United States Patent

[11] 3,633,824

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[54] **SPRAY-PRODUCING DEVICE IN WHICH THE OUTPUT JETS ARE AERATED**
24 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **239/428.5,** 239/553.3, 239/590.3, 239/590.5
[51] **Int. Cl.** **E03c 1/084**
[50] **Field of Search** 239/428.5, 552, 590, 590.3, 590.5, 553.3, 553.5

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ABSTRACT: A shower head or other device producing a spray in which there are a plurality of high velocity individual jets that at no time overlap each other and which pass through a screen or screens. The screens are so related to the velocity and size of the jets that the jets essentially retain their direction. The jets do not, when they pass through the screens, enlarge to the extent that they touch each other and they do not otherwise coalesce. The output jets form a showerlike discharge of a novel character, each jet being laden with bubbles due to the aerating action resulting from passing through the screens in the presence of air.

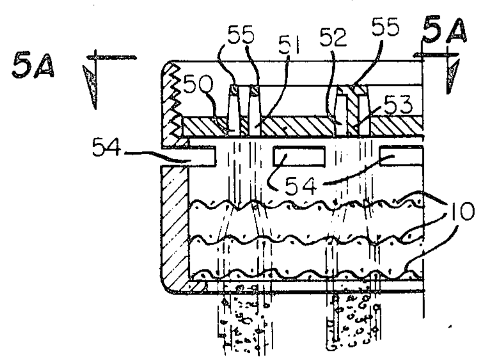


FIG. 1.

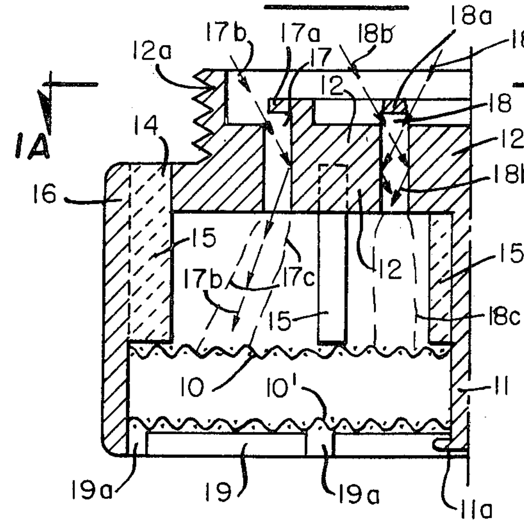


FIG. 1A.

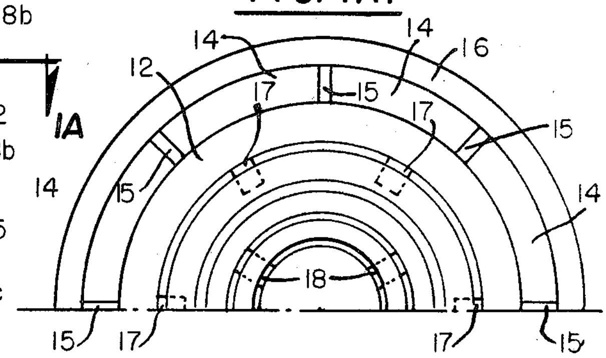


FIG. 2A.

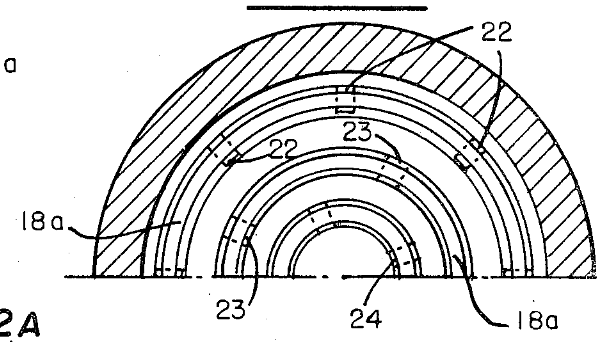


FIG. 2.

