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Parkison et al.

[11] **3,827,636**

[45] **Aug. 6, 1974**

[54] SUBSTANTIALLY LEAKLESS AERATOR

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[73] Assignee: **American Standard Inc.**, New York, N.Y.

[22] Filed: **Feb. 15, 1973**

[21] Appl. No.: **332,982**

[52] **U.S. Cl.** **239/428.5**, 239/553, 239/590.3, 285/328

[51] **Int. Cl.** **E03c 1/08**

[58] **Field of Search** 239/428.5, 553, 590.3; 285/328, 423

[56] **References Cited**

UNITED STATES PATENTS

1,190,511	7/1916	Buscher	239/428.5
2,388,992	11/1945	Pape et al.	285/328 X
3,104,827	9/1963	Aghnides	239/428.5
3,270,965	9/1966	Aghnides	239/428.5
3,321,140	5/1967	Parkison et al.	239/428.5
3,388,868	6/1968	Watson et al.	239/428.5 X
3,531,051	9/1970	Classen	239/428.5
3,635,405	1/1972	Shames et al.	239/428.5
3,642,213	2/1972	Parkison	239/553 X
3,672,574	6/1972	Knapp	239/428.5
3,712,548	1/1973	Aghnides	239/428.5

FOREIGN PATENTS OR APPLICATIONS

224,740	11/1924	Great Britain	285/328

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Assistant Examiner—Andres Kashnikow
Attorney, Agent, or Firm—Jefferson Ehrlich; Robert G. Crooks

[57] **ABSTRACT**

This application covers an aerator for a faucet. The aerator includes four principal parts: a disk or diaphragm having a plurality of apertures at its upstream end for converting incoming water into a plurality of jets of water; a substantially cylindrical body having an upper shoulder to support the diaphragm and having apertures to admit air to be mixed with the water jets produced by the diaphragm; and a pair of spaced screens of different dimensions downstream of the diaphragm for additionally mixing and emitting the air and water combination. The incoming air and the water jets developed by the diaphragm are combined and mixed in the space or chamber above the two screens before being discharged through the discharge outlet of the aerator. The diaphragm embodies a so-called "crush ring" positioned peripherally at its upstream end. The crush-ring contacts a flat ring near the end of the faucet spout and, because it is "crushed" or distorted to overcome and absorb irregularities in the end of the spout, it forms a primary obstruction to prevent leakage through the narrow spaces formed by the threaded segments that hold the aerator against the faucet spout. The body also provides additional spaces along its periphery to aspirate water that may be otherwise leaked out of the above-noted threaded portions of the structure and hence such water will be emitted from the downstream discharge end of the aerator, thereby avoiding leakage from the device.

