Sept. 24, 1963 E. P. AGHNIDES 3,104,819

SPIRAL SCREENED FLUID MIXING DEVICES

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FIG. 1.

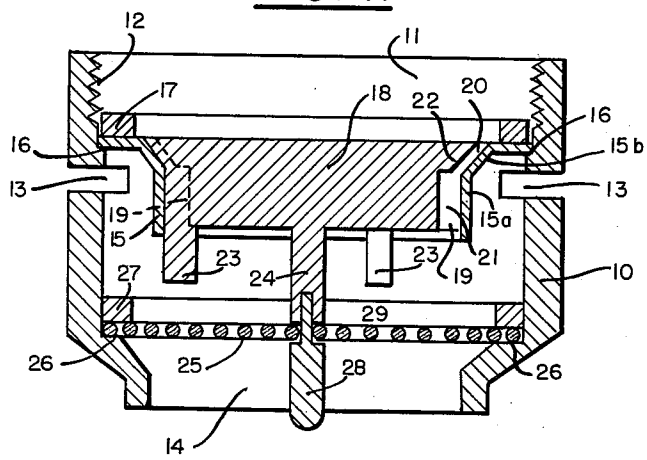


FIG. 2.

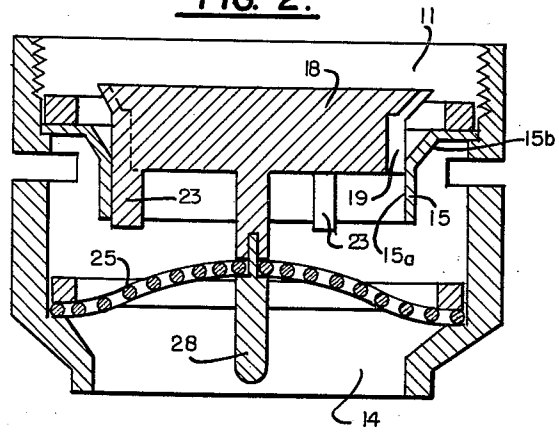
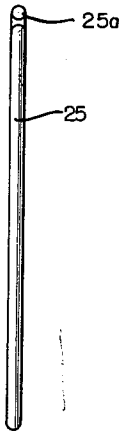


FIG. 3B.



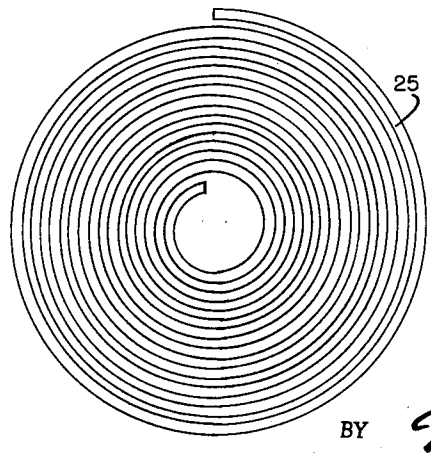


FIG. 3A.

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FIG. 3C.

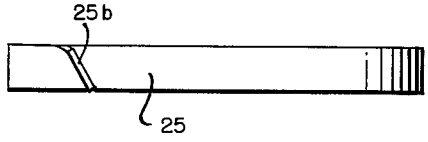


FIG. 3D.

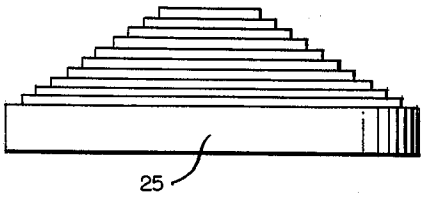


FIG. 4.