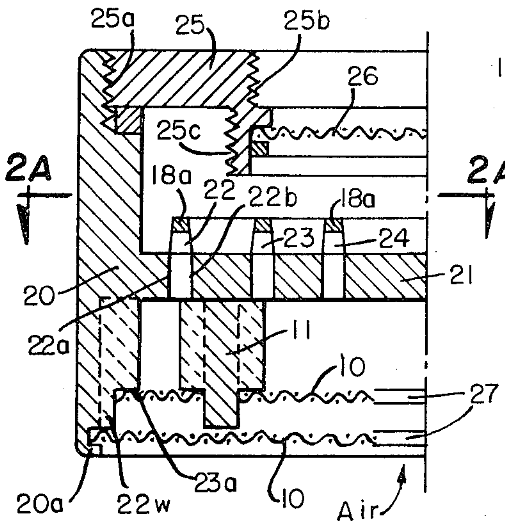
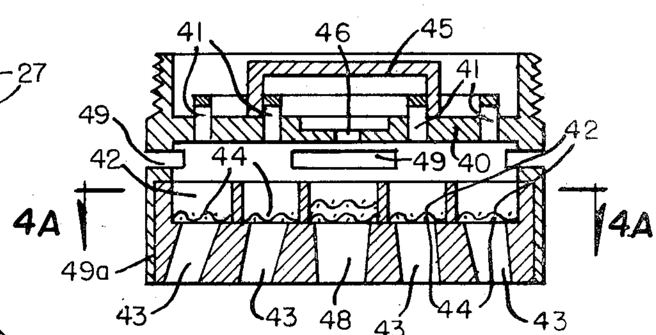


FIG. 4.



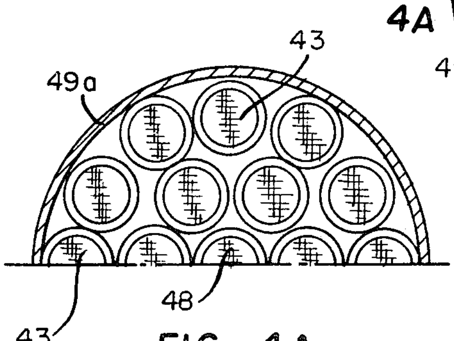


FIG. 4A.

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FIG. 3.

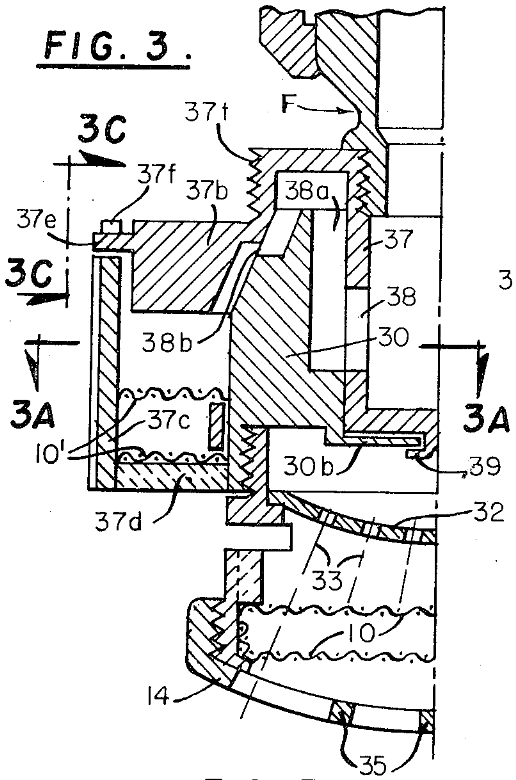


FIG. 3A.

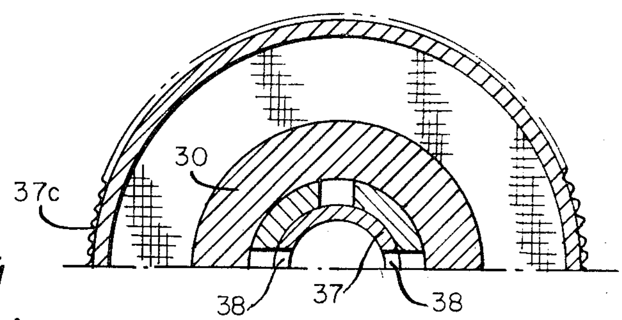


FIG. 3B.

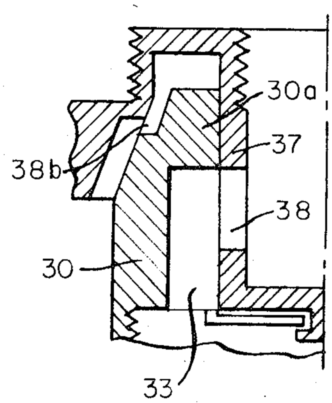


FIG. 3C.

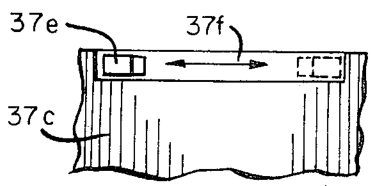


FIG. 5A.