20 Claims, 14 Drawing Figures

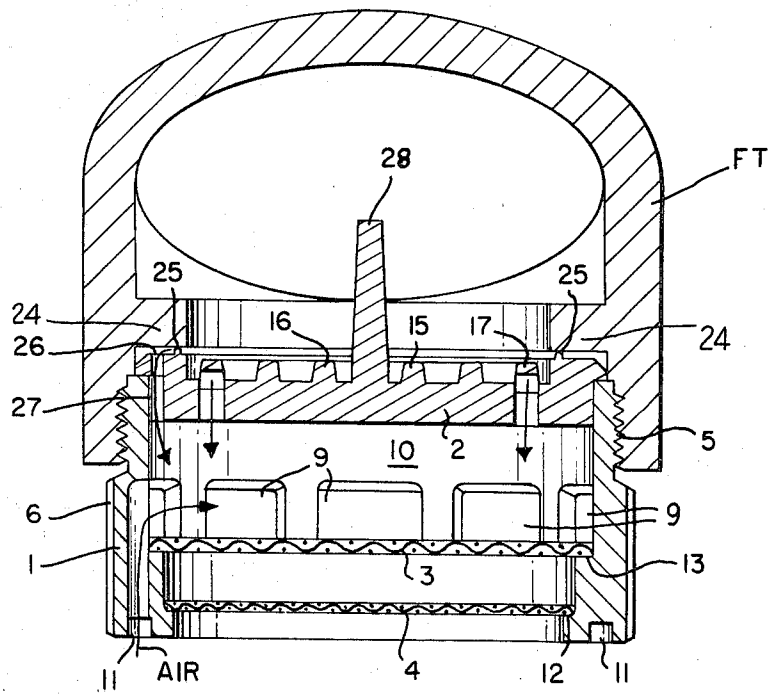
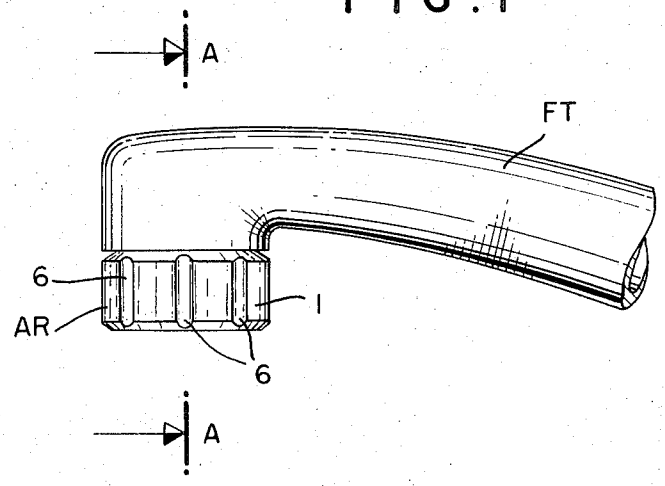


FIG. 1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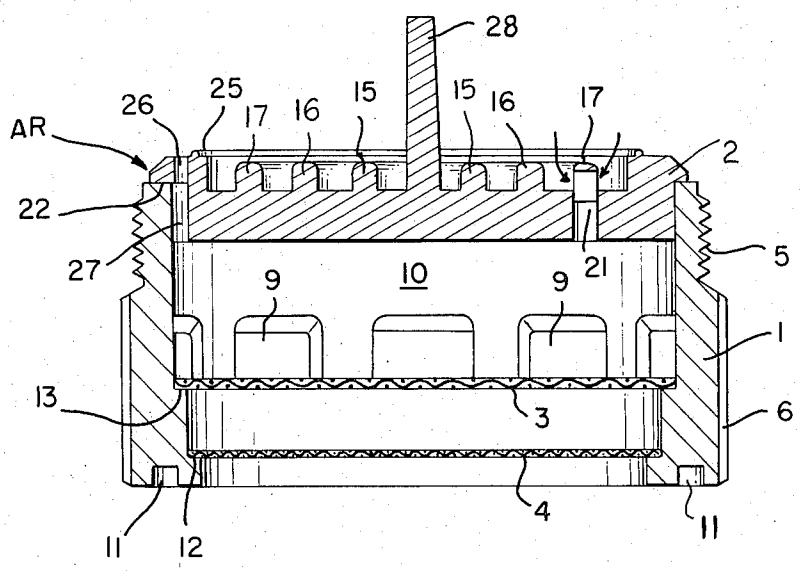
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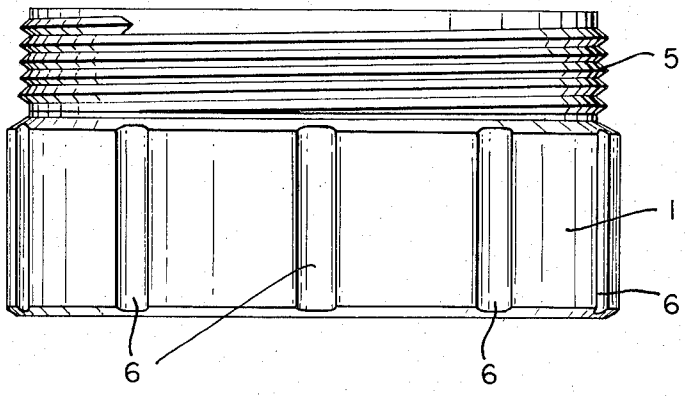
FIG. 2

