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O. W. HOLDEN

2,643,104

AERATING DEVICE

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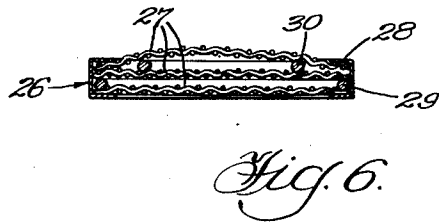
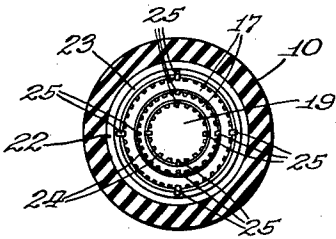
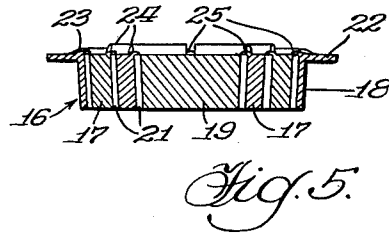
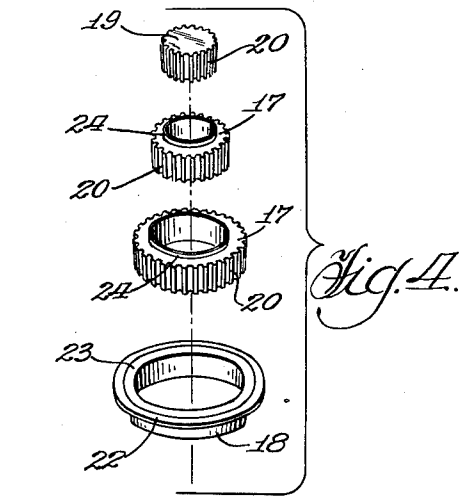
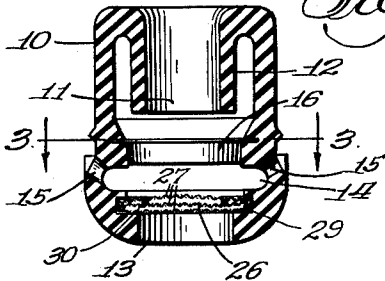
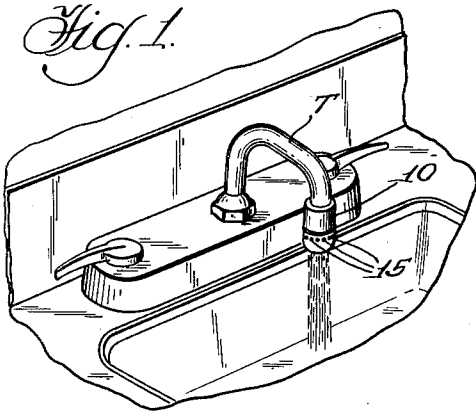


Fig. 3.

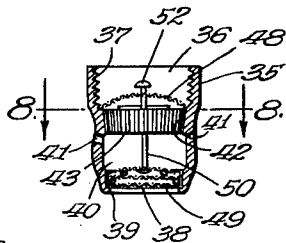


Fig. 7.

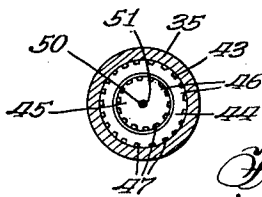


Fig. 8.

INVENTOR.

Orloff W. Holden

BY

Ismael L. Mueller
Atty.

UNITED STATES PATENT OFFICE

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AERATING DEVICE

Orloff W. Holden, Chicago, Ill., assignor to Orloff W. Holden and Margurite H. Holden, doing business as Knickerbocker Rubber Company, Chicago, Ill., a partnership

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4 Claims. (Cl. 261—76)

1

This invention relates to a device for aerating a liquid under pressure, and more particularly to an aerator for use with a water faucet.

Devices of the liquid-aerating type have been used which comprise a casing in which is disposed a perforated plate or diaphragm, with a screen or similar foraminous member spaced from the diaphragm to define a mixing chamber between the diaphragm and screen. Liquid passing through the diaphragm draws air into the mixing chamber through apertures in the casing, with the liquid becoming mixed with the air and then being discharged through the screen in a soft stream. The casing of such units have been made of two separable parts, which may become undesirably loose in use and be separated by the force exerted by the liquid. The number of perforations or openings which may be provided in the diaphragm of a small unit is limited and this limits the amount of water which may be passed through the aerator.