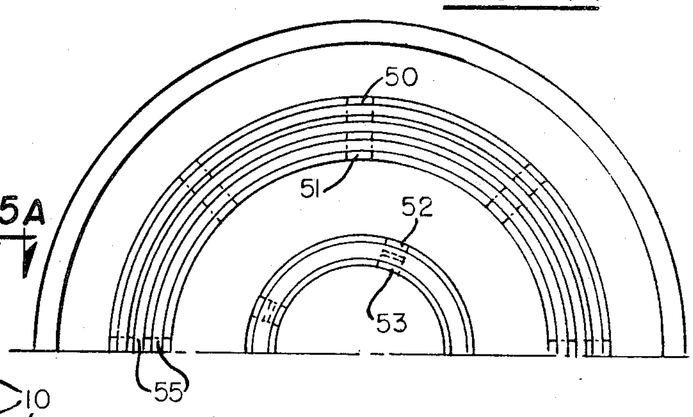
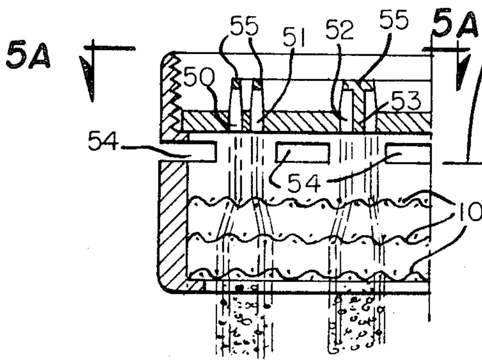


FIG. 5.



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SPRAY-PRODUCING DEVICE IN WHICH THE OUTPUT JETS ARE AERATED

BACKGROUND OF THE INVENTION

Over 30 years ago an aerator was adapted to the household faucet which consisted of one or more jets directing water upon a screen or plate so that the water was aerated. Since that time efforts have been made to adapt the basic faucet aerator principle to a shower head but this has consistently met with failure. One such attempt was my prior U.S. Pat. No. 2,962,224 of Nov. 29, 1960, entitled "Aerating Devices For Producing Streams of Large Cross section." In this device the main object of the invention was to produce separate and individual streamlets which were coalesced at the output of the device, and therefore it was provided, during the passage of the streamlets through the screens, that the jets of water fanned out so as essentially to fill a large outlet area with a solid stream of aerated water. Such a device basically failed to replace the conventional shower head as most of the water energy was utilized to provide the maximum possible amount of foam and as the bubbles were quickly dissipated from the lifeless slow-moving stream after it left the outlet of the device, so that the stream gradually decreased its diameter immediately upon discharge from the outlet, thereby resulting in a single small solid stream of unaerated water. Other attempts, to provide a shower head whose output is aerated, have produced little more than one or more lazy output streams. The characteristics of these output streams being entirely dissimilar from the conventional spray produced by a conventional shower head, the result was not satisfactory from the commercial standpoint.

BRIEF SUMMARY OF THE INVENTION

The invention resides in providing a means for producing a multiplicity of individual spaced jets of water directed upon one or more screens of such wire size and mesh that the jets essentially retain their direction and emerge at high velocity without in any way coalescing or merging together; thereby forming a spray each jet of which is a bubbly stream.

IN THE DRAWINGS

FIG. 1 is a cross-sectional view of one form of the invention.

FIG. 1A is a cross-sectional view of FIG. 1 taken along line 1A—1A.

FIG. 2 is a cross-sectional view of another form of the invention.

FIG. 2A is a cross-sectional view taken along line 2A—2A of FIG. 2.

FIG. 3 is a cross-sectional view of another form of the invention.

FIG. 3A is a cross-sectional view, of a connector which may be utilized with the device of FIG. 3, and is taken along line 3A—3A of FIG. 3.

FIG. 3B is a cross-sectional view of the connector of FIG. 3 in which certain parts constituting a valve have been shifted to an alternate position from that shown in FIG. 3.

FIG. 3C is a detailed view of one feature of the invention taken along line 3C—3C of FIG. 3.

FIG. 4 is a cross-sectional view of another form of the invention.

FIG. 4A is a cross-sectional view taken along line 4A—4A of FIG. 4.

In connection with all of the forms of the invention set forth hereinbelow, it is to be understood that there is an upstream jet-forming diaphragm which produces a multiplicity of individual jets of high velocity. These jets are preferably (though not necessarily) arranged to diverge, and as they pass out the bottom end of the shower head, they strike screens composed of sufficiently small wire and proper mesh so that the jets essentially retain their direction and high speed, although air bubbles have been added thereto. The result is a multiplicity of diverging jets which at no time overlap or in any way coalesce. The resulting spray has the basic characteristic of a conventional shower head to the extent that there are a multiplicity of high-velocity jets, but there is the remarkable difference that these individual jets are, for a limited distance from the shower head, in the form of bubbly streams.

Since shower heads are used under a wide range of water pressures, as well as with different size of pipes for feeding the same, a few examples will now be given to show how to build a suitable aerator adapted to function as a shower head.