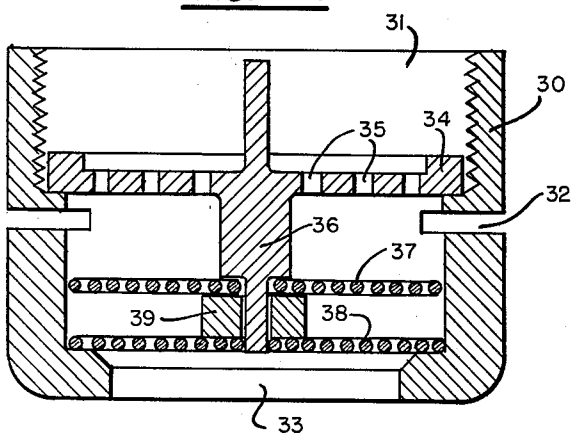
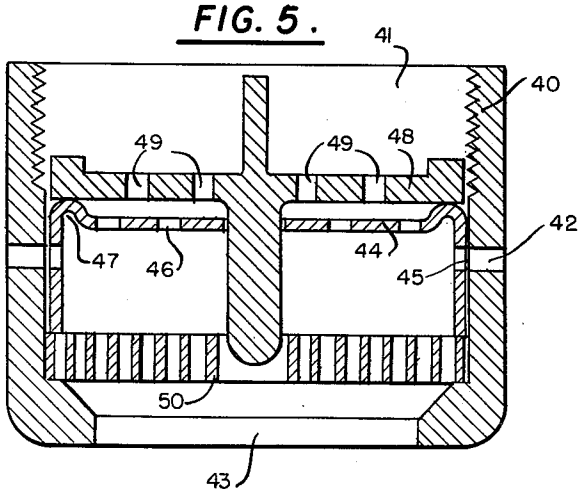


FIG. 5.



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SPIRAL SCREENED FLUID MIXING DEVICES

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17 Claims. (Cl. 239—106)

The present invention relates to improvements in fluid mixing devices, for instance of the type described in my prior U.S. Patents No. 2,210,846, granted August 6, 1940, entitled: "Fluid Mixing Device," and No. 2,316,832, granted April 20, 1943, also entitled "Fluid Mixing Device." Such devices may be employed, for instance in aerating water; and they ordinarily comprise a casing having therein an upstream diaphragm or similar means providing one or more orifices in combination with one or more downstream screens, so proportioned and arranged with respect to each other, and with respect to water and air inlets provided in the casing, that a whitish bubble-laden coherent jet of water emanates from the casing.

In the normal operation of fluid mixing devices or aerators, generally of the types described, it often occurred that particles of foreign matter became lodged within the mixing device structure itself; and in order to assure proper operation of the mixing device or aerator, it is therefore necessary that the interior of the device be cleaned from time to time. In the past, such a cleaning operation has required that the fluid mixing device or aerator be disassembled, and this has in turn raised the possibility of subsequent incorrect reassembly or loss of parts. In addition, by the very nature of the cleaning operations necessary heretofore, the cleaning process has required appreciable time.

The present invention serves to obviate these difficulties and provides improved fluid mixing or aerating devices which may be cleaned on the interior thereof in a very simple manner without disassembling the device itself and without removing the said device from a source of fluid under pressure, such as a faucet. In particular, the present invention contemplates the provision of an improved aerator having separable parts so disposed therein that simple manual depression of a handle, provided for that purpose, causes separation of the several parts, thereby to enlarge orifices defined therebetween so that the interior of the aerator or fluid mixing device can be flushed and thereby readily cleaned.

In providing for this improved structure, the present invention further contemplates the provision of an improved arrangement of parts within an aerator whereby an improved spring structure effects the dual function of supporting and resiliently maintaining the aforementioned separable parts in a desired position relative to one another, and at the same time produces a desired resistance to fluid flow through the aerator casing thereby to perform the function of mixing screens normally placed adjacent the downstream end of the casing. The arrangement thus provided is simpler to manufacture, assemble and maintain than aerators suggested heretofore; utilizes fewer parts, in that the aforementioned spring performs a dual function; and provides for more thorough cleaning of the casing of the aerator than has been possible heretofore inasmuch as a cleaning operation achieves an enlargement of both upstream and downstream orifices thereby to assure that relatively large particles of foreign matter are flushed from the casing.