FIG. 3



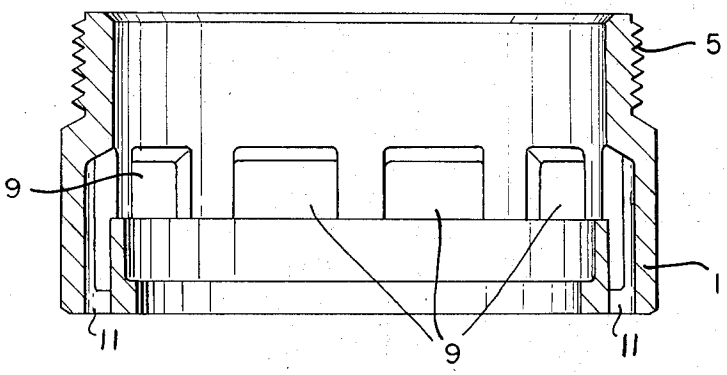


FIG. 4

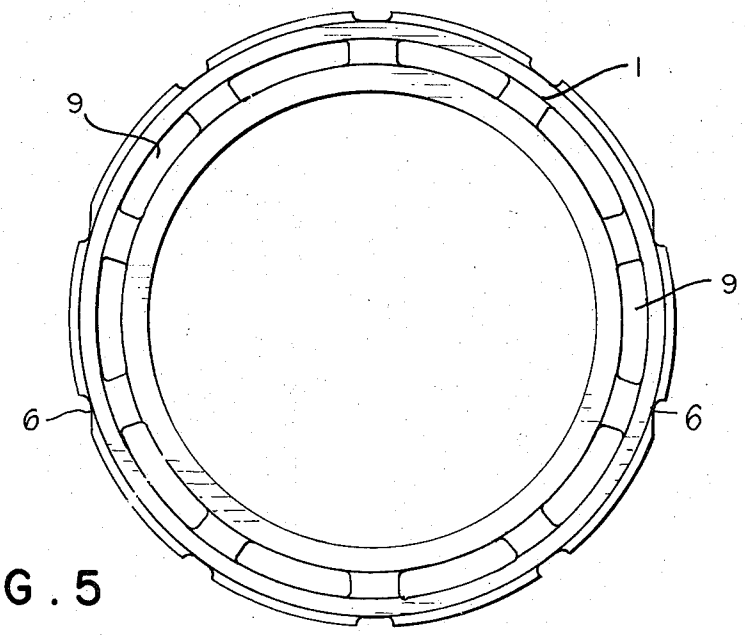
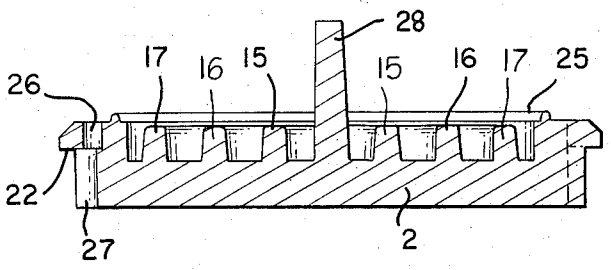