A device having nine holes, aggregating 12 sq. mm., in the upstream diaphragm, and a total screen area of 615 sq. mm., produced nine lively foamy streams. When the holes are of square cross section, this would provide an overall periphery of holes in the diaphragm of 41 mm., or a screen area per hole of about 68 sq. mm. The screen area divided by the periphery of the holes is 15.

Another typical example is a device having 20 square holes in the upstream disk, and having an aggregate area of 26 sq. mm. The overall aggregate periphery of the holes is 91 mm. The screen area in this case would be 1,133 sq. mm. The screen area divided by the area of the holes is therefore 45, and the screen area per hole is 58 mm.^{2}. The screen area divided by the periphery of the holes is 12.5.

A third example is a device having 38 square holes in the upstream disk, with an aggregate area of 38 sq. mm. The overall periphery of the holes is 152 mm. and the screen area divided by the number of holes 38 mm.^{2}. The screen area would therefore be 1,452 sq. mm. The screen area per hole is 38 sq. mm., and the screen area divided by the periphery of the holes is 9.5.

These three devices created back pressures of 60 lbs., 20 lbs., and 12 lbs. respectively on a faucet where standard faucet aerators of a different make produced back pressures varying between 40 and 14 lbs.

To be certain of satisfactory operation, the screen area should be at least the square of the aggregate cross section of the divergent jets passing through the same, assuming that there is a single continuous screen which intercepts the jets and assuming also that the orifices producing said jets have a cross section exceeding 1 mm. diameter. Indeed, division of the overall opening in the diaphragm into too many orifices leaves smaller screen area per orifice, and, moreover, decreases the velocity of the issuing bubbly streams, even though the rate of flow remained about the same.

The devices herein described are designed and adapted to operate on ordinary domestic water supplies. The pressure in a house may vary from 14 to 90 pounds per square inch and the shower heads herein described may be built to work within that range.

The screens used in the shower heads described herein may vary depending on the number used in tandem, but if two parallel screens are used, the wire diameter is preferably less than 1 millimeter in diameter and the openings in the screens are, of course, smaller than the jets of water impinging on the screens. For example there are preferably more than 12 wires per inch.

The jet-forming means used may be of the type disclosed in my U.S. Pat. No. 2,998,929 for "Water Aerators," issued Sept. 5, 1961, for delivering jets of brokenup water which require fewer screens. Alternatively (although with less efficiency), the jet-forming means may be simple perforated disks as shown in my U.S. Pat. No. 2,316,832 entitled "Fluid Mixing Device," issued Apr. 20, 1943, or they may be mere perforate disks in conjunction with greater screen resistance.

The term "spray" as used herein refers to a multiplicity of jets proceeding in the same general direction and having spaces between jets which are large as compared to the transverse dimensions of the jets. The jets of the spray may diverge, especially if they emanate from a small source, and they may be parallel or even converge to a limited degree if they emanate from a large source.

In determining whether the spaces between jets are large as compared to the transverse dimensions of the jets, I make the measurements at 1 foot from the outlet end of the shower head except when the jets gradually converge when my measurements are made adjacent the outlet of the device. This is for the reason that if I measure directly at the outlet of the shower head the result would be misleading in the case of a small shower head producing its spray in the form of diverging jets.

In the appended claims, whenever reference is made to jets or streams of water that has emerged from the mixing means (such as screen means) or which has passed through the screen means which are spaced apart or are spaced widely apart, such spacing shall be determined as provided for in the immediately preceding paragraph.

There are a number of preferred parameters that may be employed in an embodiment of the invention. There are preferably between nine and 38 orifices in the jet-forming means having an aggregate cross-sectional area of between 12 and 38 sq. mm. The aggregate screen area should exceed 12 mm. per orifice in the jet-forming means. Stated another way, the ratio of the aggregate screen area to the aggregate orifice area exceeds 15, and in still another way, the aggregate screen area is greater than 4 times the aggregate periphery of the orifices.

In stating the screen area, it is understood that I refer to the area of only the downstream screen where there are two or more screens in parallel. Moreover, since the water impinges on only a multiplicity of limited portions of the screen, it is possible, at added expense, to adopt either of the following equivalent arrangements, (1) eliminate portions of the screen interposed between the jets, or (2), alternatively, to include some solid material in place of the screen intermediate between the areas contacted by the jets. Therefore, in the above specifications, I have assumed a continuous screen which intercepts all of the jets.