It should moreover be noted that the spring structure, to be described, in providing for the aforementioned resistance to fluid flow through the casing, represents an improved form of resistance producing means not contemplated heretofore; and the utilization of such a coiled structure in place of, or in addition to, conventional

mesh-type mixing screens for providing resistance to fluid flow, represents one particular feature of the present invention.

It is accordingly an object of the present invention to provide improved fluid mixing devices or aerators employing improved resistance producing means comprising a coiled structure disposed transverse to the direction of fluid flow through the casing.

Another object of the present invention resides in the provision of improved, easily cleanable fluid mixing devices or aerators.

Still another object of the present invention resides in the provision of an improved fluid mixing device or aerator having both upstream and downstream orifices so arranged and constructed that the said orifices may be simultaneously enlarged, thereby to permit a thorough flushing and cleaning of the aerator interior.

A further object of the present invention resides in the provision of a fluid mixing device or aerator having fewer parts than those suggested heretofore, whereby the said device may be more readily manufactured and assembled than has been the case in the past.

A still further object of the present invention resides in the provision of improved resistance producing structures particularly adapted for use in fluid mixing devices or aerators.

The foregoing objects, advantages, construction and operation of the present invention will become more readily apparent from the following description and accompanying drrawing, in which:

FIGURE 1 is a cross-sectional view of an improved aerator constructed in accordance with one form of the present invention.

FIGURE 2 illustrates the aerator of FIGURE 1 with the several parts thereof displaced, as during a cleaning operation.

FIGURE 3A is a top view of the improved resistance producing means contemplated by the present invention.

FIGURES 3B through 3D inclusive comprise side views of the structure shown in FIGURE 3A, illustrating various forms which that structure may take.

FIGURE 4 illustrates another form of aerator employing the novel resistance producing means of the present invention; and

FIGURE 5 illustrates still another form of aerator employing the novel resistance producing means of the present invention.

Referring now to FIGURE 1, it will be seen that in accordance with the present invention, an improved aerator may comprise a casing **10** having a fluid inlet **11** provided with means such as threads **12** for attaching the said casing to a suitable fluid source such as a water tap. Casing **10** is further provided with air inlets **13**, and with a jet outlet **14**. The particular air inlets **13** illustrated in the figure are disposed in the side walls of casing **10**, but it will be understood that other arrangements are possible; and in particular, the air inlets may be disposed adjacent the jet outlet **14**.

Casing **10** supports, on its interior, a tubular ring or shell **15** having a first portion **15***a* disposed substantially concentric with the casing **10** and having a second portion **15***b* supported at an angle to the said casing **10**. Ring **15** is maintained in place by ledges **16** provided on the interior of the casing, in combination with an annular washer **17**. Ring **15** in turn supports a body **18** extending transverse to the direction of fluid flow through casing **10**; and the said body **18** is provided with webs **19**, the upper portions of which, as indicated at **20**, are of reduced cross dimension and are complementary to portion **15***b* of ring **15**.

When body **18** is placed within ring **15**, as illustrated in FIGURE 1, the several webs **19** cooperate with the inner surface of ring portion **15***a* to form a plurality of

elongated passages or chambers 21 therebetween, with each of the said passages 21 including a restricted inlet orifice such as 22 adjacent the upper end and inclined at an angle thereto. It will be appreciated of course that the webs 19 could be partially or entirely omitted, whereby the body 18 would cooperate with ring 15 to form a substantially annular chamber surrounding the said body 18. In either case, however, and due to the shape of the facing surfaces between body 18 and ring 15, water passing from inlet 11 through orifices 22 will enter elongated chambers 21, striking the inner walls thereof, whereby the said water is agitated and disturbed within chambers 21.

Air entering through inlets 13 is also communicated to the downstream ends of chambers 21 whereby the aforementioned disturbance and agitation of the fluid streams within chambers 21 causes a partial mixing of air and water; and the streams discharged from the downstream ends of orifices 21 are thus aerated in nature.

