Oct. 10, 1961 P. A. JOHNSON 3,003,705

AERATOR

Filed Jan. 20, 1959

Fig. 1.

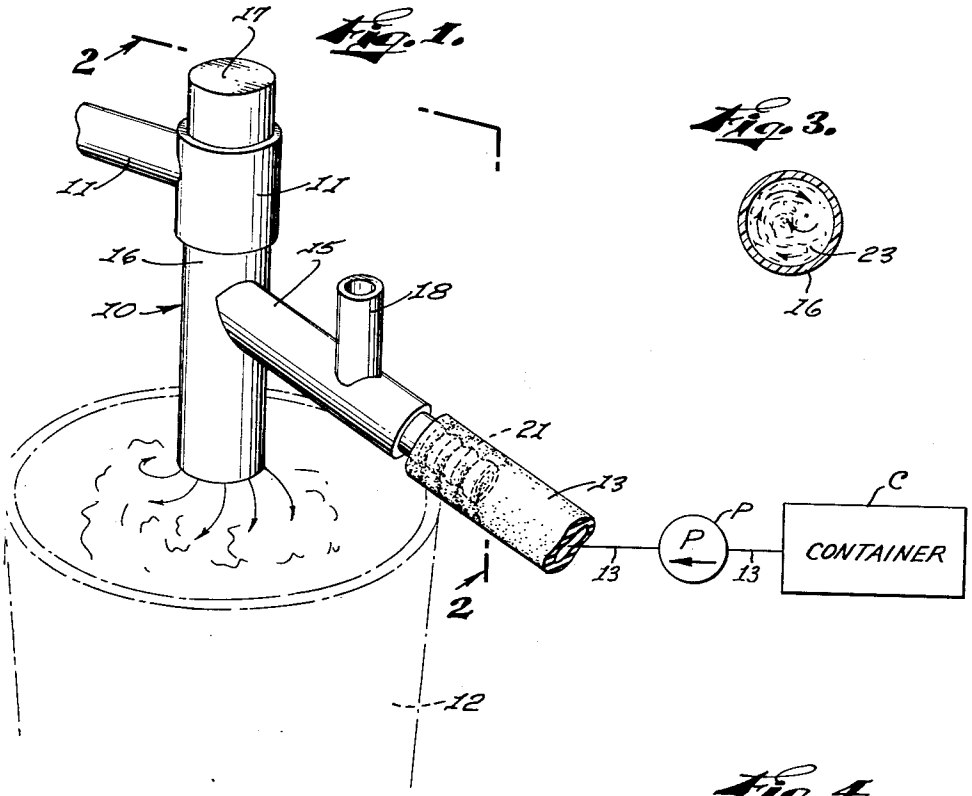


Fig. 3.

Fig. 4.

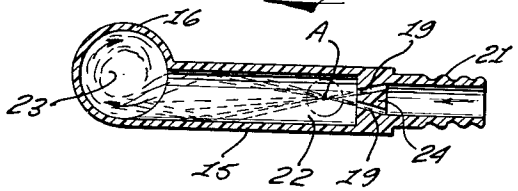
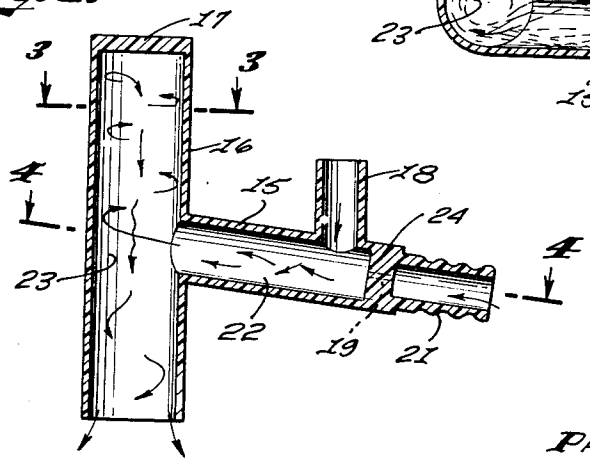


Fig. 2.



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3,003,705
AERATOR

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This invention relates to an aerator or mixing valve adapted to mix air, or other gas, with liquid. The invention is particularly adapted to the aeration of liquids which are more viscous than water, and particularly to liquids (such as milkshake mix) having a viscosity somewhat greater than that of whole milk.

Coin-operated milkshake vending machines and the like are adapted to effect aeration of a milkshake mix, composed of skim milk and various additives normally including chocolate, so that the result simulates a true milkshake composed of ice cream, etc. True milkshakes are beaten or mixed for long periods of time to produce very substantial aeration. Such aeration must be simulated, in a coin-operated milkshake vending machine, in only a few seconds. This is accomplished by forcing the milkshake mix under pressure through an aerator or mixer valve, and discharging the aerated mix into a glass adapted to be removed by the customer.