FIG. 5

FIG. 6



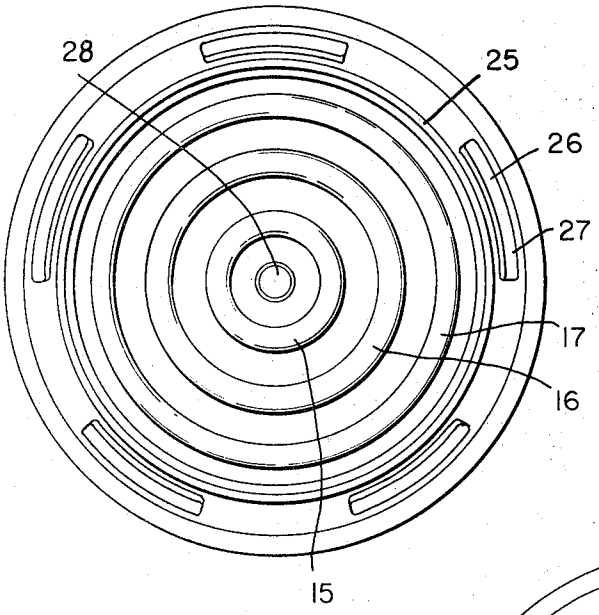


FIG. 7

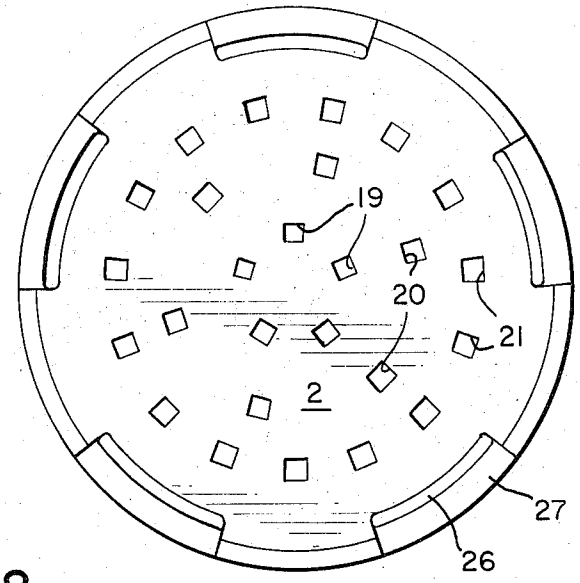


FIG. 8

FIG. 9

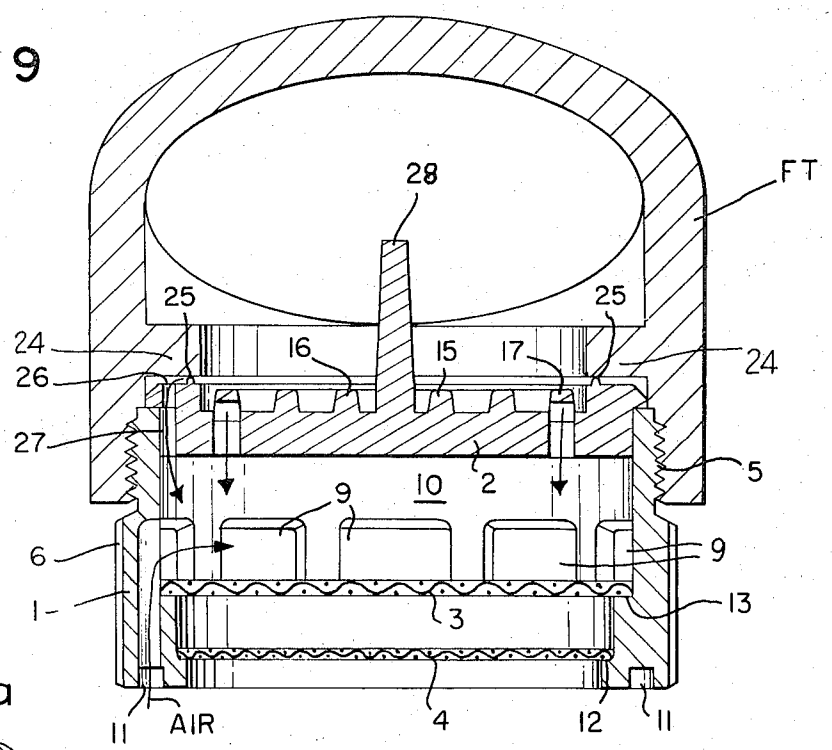
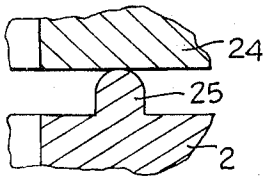