The structure described is characterized by the provision of plural relatively movable separable members defining one or more orifices or apertures therebetween, with these parts being so arranged that relative movement between the said parts causes a change in the size of the orifices, as will be described. While the arrangement thus far described in reference to FIGURE 1 comprises a preferred arrangement in accordance with the present invention, it must be understood that it is contemplated that other arrangements utilizing relatively movable separable bodies defining variable orifices therebetween could be employed without departing from the principles of the present invention.

Body 18 includes a plurality of depending guides 23 extending below the lowermost edge of ring 15. The body 18 is in fact slidable within ring 15 in a direction coaxial with that of casing 10; and during such sliding movements, guides 23 assure that body 18 remains in a position transverse to the direction of fluid flow through casing 10. Body 18 further includes a central portion 24 extending downward, as illustrated in the attached drawings.

Adjacent the outlet 14 of casing 10 is provided a continuous spiral 25 of resilient material (see FIGURE 3A), such as stainless steel or the like; and the said spiral 25 in fact comprises a spiral spring extending across casing 10 in a direction transverse to the direction of fluid flow therethrough. Spring or spiral 25 is supported adjacent its outer periphery on ledges 26 provided in casing 10 adjacent the outlet 14 thereof, and the said spring or spiral 25 may be positively retained in place adjacent its outer periphery by an annular washer 27. A handle 28 extends into the outlet 14 of casing 10 and includes a portion 29 extending through spring 25 adjacent the center thereof and attached to depending portion 25 of body 18.

Spring 25, when in the position shown in FIGURE 1, performs the normal function of mixing screens provided in aerators heretofore; and in particular, streamlets of fluid issuing from the downstream ends of chambers 21 impinge upon the convolutions of spring 25 whereby the said spring 25 imposes resistance to the flow of fluid through casing 10 and enhances the mixing of that fluid with air downstream of body 18. Due to the arrangement of parts, moreover, the body 18 is resiliently held in place by spring 25 during normal operation of the aerator thereby assuring that a jet of aerated fluid issues from outlet 14 of casing 10.

In the event that it is desired to clean the interior of the aerator shown in FIGURE 1, the handle 28 may be manually moved upward, as indicated in FIGURE 2. This upward movement of handle 28 causes body 18 to slidably move upward in ring 15 while being guided during this upward movement by guides 23. As will be appreciated by an examination of FIGURE 2, the upward movement of body 18 causes webs 19 to move from a position adjacent portion 15*a* of ring 15 to a position adjacent portion 15*b* of the said ring 15, whereby the

spaces between the body 18 and ring 15 are considerably enlarged. At the same time, this upward movement of handle 28 causes the several turns of spring 25 to spread apart from one another, thereby enlarging the downstream orifices provided between adjacent turns of the said spring 25.

A simple upward movement of handle 28 thus enlarges both upstream and downstream orifices in the casing, whereby fluid flowing in through inlet 11 causes foreign matter to be readily flushed from the interior of the casing past the enlarged openings between the turns of spring 25 to the aerator outlet 14.

While I have thus described a preferred embodiment of the present invention, many variations will be suggested to those skilled in the art. In particular, it should be noted that the relatively movable members forming the upstream orifices of the present invention may assume other configurations and may in fact include the interior walls of the casing itself as a fixed element defining said orifices. Moreover, while a single relatively flat spring 25 has been illustrated in the several drawings, it will be appreciated that two or more such spirals may be employed, if desired; and that in addition, the spirals rather than being flat could be curved so as to present a concave or convex configuration.

Certain of these other variations are illustrated in FIGURES 3, 4 and 5. For instance, examining FIGURE 3B, it will be seen that the spiral screen 25 may in fact have a circular cross-section 25*a*; and such a spiral screen has in fact been assumed in the representations of FIGURES 1 and 2. FIGURE 3C illustrates, moreover, that the spiral screen may, if desired, have a substantially rectangular cross-section 25*b*; and the spring or screen of FIGURE 3C is planar in cross dimension, similar to the screen already described in reference to FIGURES 1 and 2. Again, FIGURE 3D illustrates that the spiral spring or screen 25, rather than being flat or planar in cross dimension, may be substantially convex at the upstream side thereof; and, as mentioned previously, the spiral screens or springs of the present invention may in fact be so arranged within an aerator casing that they are concave rather than convex at the upstream side thereof.