In FIG. 1, the aerator includes a pair of superposed screens **10** and **10'** carried by inturned lips **19** which are at the lower end of the main casing **16**. A main perforated upstream disk or diaphragm **12** has threads **12***a* to permit the same to be screwed onto a faucet. The upstream disk or diaphragm **12** includes chambers **17** and **18** which respectively have covers or roofs **17***a* and **18***a* for the purposes set forth in and as more fully disclosed in my prior U.S. Pat. No. 2,998,929 for "Water Aerators," issued Sept. 5, 1961. Air may enter through openings **14** between webs **15**, and thus pass into the mixing chamber which is located between the downstream ends of chambers **17–18** and screen **10**. The upstream disk or diaphragm **12** contains an outer circular row of six chambers **17**, and an inner circular row of three chambers **18**. The chambers **17** and **18** are widely separated from each other for reasons that will hereinafter appear. The chamber **17**, by virtue of the roof **17***a*, receives water from the faucet only through the outer upper part of the chamber; in other words, generally along path **17***b*, whereas chamber **18** receives water from two sides along two paths **18***b*. Below the chambers **17** and **18** the water fans out as shown at **17***c* and **18***c*. The aerator has an outer casing wall **16** which is connected to the upstream disk or diaphragm **12** by the webs **15** so that the aerator is molded in one piece. This is made possible because there are inturned lips **19** holding the loose screen **10'**. A single centrally located pin **11** extends through holes in the centers of screen **10** and **10'** and has an enlargement **11***a* below screen **10'** to hold the latter more securely in place. To facilitate molding the aerator (except for the screens), in one piece, there are indents or voids **19***a* in the inturned lip **19** which indents are aligned with the webs or ribs **15**. The outer diameter of the upper screen **10** is slightly larger than the inside diameter of casing **16** and its inner diameter is slightly smaller than the inner diameter of pin **11** so that it is press-fitted in place to do away with the need for spacer rings or other supporting device. This permits easy cleaning of the screen from below by means of a brush when the loose screen **10'** is pushed against screen **10**.

In one specific embodiment of the invention, the center-to-center diameters of said chambers were 18 mm. in the outer row and 8 mm. in the inner row. Six chambers were provided in the outer row and three in the inner, located in respect to each other as shown in FIG. **1A**. The screens used had an effective diameter of approximately 32 mm. and were 40×40 wires of 0.0085-inch wire diameter located 5 to 6 mm. from the discharge end of chambers **17** and **18**. The cross section of the chambers **17** and **18** were 1.14×1.14 mm., and the apertures were 1.14 mm. wide and 0.95 mm. high. As water entering only through the single paths **17***b* produce divergent jets, the six outer foamy streams produced were divergent as shown by **17***b* and clearly moved away from each other. The approximate diameter of each of the foamy streams at the discharge end of the aerator was 4 to 6 mm., but varied according to the number of screens used and on the water pressure. When the aforesaid nine foamy streams are parallel instead of being divergent, it may be necessary to further space apart the chambers **17** and **18** and accordingly extend the screen area to prevent the foamy streams from joining each other. While the device operates well with two screens as shown, it may be advisable to use three screens inasmuch as the rate of water flow is small and the jet velocity is high. With three screens, the space between the chambers should be greater to prevent overlapping of bubbly streams discharged, inasmuch as jets from chambers **17** and **18** traversing three screens instead of two produce bubbly streams of larger diameters.

In FIG. **2**, the aerator embodies upper and lower screens **10** to perform the same function as the screens **10** and **10'** of FIG. **1**. These screens are supported by casing **20** which is integral with the upstream disk or diaphragm **21**. This diaphragm has three annular rows of chambers **22, 23** and **24**, terminating at their upstream ends in roofs or bridges **18***a* which perform the function of the roofs or bridges **18***a* of FIG. **1**. The center-to-center distances of chambers **22** in one form of the invention were 29 mm. and between chambers **23**, those distances were 21 mm. Between chambers **24**, those distances were 13 mm. The diameter of the screen area was about 40 mm. The outer annular row of chambers **22** comprises eight chambers, the middle annular row of chambers **23** comprises four chambers, and there are four chambers **24** in the inner annular row. Hence the aerator produced 16 foamy streams with no more water than was needed by a conventional aerator but with a visibly far greater amount of bubbles for the same splashlessness and/or softness to the touch.

The aerator of FIG. **2** includes a number of ribs or webs **22***w* which have a seat **23***a* against which the upper screen **10** is inserted with a press-fit, as was more fully described in connection with FIG. **1**. The upper screen **10** has perforations through which the pins **11** pass, these pins being integral with the upstream disk or diaphragm **21**. The lower one of the two screens **10** is carried by inturned lip **20***a* in the bottom of casing **20** and is held in place against upstream pressure (such as if one inserts his finger in the bottom of the aerator) by the pins **11**. The jets emanating from the three rows of chambers **22, 23** and **24**, may be caused to diverge by inclining the jets **22** at an angle to the vertical of 6°. This may be done, for instance, by dishing the plastic diaphragm **21** so that chambers **22, 23** and **24** be inclined about 6°. This may also be done, even if the diaphragm is not dished, by inclining the sidewalls of chambers **22, 23** and **24**.