FIG. 9a



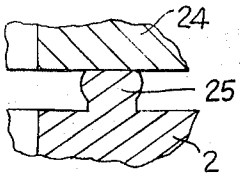


FIG. 9b

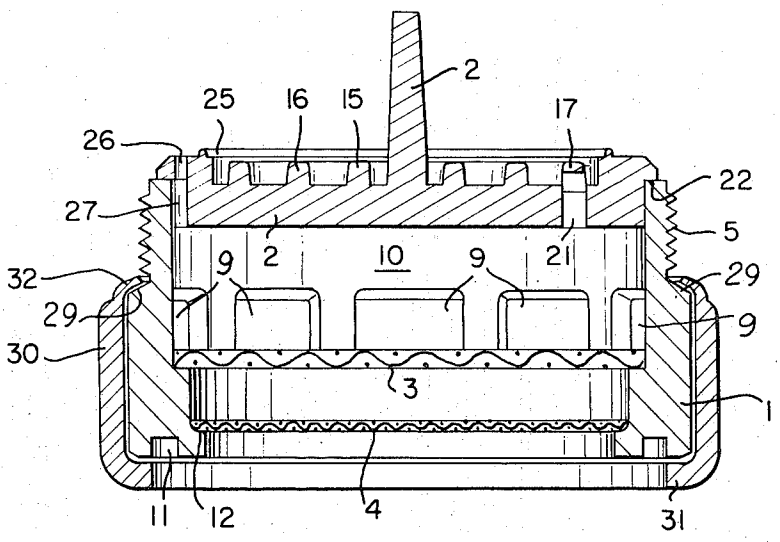


FIG. 10

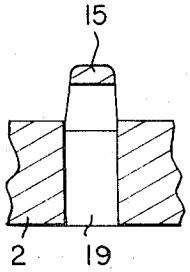


FIG. 11

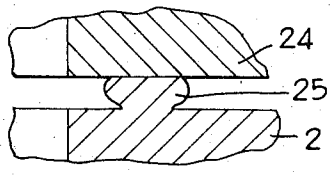


FIG. 9c

SUBSTANTIALLY LEAKLESS AERATOR

This invention relates to aerators for spouts and faucets and, more particularly, to aerators which are sturdy and simple in construction, easily assembled on a spout or faucet, easily removed and disassembled for cleaning purposes, long-lasting, easily reassembled and connected to the faucet, and low in cost.

As is well known, a conventional aerator is a device which is attachable to, or may be part of, a spout or faucet or other liquid discharge structure for admitting air and combining the admitted air with the liquid to be discharged as a coherent air-liquid stream of improved appearance.

Presently available low-cost aerators are usually composed of an upstream diaphragm providing a plurality of apertures to receive incoming water and convert the incoming water into a plurality of jets which are to be mixed with incoming air before the mixture is discharged by the device. The mixing means is usually located downstream of the diaphragm, and it may include a so-called mixing plug or "onion," with or without a screen positioned downstream of the mixing plug (see Goodrie et al., U.S. Pat. No. 3,010,659 issued Nov. 28, 1961), or, on the other hand, the mixing means may include a pair of identical screens which are spaced from the jet-forming diaphragm and from each other near the discharge end of the device (see Aghnides U.S. Pat. No. 2,210,846, issued Aug. 6, 1940, now expired). In the latter case, for example, air is drawn into the space between the diaphragm and the screens and the combination or mixture of air and water is discharged from the downstream end of the device.

Experience has demonstrated that, in a device employing a pair of screens transmitting a relatively high velocity air and water mixture, especially if the components of the device are all molded into a unitary or one-piece structure (as disclosed in the Aghnides U.S. Pat. No. 3,270,964, issued Sept. 6, 1966), the screens may decay and deteriorate rapidly due to the speed and force of the transmitted fluids, and due to foreign matter accumulated on the screens, and due to abrasions of the screens by brushes and cleaning cloths and chemicals and polishes employed for cleaning purposes. These decaying and deteriorating factors soon render the aerator inefficient and perhaps useless or valueless. If the aerator becomes inefficient or worthless, the faucet likewise becomes inefficient and the user becomes annoyed and dissatisfied with the faucet and its operation as well as with the sink or lavatory structure of which the faucet is an important component. Such conditions have created difficult or serious problems which demand appropriate solutions.

Experience has also demonstrated that the conventional type of aerator which is threaded into the discharge end of a faucet develops leaks especially at the threaded segment, and this can be, and usually also is, a source of considerable annoyance to the user as well as a wastage of valuable water. According to this invention, this type of leakage will be greatly reduced, if not eliminated, by coordinated leakage prevention means.