By the present invention, I provide a one-piece casing in which a novel nozzle is employed, and also a novel foraminous member, which greatly increase the effectiveness of the device. The one-piece casing, of course, obviates the possibility of undesired separation of the device in use, and also reduces the cost of the device. A mixing chamber is defined between the nozzle and the foraminous member with the casing including openings through which air is drawn into this chamber. The nozzle comprises a plurality of nested members of frusto-conical form in which serrated edges cooperate with the engaging edges to provide openings extending through the nozzle and converging toward the mixing chamber. By this construction, a large number of openings may be provided in the nozzle and the liquid flowing through the casing is thus broken up into a great number of very fine streams. Moreover, the construction of the nozzle causes these fine streams of the liquid to converge somewhat so as to be concentrated centrally of the foraminous member, and consequently to encounter greater resistance to passage through that member when the liquid first impinges thereon, by what may be called a "jamming" due to said concentration.

The foraminous member employed in the device of this invention comprises a plurality of discs of foraminous or screen material, these discs being in overlying relation to each other and secured together at their edges. Preferably three such discs are employed, although the number may vary from two up. The discs may be spaced from each other by any suitable means,

2

such as rings of wire. The disc closest to the mixing chamber is bulged or convexed inwardly toward the mixing chamber by a ring of smaller diameter than the disc which is disposed between this disc and the adjacent disc. By this construction of the screen or foraminous member, greater obstruction to the outflow of liquid from the casing is provided, thus assuring a thorough mixture of air with the liquid in the mixing chamber. Furthermore, the bulged or crowned innermost disc so deflects the streams of liquid impinging upon it from the nozzle heretofore described that the liquid is well distributed in the mixing chamber to increase the effectiveness of the mixing action.

Two forms of the invention are disclosed, in the first of which the nozzle members are secured together as a unit by very simple means, which take advantage of the particular construction of the members. Briefly, the nozzle members are held by being affixed at the larger faces thereof, with the larger members having portions overlying the members nested within them. In the other form disclosed, the nozzle members are not permanently secured together, so that they may be separated for cleaning when desired, but are held in engagement with each other and with the foraminous member by an elongated element such as a pin or rod secured to the central member of the nozzle and to the foraminous member. Thus, none of the parts can become lost or misplaced upon disassembly of the device for cleaning or inspection thereof.

One object of the present invention is the provision of a liquid aerating device which is simpler, cheaper, and more effective than prior devices of this type.

Another object is the provision of a liquid aerating device including a one-piece casing in which is disposed a nozzle of novel construction.

A further object is to provide a liquid aerating device having a foraminous member therein of novel and improved construction.

Still another object is the provision of a liquid aerating device which includes a nozzle and a foraminous member both of novel construction and having means for securing the same together in limited separable relation.

It is also an object of the invention to provide a device for aerating liquid under pressure in which a novel construction is provided for causing convergence of the liquid in fine streams adjacent the central portion of a foraminous member which is also of novel construction and includes a portion which is convex in the direction

3

of the nozzle to distribute the liquid converging thereon.

Other and further objects, advantages and features of the invention will be apparent to those skilled in the art from the following description, taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view showing one form of the invention secured to a tap, with a liquid stream flowing therefrom;

Fig. 2 is a longitudinal cross-sectional view of the aerating device shown in Fig. 1;

Fig. 3 is a sectional view taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is an exploded view of the nozzle member shown in Figs. 2 and 3;

Fig. 5 is an enlarged vertical sectional view through the assembled nozzle;

Fig. 6 is an enlarged cross-sectional view of the foraminous member shown in Fig. 2;

Fig. 7 is a longitudinal sectional view through another form of the device; and

Fig. 8 is a sectional view taken substantially along the line 8—8 of Fig. 7.