When the walls of a chamber are inclined, it is thus possible to incline, for example, both walls **22***a* and **22***b*, or mold diaphragm **21** with the wall **22***a* alone inclined. When both of these walls were inclined to direct the jet downwardly and outwardly at an angle of about 6° to the vertical, with a cross section of 1.14×1.14 mm., the device produced very highly aerated divergent foamy streams. In such a device the distance between the bridges **18***a* and the top surface of disk **21** was 0.80 mm. The opening into the chambers would in that case be 0.80 mm. on each side. Alternatively, in the device of FIG. **2**, the bridge or roof **18***a* may be replaced by a roof of the type shown at **17***a* in FIG. **1**, to produce divergent foamy streams. In such case, good results are obtained when the chambers **22** have a cross section of 1.25×1.25 mm. and the opening between the roof and the top of the upstream diaphragm **21** is 1 mm. high and 1.25 mm. wide.

The main aerator casing **20** may be connected to a faucet by means of connector **25** having threads **25*a*** to mate with those on casing **20** and threads **25*b*** to mate with those on the faucet. The connector carries a preliminary screen **26** that prevents any foreign bodies being carried into the aerator by the water. With the connector **25** inserted in the aerator **20**, as shown in FIG. **2**, the threads **25*b*** mate with those of a faucet having male (external) threads. However, if the connector **25** is inverted from the position shown and threads **25*a*** are screwed into the casing **20**, the threads **25*c*** are exposed and project above the top of the aerator casing so as to mate with those of a faucet having female (internal) threads.

There are central openings **27** in the screens **10** for admission of air to the mixing chamber which is, of course, immediately above the upper one of screens **10**. In the absence of openings **27**, the unflooded parts of the screen serve as air passageways.

In FIG. **3**, a main diaphragm **32** is adapted to deliver divergent jets **33** on a wide-screen area **10** so as to effect a far greater aeration than would be obtained with a conventional aerator. When the aerator is small, perforate member **14** may be added to make certain the aerated water is divided into separate foamy streams, for the purpose of producing a shower or spray of foamy streams. The aerator of FIG. **3** may be screwed either directly onto a faucet or onto the connector **30** shown in FIGS. **3** and **3B**. This connector may be operated to alternatively produce a bubblefree conventional shower or a spray of foamy streams. To attain this dual purpose, the connector consists of a tubular member **37** provided with two openings **38**, one opposite the other. Said member **37** is surrounded by a rotatable member **37*c***, which cooperates with member **37*b***, and has grooves **38*a***. Hence, water may be led either to the diaphragm **32** of the aerator or to the opening **38*b*** by rotating member **37*c***. In the former case, water is directed upon the screens **10** and in the latter case in the absence of screens **10′**. Any water that passes through the orifice **38*b*** and strikes screens **10′** flows out the opening below those screens, producing a spray of foamy streams.

Webs or ribs **37*d*** connect knurled member **37*c*** to the main supporting member **30**. Moreover, as shown in FIG. **3C**, the knurled member **37*c*** has a slot or indent **37*f*** in which the lever **37*e*** may move so that the aerator may be selectively controlled to give either the spray of foamy or foamless streams (through orifice **38*b***), or aerated water through orifice **33** and screens **10**.

When the lever **37*e*** is at one end of its range of adjustment, the passageway **38*a*** is closed, as shown in FIG. **3B**, it being noted that a valve part **30*a*** (FIG. **3B**) which is integral with part **30** is now interposed between the water inlet **38** and the orifice **38*b***. In such case, the only path for water flow from the faucet is through the orifice **33**, and screens **10**. If the lever **37*e*** is thrown to its other extreme position, the water may take the alternate path from opening **38**, **38*a***, **38*b***, to the screens **10′**, as shown in FIG. **3**.

The member **37** has an outwardly turned lip **39** which supports a disk portion **30*b*** of the member **30** to thus support the latter and hold it within the aerator. Disk portion **30*b*** has suitable openings so as not to interfere with water traversing opening **33** (see FIG. **3B**).

Instead of connecting the member **37** directly to a faucet, it may be connected to a swivel coupling which in turn may be connected to a faucet, and the reference number F is intended to refer either to the faucet or the swivel connecting device as the case may be. Threads **37*t*** permit the attachment of the device to a corresponding female threaded water spout.