Previously-known aerators or valves of the type indicated were deficient in one or more of the following, and other respects. In the first place, such valves did not achieve 100% aeration or anything reasonably approaching it, which had the effect of reducing the number of glasses which could be vended from a standard volume (before aeration) of refrigerated mix. Furthermore, such prior-art aerators frequently resulted in splashing or throwing of the mix to undesired areas, causing contamination and gumming of the inside of the machine, the outside of the glass, etc. Other defects of previously-known aerators of the type indicated included relatively low capacity and relatively high production costs.

In view of the above and other factors relative to aerators or mixing valves of the type indicated, it is an object of the present invention to provide an aerator which accomplishes substantially 100% aeration and operates without spilling or throwing of the liquid to undesired areas.

A further object is to provide an aerator which is simple and economical to mass produce and operate, and which has a high capacity.

Another object is to provide an aerator which discharges the aerated liquid into a glass or the like in a whirling or centrifugal manner adapted to prevent splashing.

These and other objects and advantages of the invention will be more fully set forth in the following specification and claims, considered in connection with the attached drawing to which they relate.

In the drawing:

FIGURE 1 is a perspective view illustrating an aerator or mixing valve, constructed in accordance with the present invention, as employed in filling a glass in a milkshake vending machine or the like;

FIGURE 2 is a vertical sectional view taken on line 2—2 of FIGURE 1, and incorporating arrows to illustrate the liquid and air flow directions;

FIGURE 3 is a horizontal section on line 3—3 of FIGURE 2; and

FIGURE 4 is a generally horizontal section taken on line 4—4 of FIGURE 2, and illustrating the impingement of two or more jets or streams of liquid in the first aeration chamber.

Referring to the drawing, the aerator device is indicated generally at **10**, and is illustrated as mounted in a

suitable support **11** above a glass **12** adapted to be filled with aerated liquid such as milkshake mix. Such liquid is pumped into the aerator **10** through a hose **13** from a suitable container C and by means of a pumping and metering device P. A suitable pumping and metering means is described and claimed in my co-pending application Serial No. 740,268, filed June 6, 1958, for a Hose-Type Pump.

The device **10** is illustrated to comprise a first generally horizontal tube **15** which communicates with the mid-portion of a second and larger tube **16**, the latter being vertical and having its lower or discharge end disposed on the axis of glass **12** at about the same elevation as the rim. The upper end of the second tube is illustrated as being closed by means of a wall **17**, but it is to be understood that the center portion of such wall may be provided with a relatively small vent hole (not shown) adapted to equalize the pressure in tube **16**.

An air-intake conduit **18** communicates with the upper side of first tube **15** at a point spaced a substantial distance from the second tube **16**. Such conduit **18** extends upwardly for a distance sufficient to insure that no liquid may spill therethrough, particularly when inflow of liquid from hose **13** is being terminated.

Means are provided to inject liquid from hose **13** into tube **15** in an impinging manner effecting breaking up of the liquid and sucking in of air through conduit **18**. Such means are illustrated to comprise two passages or ports **19** (FIGURES 2 and 4) which converge toward each other in such manner that liquid injected therethrough will meet in the first tube **15** and cause a breaking up of the streams into large numbers of particles. Thus, and referring to FIGURE 4, the streams of liquid forced through passages **19** are shown as meeting at A, in the outer portion of tube **15**. The passages **19** communicate with a hose fitting **21** over which hose **13** is adapted to be mounted, such fitting being coaxial with tube **15**.

It is to be understood that the hose fitting **21** may be formed in two separate pieces adapted to define the passages **19**, and that such pieces may be inserted in the tube **15** and then secured together by a suitable adhesive (not shown). All of the elements are preferably formed of a suitable clear plastic.

The passages or ports **19** lie in a generally horizontal plane which contains the axis of tube **15**. The phrase "generally horizontal" is not intended to mean perfectly horizontal, however, since the tube **15** actually inclines upwardly as the second tube **16** is approached. The illustrated angle of upward incline is approximately 6° from the horizontal, but it is to be understood that such inclination angle may be varied somewhat in accordance with factors including the weight of the liquid, and the length of tube **16**. Tube **15** thus defines an acute angle with the lower part of tube **16**, and an obtuse angle with the upper or closed part thereof, both such angles approaching 90°.

Not only does the tube **15** incline upwardly, but it communicates with the tube **16** in an offset manner, tangentially instead of radially. Referring to FIGURE 4, one inner wall portion of tube **15** is shown as merging with an inner wall portion of tube **16** in a tangential manner. Another inner wall portion of tube **15**, toward the top in FIGURE 4, communicates with tube **16** at about the central portion thereof or generally radially. The inner diameter of tube **16** is illustrated as being somewhat greater than the inner diameter of tube **15**.