Referring particularly to Figs. 1 to 6 of the drawings, there is shown one embodiment of the invention comprising a one-piece casing 10 which is generally cylindrical in form and has at one end an inlet 11 defined by an inturned portion 12 which may be slipped over the open end of a water faucet or tap to secure the casing 10 thereon. In Fig. 1, the device is shown applied to a tap T. The casing is formed of rubber or similar resilient material, and the inturned portion 12 may be of reduced thickness to increase the flexibility and resilience thereof. At the end of the casing 10 opposite to the inlet 11 is an outlet opening 13, and between the inlet and outlet a mixing chamber 14 is formed in the casing. A plurality of apertures 15 are provided in the casing leading from the mixing chamber 14 to the atmosphere outside of the casing. When liquid under suitable pressure goes through the casing, it causes air to be drawn inwardly through the apertures 15 into the mixing chamber 14. The air and liquid are mixed in the chamber 14 through the operation of parts of the device which are described in detail hereinafter.

Disposed in the casing 10 between the inlet opening 11 and the chamber 14 is a nozzle 16 which is formed by an annular supporting member 18, a plurality of annular members 17, and a central member 19. In the present instance, two annular members 17 are illustrated, although the number may vary depending on the size of the device and the application for which it is used. The annular members 17 are of similar construction but of different size, the inner diameter of one being substantially equal to the outer diameter of another so that one may nest within the other. The member 18 has its inner diameter equal to the outer diameter of the largest of the members 17. The outer peripheral surfaces of the members 17 and 19 are provided with serrations 20, and the inner peripheral surfaces of the members 17 and 18 are smooth and, of course, tapered to correspond to the taper of the outer surfaces of the members nested therein. The manner in which the members 17, 18 and 19 are assembled is illustrated in Figs. 3, 4 and 5. When so assembled, the serrations 20 on the outer surfaces of the members 17 and 19 define nozzle openings 21 with the smooth surfaces of the members in which they are nested.

4

The nozzle 16 is so disposed in the casing that the larger faces of the members are adjacent the inlet opening 11 and the smaller faces are directed toward the outlet opening 13, and consequently the nozzle openings 21 converge in the direction of the outlet. The supporting member 18 is provided with a peripheral flange 22 which is inserted in a groove in the casing wall. The wall may be thickened at this point, if desired, so that the casing is not weakened too much by the groove.

The nozzle members 17, 18 and 19 are secured in assembled relation by very simple yet altogether effective means. On its larger face, the supporting member 18 is provided with a projection 23 extending adjacent the inner periphery, and similar annular flanges or projections 24 are provided on each of the members 17 adjacent the inner margins thereof and on the larger faces thereof. At a plurality of points, the projections 23 and 24 are staked over against the larger face of the respective members nested within the members having the projections, as indicated at 25 in Figs. 3 and 5. In other words, the larger member 17 is held against removal from the supporting member 18 by the portion 25 of the projection 23 which extends over its outer marginal portion, the smaller annular member 17 is similarly held by the portion 25 of the projection 24 of the larger portion member 17, and the central portion 19 is held secured in the smaller annular member 17 by the portions 25 of the projection 24 of the smaller member. The nozzle members are thus held against separation by movement in the direction toward the larger faces thereof by the staked over portions 25, and against separation by movement in the direction of the smaller faces by reason of the tapered construction. It is not necessary to the invention that the projections 23 and 24 extend entirely about the members on which they are formed, as the members need be secured at only a few points.

Between the mixing chamber 14 and the outlet opening 13, there is disposed a foraminous member 26 which extends entirely across the outlet 13. The member 26 comprises a plurality of discs 27 of metal screen or other suitable foraminous material, which overlie each other and have their edges secured together by any suitable means, such as the annular channel member 28. The channel member 28 may extend into a suitable annular recess in the casing 10 to secure the member 26 in position. In the present instance, three discs 27 are disclosed, although a different number may be used if desired. The outermost and middle discs are spaced apart by a ring 29 of wire or similar material which has a diameter substantially equal to that of the discs, and thus extends along the peripheral portions thereof. The innermost and the middle discs are also spaced apart by a ring 30 which may also be of wire or similar material. The ring 30 has a diameter smaller than the diameter of the discs with the result that the innermost disc 27 is bulged or convexed in the direction of the nozzle 16. The construction and arrangement of the foraminous member 26 will be clear from Figs. 2 and 6.