In FIG. **4**, the diaphragm **40** includes a series of chambers **41** similar to the chambers **18–18*a*** of FIG. **1**, and water from these chambers impinges upon the screens **44**. Each chamber **41** discharges its stream into a funnel **42** which has a restricted outlet **43**, each screen resting upon the ledge at the top of its restricted outlet **43**.

There is a cover in the form of an inverted cup **45** which covers several of the orifices of chambers **41**. This cover is used in houses where the water pressure is on the low side of the acceptable pressure range and restricts the flow of water to the outer ring of orifices or chambers, thus providing the desired high velocity notwithstanding the low operating pressure.

In houses where the water pressure is high, the inverted cup **45** is removed so that water flows through all of the orifices of chambers **41** as well as through the central opening **46**, through two screens, and then through outlet funnel **48**. Air enters slots **49** in the sidewall of the aerator body **49*a***.

In FIG. **15**, the orifices **50** and **51** form one set of chambers while the orifices **52** and **53** form another set of chambers. In this case each set of orifices discharges through the superposed screens **10** in spaced relation to the other set of orifices so that there is no overlapping of the streams of one of said sets with that of another set. Air enters the side slots **54**. Two or three closely adjacent orifices such as **50** and **51**, having 1 $mm.^2$ cross section each, preferably embodied with bridges **55** of a cross section 0.75×0.75 mm., produced also good foamy streams separate from each other. Each individual orifice may have its own bridge **55** or a set of orifices may have a common bridge; both arrangements being illustrated in the drawing.

If the jets are produced by simple orifices in a diaphragm (as, for example, as shown in my prior U.S. Pat. No. 2,316,832, Apr. 20, 1943, "Fluid Mixing Device,") each orifice will produce one jet which will in turn produce one foamy stream at the output, whether or not such orifice has a bridge **55**. Two or more closely adjacent simple orifices, either with or without bridges **55**, may be employed to produce each output foamy stream.

I claim to have invented:

1. A device for producing a spray comprising screen means for finely breaking up and adding air bubbles to jets of water impinging thereon transverse to the surface thereof; and jet-forming means for producing a multiplicity of spaced jets of water directed transversely to the surface of the screen means and whose parameters are so related to the wire size and mesh of the screen means that the jets pass through the screen means in essentially straight lines and emerge in the form of a spray which is made up of a multiplicity of individual coherent streams laden with air bubbles and spaced apart widely as compared to their transverse dimensions.

2. A device for producing a spray in which the jets thereof are aerated comprising means for producing a spray made up of a multiplicity of jets each of which is a coherent stream of aerated water and spaced from the other jets widely as compared to the transverse dimensions of the jets, said means comprising a diaphragm producing a multiplicity of jets and screen means having a screen surface transverse to the direction of the jets and so related and proportioned to the jets that the jets pass through the screen means in substantially straight lines and separately emerge laden with bubbles, said first-named means and said second-named means being so related that the spray upon dissipating its bubbles after leaving the second-named means assumes the form of a conventional spray.

3. A device as defined in claim **1** in which there are between nine and 38, both inclusive, jets producing openings in the jet-forming means having an aggregate cross-sectional area of between 12 and 38 square millimeters cross section.

4. A device as defined in claim **3** in which the screen means is composed of wires not larger than 1 millimeter diameter with at least 12 wires per inch.

5. A device as defined in claim **1** in which the screen means is composed of wires not larger than 1 millimeter diameter with at least 12 wires per inch.

6. A device as described in claim **1** in which the jet-forming means has orifices for producing the jets and the aggregate screen area exceeds 12 millimeters per orifice in the jet-forming means.

7. A device as described in claim 2 in which the jet-forming means comprises a multiplicity of orifices and the ratio of aggregate screen area to aggregate orifice area exceeds 15.

8. A device for producing a spray formed by separate foamy streams comprising, jet-forming means for producing jets of high velocity, and fluid mixing means downstream said jet-forming means for breaking up said jets and mixing them with air and thereby producing said foamy streams, said jet-forming means having orifices adapted to direct water that impinges said fluid mixing means at areas sufficiently distant from each other to permit access of air around the water traversing each area without direct interference from water impinging neighboring areas and to discharge the aerated water as separate foamy streams.

9. A water aerator comprising a casing, output means near the downstream end of the casing and through which the water is discharged, said output means consisting of screen means adapted to break up a plurality of small, high-velocity spaced jets of water and mix each such jet with air and discharge it as a coherent distinct jet spaced from similar jets produced by the other such jets, and jet-forming means in the casing, spaced upstream from the screen means, for producing a plurality of spaced high-velocity jets directed at the screen means, and which pass through the screen means in straight lines and in spaced relation whereby to produce a shower of spaced distinct aerated jets.