Moreover, as mentioned previously, the improved spiral screens of the present invention comprise a particular feature of the present invention, even as divorced from easily cleanable aerators; and in fact comprise an improved form of resistance producing means adaptable for aerators in general. When employed in place of conventional mesh type mixing screens, the spirals of the present invention exhibit the substantial advantages that they need not be framed, whereby they do not reduce the mixing area provided within the casing; and even as so unframed, they do not present any loose wire ends which might fall off and pass through the casing with fluid flow therethrough, as has been the case in the past with various forms of conventional mesh type screens. In addition, the improved spiral resistance producing means of the present invention may be retained in place within an aerator casing by the inherent resiliency of the spiral or spring itself, thereby obviating the necessity of special mounting structures within the casing.

Two examples of the use of the spirals of the present invention in place of mesh type screens are shown in FIGURES 4 and 5. Thus, referring to FIGURE 4, it will be seen that in accordance with this further form of the present invention, an aerator casing 30 having a fluid inlet 31, air inlets 32, and a jet outlet 33, may be adapted to support a diaphragm structure 34 defining a plurality of orifices 35. Diaphragm 34 includes a downward extending projection 36 which in turn supports two spiral surfaces 37 and 38 thereon. Spirals 37 and 38 thus act as two mixing screen surfaces, with the said springs 37 and 38 being maintained in spaced relation to one another by an interposed disc element 39. The example

of FIGURE 4 is thus illustrative of an improved aerator device utilizing plural spirals or springs maintained in spaced relation to one another in place of plural conventional mesh type screens employed heretofore; and it will be noted that the overall unit, comprising diaphragm **34**, projection **36**, springs or screens **37** and **38**, and disc **39**, may be removed from casing **30** as a unit.

A further example of the use of the improved spring or screen of the present invention is shown in FIGURE 5; and in this particular form of the invention, a casing **40** is again provided with a fluid inlet **41**, air inlets **42**, and jet outlet **43**. The casing includes an inverted cup **44** having perforations **45** communicating with air inlets **42**, whereby air may be introduced into the interior of cup **44**. The said cup **44** further includes a plurality of orifices **46** as well as an upstanding annular portion **47** adapted to support thereon a diaphragm **48** having plural orifices **49**. The diaphragm **48** and inverted cup **44** are supported in separable relation to one another, and these two units are in turn supported upon a spiral surface or spring **50** having a substantially rectangular cross-section of the type described in reference to FIGURE 3C. It will be noted that the arrangement thus shown in FIGURE 5 comprises a plurality of separable parts; and these parts may be separately removed from the casing **40**. Even in this arrangement, however, it should be noted that the spring or spiral **50** is maintained in place within casing **40** without any special mounting means being required, and that the mixing surface presented thereby is not reduced by any forms of framing structure which have been considered necessary heretofore in various types of mesh screen structure. Moreover, spiral **50**, because of its height, may replace two or more spirals of round cross-section.

Still other variations will be suggested to those skilled in the art, and it must therefore be emphasized that the foregoing description is meant to be illustrative only and should not be considered limitative of my invention. All such variations and modifications as are in accord with the principles described, are meant to fall within the scope of the appended claims. For instance, the diameter of spirals of round cross-section or the thickness of flat spirals may be as small, or even smaller, if desired, than the diameter of the wires forming the wire mesh screen of present commercial aerators. The height of the latter may vary according to the needs of a particular structure.

