of the discharge slot 62 may be located directly along the transverse axis of the cylinder 47.

Pumps embodying this invention have been operated over extended periods of time and have been found to be free from the accumulation of gas bubbles and the attendant difficulties.

While the invention has been described in connection with specific arrangements and details of construction, various modifications will occur to those skilled in the art and therefore it is not desired that the invention be limited to the specific details illustrated and described and it is intended by the appended claims to cover all modifications which fall within the spirit and scope of the invention.

I claim:

1. A liquid pump for pulsed jet oral hygiene appliances and the like comprising a cylinder block having a cylinder therein a piston mounted in said cylinder for reciprocation therein, said pump having an intake connection and a discharge connection communicating with said cylinder, said piston having a skirt-like sealing portion providing a pocket opening into said cylinder, and means for directing liquid entering said cylinder from said intake connection in a jet longitudinally into the skirt portion of said piston whereby any gas bubble collected in said skirt portion is displaced therefrom.

2. A liquid pump as set forth in claim 1 wherein said last mentioned means comprises an orifice for directing liquid axially into said cylinder on one side of the central axis thereof.

3. A liquid pump as set forth in claim 1 wherein said block includes a cylinder head having an intake chamber and an exhaust chamber therein and communicating with the respective ones of said connections, a spring pressed valve for controlling the admission of liquid to said intake chamber, said intake chamber having one wall extending laterally across a portion of said cylinder, and said directing means comprising an orifice in said wall directed axially into said cylinder and one side thereof for directing liquid from said pump intake connection into said cylinder and forcing any gas bubble out of the skirted portion of said piston and into said discharge chamber.

4. A liquid pump as set forth in claim 1 wherein said block includes a head portion having therein a generally cylindrical chamber in open communication with said cylinder and extending transversely thereof, said cylindrical chamber having a first cylindrical portion adjacent said cylinder and a second larger concentric cylindrical portion axially thereof on one side of said cylinder, closure means for said larger cylindrical portion having an inlet centrally thereof along the axis of said chamber and communicating with said pump inlet connection, a cylindrical liner having walls conforming to the internal walls of said cylindrical portions and slidably fitted therein, the smaller

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cylindrical portion of said liner being closed at its end remote from said larger portion and having slidably mounted in its closed end a stemmed intake valve for closing said inlet, a spring about the stem of said valve for biasing said valve toward said central inlet, said 5 smaller wall portion of said liner extending over a portion of said cylinder and having an orifice therein constituting said means for directing liquid into said cylinder and positioned to direct liquid from within said liner axially into said cylinder.

10 103—153, 228; 128—66

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ROBERT M. WALKER, *Primary Examiner*.

U.S. Cl. X.R.