10. A device for producing a spray comprising screen means for finely breaking up and adding air bubbles to jets of water impinging thereon transverse to the surface thereof; and jet-forming means for producing a multiplicity of spaced jets of water directed transversely to the surface of the screen means and whose parameters are so related to the wire size and mesh of the screen means that the jets pass through the screen means and emerge in the form of a spray which is made up of coherent streams laden with air bubbles and spaced apart widely as compared to their transverse dimensions.

11. A device for producing a spray as defined in claim 10 in which the jet-forming means comprises a plate with a multiplicity of spaced orifices therein, and means at the upstream ends of the orifices for altering the direction of the water entering the orifices.

12. A device for producing a spray as defined in claim 10 in which the jet-forming means comprises a plate with a multiplicity of spaced orifices therein, and means for imparting turbulence to the water as it passes through the orifices.

13. A device for producing a spray as defined in claim 10 in which the jet-forming means produces jets at least some of which diverge and which pass through the screen means in straight lines to thus produce a spray at least some of the streams of which diverge.

14. A device for producing a spray as defined in claim 10 in which the jet-forming means includes two concentric rows of orifices, the outer row directing its jets downwardly and outwardly and in diverging relation to the jets in the inner row, all jets being so related to the screen wire diameter and spacing as to pass through the screen in straight lines to thus produce a diverging spray.

15. A device for producing a spray as defined in claim 14 in which the said outer row of orifices is provided with bridge means at the upstream ends of the orifices to direct the water, as it goes downwardly into the orifices, inwardly so that the outputs from the orifices have an outward component.

16. A device for producing a spray as defined in claim 10 in which there is a body for the device having a large diameter as compared to that of the pipe to which the body is adapted to be connected, said body having internal threads at its upper end, and a cylindrical coupler for connecting said body to said pipe, said coupler having external threads on its outer cylindrical wall adapted to mate with said internal threads of the pipe, said coupler defining a central cylindrical hole therein threaded to mate with external threads on a pipe to which the coupler is adapted to be connected, said coupler also having a ring-shaped projection of larger diameter than said hole and concentric therewith, said ring-shaped projection having external threads on the outer surface thereof to mate with internal threads on the pipe to which the connector is adapted for connection.

17. A device for producing a spray as defined in claim 10, in which the device has a body with inner and outer portions, each of said portions including said jet-forming means and said screen means to produce a spray made up of individual coherent bubbly jets, said body being adapted at its upstream end to be connected to a source of water under pressure and including valve means operable to limit the flow of water to one of said portions.

18. A device for producing a spray as defined in claim 10, in which the jet-forming means has a multiplicity of orifices, and means operable to limit the flow of water to only a part of said orifices to thus increase the velocity of the water directed upon the screen means.

19. A device for producing a spray as defined in claim 18, in which the means operable to limit the flow of water comprises closure means adapted to close the entrance opening to at least one orifice.

20. A spray-producing device comprising a chamber adapted to be connected to a source of water under pressure and including means for discharging from the chamber a spray made up of a multiplicity of substantially spaced independent jets, and means for mixing air with the water to render the jets soft, bubbly and whitish for a limited distance after their discharge and permitting the multiplicity of jets to take the form of simple independent jets of a spray if the water of the jets has travelled so far away from the mixing means that the bubbles have dissipated therefrom, whereby an object exposed to the spray is struck by a multiplicity of soft bubbly aerated jets if the object is close to the mixing means and is struck by a conventional spray if the object is far away from the mixing means.

21. A device for producing a spray as defined in claim 8 wherein the jet forming means and the fluid mixing means are so proportioned and arranged that the area of the airspace between the jets is larger than the aggregate area of the jets.

22. A spray-producing device comprising means adapted for connection to a source of water under pressure including aerating means for mixing the water with air to form a large number of small bubbles in the water and dividing means for dividing the water into a multiplicity of streamlets each of which is coherent and remains distinct, separate and apart from the other streamlets to form a spray in which each streamlet in the spray is of very small cross section as compared to the overall cross section of the area covered by the spray whereby if an object is placed near the outlet of the device a multiplicity of foamy spaced streamlets will impinge on the same.

23. A spray-producing device comprising means adapted for connection to a source of water under pressure including dividing means for dividing the water from said source into a multiplicity of spaced separate coherent and independent streamlets and which remain spaced, separate and independent after their discharge from the device, and aerating means for mixing the water with air so that the streamlets include a large number of small bubbles, said dividing means producing streamlets each of which is of very small cross section as compared to the cross section of the airspace between the streamlets.

24. A spray-producing device as defined in claim 23 in which the dividing means comprises a plurality of superposed perforated diaphragms.

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