I claim to have invented:

1. A fluid mixing device comprising a casing having first and second fluid inlets and a fluid outlet therein, said casing defining a chamber for mixing fluids from said first and second inlets and for thereafter discharging said mixed fluids through said outlet, a plurality of spaced separable members extending across said casing and defining at least one orifice therebetween located at the upstream end of said chamber and downstream of said first fluid inlet, said members being constructed and arranged to vary the size of said orifice when they are separated, a spiral coil of resilient material extending across said casing downstream of and in the path of fluid from said orifice and transverse to the path of fluid flow through the casing, said spiral coil being adjacent the downstream end of said chamber and acting to resist the flow of fluids out of said chamber thereby to effect said mixing of fluids in said chamber, the outer periphery of said coil being held at substantially a fixed position within said casing, means connecting a part of said spiral coil that is remote from said periphery to at least one of said plurality of separable members, and means for moving said one separable member against the restraint of said resilient coil thereby selectively to change the relative positions of said spaced separable members so as to enlarge said orifices, thereby to change the degree of fluid mixing effected within said chamber.

2. The combination of claim 1 wherein said spiral coil comprises a substantially flat coiled spring of substantially circular shape, means for supporting the outer periphery of said circular spring adjacent the inner walls of said casing, and manually movable handle means in contact with said circular spring adjacent the center thereof for effecting said movement of said one spaced member.

3. The combination of claim 2 wherein said handle means includes a portion extending through said spring adjacent the center thereof and attached to one of said separable members, said handle means including a manually engageable portion extending into the fluid outlet of said casing.

4. The combination of claim 1 wherein said spaced separable members comprise an annular ring supported within said casing, and a webbed body slidably supported within said ring, said orifice being defined between the interior surface of said ring and the webs on said body.

5. A fluid mixing device comprising a casing having a fluid mixing chamber therein, said casing including means defining first and second fluid inlets and a fluid outlet in communication with said mixing chamber whereby fluids from said inlets are mixed in said chamber and thereafter discharged through said outlet, a first plurality of spaced separable members defining first apertures therebetween, said first apertures being disposed between one of said fluid inlets and said mixing chamber for imposing resistance to the flow of one of said fluids into said mixing chamber, a second plurality of spaced separable members defining second apertures therebetween, said second apertures being disposed between said mixing chamber and said fluid outlet for resisting the flow of fluids out of said chamber thereby to effect said fluid mixing, and means for simultaneously separating said first and second pluralities of separable members thereby simultaneously to enlarge said first and second apertures so as to decrease the amount of fluid mixing occurring in said chamber and to permit relatively large particles of foreign matter to be flushed past both said resistance imposing means and out of said casing.

6. The combination of claim 5 wherein said second plurality of spaced separable members comprise plural convolutions of a spiral coil of resilient material.

7. The combination of claim 6 wherein said spiral coil is substantially flat in configuration, said flat coil being disposed transverse to said casing adjacent said fluid outlet.

8. An aerator for producing a bubbly stream of water comprising a casing having a mixing chamber therein, said casing including means defining a restricted water inlet, an air inlet, and a stream outlet in communication with said mixing chamber, and resistance producing means between said mixing chamber and said jet outlet for breaking said water and mixing it with air to produce a bubbly stream at said outlet, said last-named means comprising an elongated strip of material wound in a continuous spiral, said spiral being substantially coaxial with said casing and extending across said casing in the path of water flow therethrough.

9. The combination of claim 8 including means supporting the outer periphery of said continuous spiral adjacent the inner walls of said casing, and means adjacent the center of said spiral coil for selectively moving the center of said coil away from its quiescent position thereby to change the spacings between adjacent convolutions of said spiral.

10. The combination of claim 9 including means adjacent said water inlet defining a plurality of variable orifices for resisting the flow of water into said chamber, and means for varying the size of said orifices simultaneous with changes in spacing between adjacent convolutions of said spiral thereby to simultaneously vary the resistance to fluid flow at both the upstream and downstream ends of said chamber so as to vary the amount of fluid mixing occurring within said chamber.

11. In combination, an aerator for producing a bubbly

stream of water comprising a conduit having a restricted water inlet, an air inlet, and a bubbly stream outlet, and means for imposing resistance to the flow of water through said conduit from said water inlet to said stream outlet whereby water and air may be thoroughly mixed to produce said bubbly stream at said outlet, said last-named means comprising an elongated strip of resilient material wound in a spiral, said spiral being disposed across said conduit transverse to the direction of water flow therethrough.