The foraminous member 26 has several important advantages over prior screening or foraminous members employed in liquid aerating devices. First of all, the provision of several foraminous discs provides greater obstruction to the flow of liquid through the casing, and thus

5

aids in obtaining a higher proportion of air mixed with the liquid. The spacing between the discs also provides chambers in which the liquid already mixed with air in the mixing chamber is further mixed with air before passing out of the opening 13. The convexity of the innermost disc 27 in the direction of the nozzle 16 causes the stream of the liquid passing through the nozzle 16 and directed by the nozzle openings 21 toward the center portion of the foraminous member 26, to be deflected radially outwardly and upwardly so as to be dispersed substantially throughout the mixing chamber 14, so that the mixing of the liquid with air is facilitated and enhanced.

The construction of the nozzle 16 is advantageous, apart from the simplicity of its formation and securement of its members as already pointed out, in that a greater number of openings 21 may be provided in a given area than is possible, at least as a practical matter with a perforated plate or diaphragm. Furthermore, the greatly increased thickness of the nozzle as compared to a plate or diaphragm permits the nozzle openings to have sufficient length to impart a desired direction to the stream passing through the opening. The streams of liquid passing through the nozzle may thus be concentrated on the foraminous member 26, as described above. The fact that a large number of small openings may be provided in the nozzle permits the liquid to be broken into a correspondingly large number of similarly fine streams, and it will be obvious that such a breaking up of the liquid greatly facilitates a mixture of air therewith in the mixing chamber.

In Figs. 7 and 8 there is illustrated another embodiment of the invention in which a one-piece casing 35 of metal or similarly rigid material is provided having at one end an inlet opening 36 which may be internally threaded at 37 for connection of the device on a threaded faucet or the like. At the opposite end of the casing an outlet opening 38 is provided which may be defined by an inturned lip or flange 39 of the casing. Between the inlet opening 36 and outlet opening 38 a mixing chamber 40 is provided which is open to the atmosphere through a plurality of suitable passages or apertures 41.

Between the inlet opening 36 and chamber 40, the interior surface of the casing 35 is formed to provide a tapered seat 42 having its smaller end adjacent the chamber 40. A nozzle 43 is provided which is essentially similar to the nozzle 16 of the first described form of the invention, but is different in certain respects which will now be set forth. An annular member 44 serrated on its outer periphery and tapered to correspond to the tapered seat 42 is disposed in nested relation in the seat, and a central frusto-conical member 45 similar to the member 19 of Figs. 1-6 is nested in the member 44. Serrations 46 are provided on the periphery of the member 45 and on the outer periphery of the member 44, substantially similar to the serrations 20 of the first form of the invention, and providing nozzle openings 47 in substantially the same manner.

A screen member 48 may be provided extending over the larger side of the nozzle 43 to strain out foreign matter which may be contained in the liquid entering the casing 35. At the outlet opening 38 and retained in place by the lip 39 is a foraminous member 49 which is substantially identical to the foraminous member 26

6

already described, and is therefore not further explained.

A pin or similar member 50 is provided for securing the screen 48, the central member 45 of the nozzle, and the foraminous member 49 together. The members 44 and 45 of the nozzle 43 are not secured in fixed relation but are held against complete separation by the pin 50. The member 44 cannot slide past the member 45 because of the tapered engaging surfaces thereof and it cannot slide past the foraminous member 49 because the opening in the member 44 is not large enough to clear the member 49. The diameter of the member 49 is slightly smaller than the diameter of the smaller end of the seat 42, so that it may be removed from the casing 35 through the inlet opening 36, with the entire assembly within the casing 35 being therefore removable by means of the pin 50, when the device is removed from the tap on which it has been connected. The nozzle and the foraminous members 48 and 49 may thus readily be cleaned, the cleaning of the nozzle 43 being especially facilitated by reason of the separability of the parts 44 and 45. At the same time, while the parts may be sufficiently separated for proper inspection or cleaning, they remain connected together by the pin 50, and no part can become lost or be improperly assembled on replacement of the product.