Furthermore, the structure of the aerator device of this invention will have spaces or apertures positioned adjacent to the jet-forming apertured diaphragm and these spaces or apertures will aspirate any water that would otherwise leak out of the device. This will cause any such water to be brought into the main stream of the device and discharged through the downstream discharge port of the device. Hence, the troublesome leakage factor will be minimized or eliminated by the introduction and employment of the present invention.

Furthermore, the conventional aerator, especially the one-piece type, necessarily embodies a thin somewhat tender outer wall. Because of the thinness and tenderness of the wall structure, the heavy hand of a plumber or installer would often produce a crack in the outer wall of the aerator and this would ordinarily require the aerator to be replaced. This wall weakness introduces an acute condition especially when the plumber or installer employs a wrench as is customary in making attachments to plumbing fittings. Any damage to the aerator due to inherent faults in the materials or the installation practices casts a cloud about the installer and saddens the homeowner and, moreover, mars the image of the manufacturer. These conditions will be minimized or eliminated by the construction of the device of the present invention.

These and other features and objects of this invention will be better and more clearly understood from the more detailed description and explanation hereinafter following when read in connection with the accompanying drawing in which:

FIG. **1** illustrates a typical assemblage of a faucet bearing an aerator device of the type involved in this invention;

FIG. **2** illustrates a general assembly of the parts of the aerator of this invention shown in a cross-sectional view taken through the central or longitudinal axis of the aerator device of this invention;

FIG. **3** shows a front elevational view of the body or outer structure of the aerator of this invention;

FIG. **4** shows a cross-sectional view of the body or outer structural component of the aerator, this view being also taken along the longitudinal axis of the device;

FIG. **5** shows a lower plan view of the body or outer structural component of the device;

FIG. **6** shows a view of the diaphragm component of the aerator device taken in cross-section along the longitudinal axis of the device;

FIG. **7** is a top plan view of the diaphragm component shown in FIG. **6**;

FIG. **8** illustrates a bottom plan view of the diaphragm component of FIG. **6**;

FIG. **9** shows a cross-sectional view, taken along lines A—A of FIG. **1**, showing the end of a faucet having an aerator attached thereto;

FIGS. **9***a*, **9***b* and **9***c* illustrate partial segments of a crush ring employed for sealing an aerator to a faucet;

FIG. **10** illustrates a cross-sectional view of a vandal-proof aerator assembly; and

FIG. **11** represents a partial segment of the diaphragm component to illustrate the structure for producing water turbulence in the practice of this invention.

The same or similar reference characters will be employed throughout the drawing to designate the same or similar parts wherever they may occur in the drawing.

FIG. 1 illustrates the general assembly of a typical spout or faucet FT having an aerator AR attached thereto.

Referring especially to FIG. 2 of the drawing, there are shown the generally cylindrical body 1, the circular diaphragm 2 transversely positioned near the top of the body 1 and the two flat screens designated 3 and 4 transversely positioned at the lower end of body 1. All four parts are coordinated and assembled as shwon in FIG. 2, ready for installation in a faucet FT (see FIG. 1). The upper outer peripheral segment 5 of the body 1 is externally threaded so that the body 1 may be threadedly attached to the corresponding internally threaded segment of the spout or faucet FT to which the aerator structure AR is to be attached.

The four parts 1–4 just described, when assembled, represent a cleanable aerator. The aerator can be readily installed and later removed for cleaning, reassembly and re-installation. As will be described, all of the several parts are firm and durable and easily cleanable and maintain a good appearance at all times.

As shown more clearly in FIG. 3, the lower exterior part of the body 1 has a plurality of substantially peripheral parallel recesses 6 molded on the outer surface of the body 1. These exterior recesses 6 may be used by an installer to grip the device for the purpose of attaching the device to a spout or faucet FT or may be used by a homeowner for removing the device from the spout or faucet FT for cleaning and replacement. The connection to the spout or faucet may be performed by hand or by a tool such as a wrench or pliers. When the aerator device AR is affixed to a spout or faucet FT, the diaphragm 2 and the screens 3 and 4 are easily arranged and held in place within the body 1 and remain fixed in position. On the other hand, when it is desired to clean the aerator structure to remove foreign matter that may have accumulated on the upstream side of the diaphragm 2 or on the surfaces of the screens 3 and 4, it is merely necessary to unscrew the threaded body 1 from the spout or faucet and then remove either the diaphragm 2, or the diaphragm 2 and the screens 3 and 4, for cleansing or other purposes, after which the same parts may be reinserted and re-assembled and the structure reconnected to the threaded end of the spout or faucet.