Operation

Throughout the description of the operation, the chamber within the first tube **15** will be referred to as the first aeration chamber, and the chamber within the second tube **16** will be referred to as the second aeration chamber. Such aeration chambers have been numbered, re-

spectively, 22 and 23. The communication opening between the first chamber 22 and second chamber 23 is unobstructed, but the outer end of chamber 22 is closed by means of the wall 24 through which the convergent passages or ports 19 are provided. Communication between chamber 22 and the atmosphere is unobstructed and is through the air-intake conduit 18.

Milkshake mix or similar relatively viscous material is pumped through hose 13 and hose fitting 21 at a substantial pressure, such as 20 p.s.i. gage. This causes flow of the liquid at high velocity through the relatively small diameter passages or ports 19, so that streams of liquid are provided which converge at point or area A. The impingement or collision of the streams at A results, as previously indicated, in break up of the liquid into large numbers of drops. Such break up, and the velocity of the liquid traveling through the chamber 22, combine to cause a large amount of air to be drawn in through the air-intake conduit 18, which air becomes mixed with the liquid.

The aerated mixture in chamber 22 flows into the second aeration chamber 23 in an upward and offset manner, preferably tangentially to the chamber 23 as previously stated. Because of the upwardly inclined and offset relationship between chambers 22 and 23, the rapidly moving liquid which enters chamber 23 from chamber 22 flows upwardly around the wall of chamber 23 in a generally helical manner. Gravity and friction have the effect of reducing the rate of such upward flow in the upper portion of chamber 23, above the inlet from chamber 22, until the upward impetus is overcome at or near the wall 17. The liquid then begins to spiral downwardly in chamber 23, and finally spirals out the lower end thereof into the glass 12. Sufficient spiralling or vortical motion remains to prevent splashing of the aerated liquid in the glass.

It is emphasized that as the liquid in chamber 23 spirals downwardly past the inlet from chamber 22, there is collision between the downwardly-spiralling liquid and the liquid entering from chamber 22. This results in additional and substantial breaking up of the particles, and in additional aeration. Aeration therefor occurs not only in chamber 22 but also in chamber 23.

It has been found that milkshake mix aerated with the present device is incapable of additional areation, whether by beating, slugging or any other process known to the invention. It follows that substantially 100% areation is achieved in a very short period of time.

The present aerator or mixing valve device is highly economical to manufacture, and may be mass produced for a few cents. In normal operation, the mixing valve 10 and the hose 13 are thrown away after the associated storage container has been emptied. This eliminates all sanitation problems since the hose 13 and the valve 10 are maintained in sterilized condition prior to loading into the milkshake vending machine.

Various embodiments of the present invention, in addition to what has been illustrated and described in detail, may be employed without departing from the scope of the accompanying claims.

I claim:

1. In an aerator device for feeding aerated liquid downwardly into a receptacle, wall means to define a generally cylindrical chamber adapted to be disposed in generally vertical relationship, said wall means being open at the lower end of said chamber, means to introduce liquid rapidly through an inlet into said chamber in upwardly inclined relationship from the horizontal when said chamber is disposed vertically, and in offset relationship from the axis of said chamber, the inclination and the amount of offset being sufficient that liquid introduced into said chamber spirals upwardly in a generally helical manner therein and then flows downwardly past said inlet thereto and out the lower end thereof into said receptacle, said last-named means comprising a liquid receptacle and liquid pump connected to said inlet, whereby the downflowing liquid in said chamber is bombarded by entering liquid and is thereby aerated prior to discharge into said receptacle.

2. A disposable plastic aerator device for milkshake vending machines and the like, which comprises a first tube adapted to define a first mixing chamber, a second tube adapted to define a second mixing chamber, said second tube being adapted to be mounted in generally vertical relationship and having its upper end substantially closed and its lower end open, said first tube having a smaller diameter than said second tube and communicating generally tangentially with the central portion of said second tube, said first tube being disposed at an obtuse angle relative to the upper closed end portion of said second tube and at an acute angle relative to the lower open end portion of said second tube, an air-inlet conduit disposed generally parallel to said second tube and communicating with the upper part of said first tube at a point remote from said second tube, injector means to inject liquid at high velocity into said first tube through the end of said first tube remote from said second tube, said injector means including means to define at least two convergent ports or passages directed to cause impingement or collision of injected streams in said first mixing chamber whereby break up of the streams occurs prior to introduction of the liquid tangentially into said second tube.

3. The invention as claimed in claim 2, in which said acute angle and said obtuse angle are both relatively close to 90° whereby the fluid introduced into said second tube from said first tube flows generally helically in said second tube in an upward direction toward said closed end thereof and then gravitates downwardly past the outlet end of said first tube and out said open end of said second tube.

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