The aerating devices, in accordance with the invention, are of simple construction and are very effective in operation. The provision of a one-piece casing provides an inexpensive unit and also prevents undesired separation of the parts of the device. The improved nozzle construction provides a large number of small streams of liquid to provide highly effective aeration. This operation is also improved by the novel screen construction. The embodiment of the invention illustrated in Figs. 7 and 8, which is adapted for use as a permanent part of a faucet or the like, has the advantage that it may be easily disassembled for cleaning and yet the parts thereof are prevented from complete separation so that reassembly thereof is facilitated.

Although certain embodiments of the invention which are illustrative thereof have been described, it is apparent that various changes and modifications can be made without departing from the intended scope of the invention as defined in the appended claims.

I claim:

1. A device for aerating a liquid under pressure, comprising a one-piece cylindrical casing of resilient material having inlet and outlet portions, said inlet portion being adapted to be supported on the end of a faucet through which liquid may flow, a nozzle in said casing including a plurality of annular members of graduated size having conical surfaces and a central frusto-conical member, said annular members being nested one within the other with said central member being nested in the innermost of said annular members, one of the surfaces of each pair of engaging surfaces of said nested members being serrated to define with the other surface of said pair a plurality of nozzle openings extending through said nozzle and converging in the direction of said outlet portion, projections on the larger side of each of said annular members adjacent its inner periphery extending over the member nested therein to hold said members unitarily assembled, and a foraminous member adjacent the casing outlet including a plurality

of superposed foraminous discs secured at their edges and separating means between adjacent discs, the separating means between the discs nearest said nozzle and its adjacent disc being a ring of appreciably smaller diameter than said discs to impart a convex conformation to said nozzle and said foraminous member defining a liquid-and-air mixing chamber within said casing, said casing having apertures therein providing entry of air into said mixing chamber, said foraminous member obstructing passage of liquid through said outlet to cause agitation thereof in said mixing chamber and mixing and entrainment of air with the liquid, and said convex disc distributing the converging liquid stream produced by said nozzle.

2. A device for aerating a liquid under pressure, comprising a one-piece cylindrical casing of resilient material having an inlet portion for connection to a source of liquid and an outlet portion for discharging the liquid, said inlet portion being adapted to be supported on the end of a faucet through which liquid may flow, a nozzle in said casing including a plurality of nested members of graduated size having conical engaging surfaces, one of the surfaces of each pair of engaging surfaces of said nested members being serrated to define with the other surface of said pair a plurality of nozzle openings, projections on the larger side of said members extending over the member nested therein to hold said members unitarily assembled, a foraminous member adjacent the casing outlet including a plurality of superposed circular screens secured at their edges and separating means between adjacent screens, the separating means between the screen nearest said nozzle and the screen adjacent thereto being of appreciably smaller diameter than said screens to impart a convex conformation to said nearest screen in the direction of said nozzle, said nozzle and said foraminous member defining a liquid-and-air mixing chamber within said casing, said casing having apertures therein providing entry of air into said mixing chamber, said foraminous member obstructing passage of liquid through said outlet to cause agitation thereof and mixing and entrainment of air with the liquid, and said convex screen distributing the converging liquid stream produced by said nozzle.

3. A liquid aerating device including in com-

ination, a one-piece cylindrical casing having an inlet and an outlet, nozzle means in said casing adjacent said inlet, and foraminous means in said casing adjacent said outlet, said nozzle means and said foraminous means defining a liquid-and-air mixing chamber within said casing, said nozzle means including a plurality of nested frusto-conical annular members with serrations on the periphery thereof forming nozzles for providing streams of liquid in said mixing chamber, said frusto-conical annular members having the smaller ends thereof positioned toward said outlet so that said streams converge toward the center of said foraminous means, said cylindrical casing having openings in the wall thereof positioned between said nozzle means and said foraminous means through which air is drawn into said mixing chamber, said foraminous means including a plurality of discs of foraminous material disposed in overlying relation, means for spacing said discs, and means for securing said discs together at their edges, said spacing means holding said innermost disc in a convex shape in the direction toward said nozzle for distributing liquid projected through said nozzle means against said foraminous means whereby agitation is produced in said mixing chamber and air is mixed with the liquid.

4. A liquid aerating device in accordance with claim 3 including means connected to said nozzle means and to said foraminous means for limiting the separation of said members of said nozzle means and said foraminous means.

ORLOFF W. HOLDEN.

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