12. In combination a conduit, means for introducing water and air to said conduit, and means for imposing resistance to the flow of fluid through said conduit thereby to thoroughly mix said water and air to produce a bubbly stream of water, said resistance means comprising a resilient spiral of resistance producing material located within said conduit substantially transverse to the direction of fluid flow therethrough, the adjacent convolutions of said spiral being disposed closely adjacent to but spaced from one another to afford sufficient resistance to said fluid flow to effect formation of said bubbly stream, the outer convolutions of said spiral being resiliently pressed against the inner walls of said conduit.

13. The combination of claim 12 wherein said resistance means comprises a plurality of said spirals of re-resistance producing material disposed in spaced substantially parallel relation to one another transverse to the direction of fluid flow through said conduit.

14. An aerator comprising a casing having a water inlet, an air inlet, and a jet outlet therein, diaphragm means extending across said casing and defining a plurality of orifices downstream of said water inlet for dividing water from said inlet into a plurality of streams, said diaphragm means including a movable portion adjacent said orifices whereby movement of said portion changes the size of said orifices thereby to change the velocity of water passing through said diaphragm means, spring means comprising a plurality of spaced resilient members extending across said casing downstream of said diaphragm means and transverse to the path of fluid flow through said casing whereby said spring means imposes resistance to the flow of fluid through said casing whereby said water is mixed with air from said air inlet in the region of said casing located between said diaphragm means and said spring means, means for connecting said movable portion of said diaphragm to said spring means, and means for manually moving said movable portion against the restraint of said spring means to enlarge the size of said orifices thereby to change the degree of mixing of said water and air in said casing region.

15. A cleanable aerator comprising a casing having a mixing chamber therein, said casing including means defining a fluid inlet, an air inlet, and a bubbly stream outlet, upstream resistance producing means between said fluid inlet and chamber for breaking up fluid from said fluid inlet, downstream resistance producing means comprising a substantially flat spiral spring extending transverse to said casing between said mixing chamber and stream outlet, whereby said spring normally imposes sufficient resistance to fluid flow through said casing to mix said fluid and air thereby to produce said bubbly stream,

the outer convolutions of said spring normally having a fixed position adjacent the inner walls of said casing, and means for selectively displacing the inner convolutions of said spring to decrease the resistance to fluid flow afforded by said spring thereby to permit particles of foreign matter to be flushed out of said casing through said downstream resistance producing means.

16. A readily cleanable water aerator comprising a conduit defining a mixing chamber therein, means for admitting air to said mixing chtmber, inlet means for applying water under pressure to one end of said conduit, first structural means at the upstream end of said mixing chamber defining first orifices between said inlet means and the upstream end of said mixing chamber for dividing water from said inlet means into a plurality of high velocity jets of water to be mixed with said air in said mixing chamber, said first structural means comprising a movable member defining at least a portion of said first orifices whereby movement of said movable member enlarges the sizes of said first orifices to permit relatively large particles of foreign matter to be flushed past said first structural means through said enlarged first orifices when cleaning of said aerator is to be effected, second structural means disposed adjacent the downstream end of said mixing chamber for imposing resistance to fluids in said chamber thereby to effect said mixing of water and air in said chamber, said second structural means defining second orifices adjacent the downstream end of said chamber to permit aerated water to flow through said second structural means and out of the other end of said conduit, said second structural means comprising a further movable member defining at least a portion of said second orifices whereby movement of said further movable member enlarges the sizes of said second orifices to permit said relatively large particles of foreign matter, flushed past said first structural means through said enlarged first orifices, to thereafter be flushed out of said conduit past said second structural means and through said enlarged second orifices when cleaning of said aerator is to be effected.

17. The combination of claim 16 including means structurally interconnecting said first-mentioned and further movable member for effecting simultaneous movement of both said movable members to simultaneously enlarge said first and second orifices when said aerator is to be cleaned.

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