It will be noted especially from FIGS. 4 and 5 that the body 1 has a plurality of peripheral parallel openings 9, ten openings being exhibited in the illustration. These peripheral openings 9 allow air to be drawn upwardly into the chamber 10 of the structure via the vertical passages 11 for mixture with the water jets traversing diaphragm 2. The incoming air arriving from the lower end passages 11 of the body 1 is drawn through openings 9 into chamber 10 by reduced pressure or so-called "suction action" produced by the water flowing downstream, i.e., in the downward direction along the longitudinal axis, and the air is added to and mixed with the jets of water and the combination of water and air is exited thereafter through the discharge port of the aerator structure.

As seen in the drawing, especially in FIG. 2 of the drawing, the body 1 has two peripheral internal substantially flat ledges, a lower edge 12 and an upper ledge 13. The screen 4 which is a finer-meshed screen and of smaller diameter than screen 3, is seated on the lower ledge 12. The other screen 3, which is of coarser mesh and of larger diameter, is seated on the upper ledge 13 of the body 1. These screens 3 and 4 are employed to cause the incoming water passing the chamer 10 and the air drawn into the chamber 10 to be brought into finer and more intimate contact with each other to establish a more uniform and laminar exiting discharge stream. Screens 3 and 4 also serve to reduce the noise factor that would be present in a rapidly flowing stream if the screens were omitted. Furthermore, these screens and their meshes are sturdy in construction, built to withstand not only the pressurized high velocity streams traversing the screens and the chemical compounds encountered in the transmitted water, but they are also able to withstand finger pressures that might be applied to them by plumbers, homeowners and other in cleaning or handling them.

Referring to FIGS. 6, 7 and 8, it will be noted that there are three concentric rows of over-hanging upward projections 15, 16 and 17. Each projection in each of the rows 15, 16 or 17 is positioned atop each of the three corresponding sets of concentric apertures 19, 20 and 21 (see especially FIGS. 2, 8, 9, 10 and 11). Each overhanging projection, such as 17, and its corresponding aperture 21, will cause the incoming water to be deflected at the upstream end of the aerator as the water is directed downstream to the appropriate aperture in the disk 2 to form a turbulent water jet. Another overhanging projection 15 and its corresponding aperture 19 are shown in FIG. 11, by way of another example, and it can be observed that water destined to pass through aperture 19 must be received via the upstream dual or lateral openings provided by the overhanging projection 15. Thus, each of the various apertures 19, 20 and 21 in the diaphragm 2, not only produces a jet of water entering the chamber 10, but each produced jet of water is caused to become turbulent due to deflection by each overhanging projection such as 15, 16 and 17. Turbulence is essential in the mixing of the water with the incoming air to effect suction action, and the greater the turbulence, the more intimate the water-air mixture and the greater the volume of air drawn through the device.

The relation between each projection, such as 17 in the outer ring of overhanging projections, and the corresponding associated aperture, such as 21, may be seen more clearly from FIG. 2. The aperture 21 is shown immediately beneath the overhanging projection 17 so that water flowing downstream from the spout or faucet will be allowed to enter via the sides of each projection 17 in a non-linear path as shown by the arrows in FIG. 2. These non-linear flow paths introduce the necessary turbulent motion to the water entering and traversing the aperture 21 and the turbulent jet stream is delivered to the chamber 10 for the mixing process. The production of a significant amount of turbulent jet motion increases the ability of the incoming water to receive air and mix with the received air entering chamber 10 from the downstream openings in the body 1.

It will be noted from FIG. 8 that each of the numerous cylindrical apertures 19, 20 and 21 are shown to be approximately of square cross-section. Although a substantially square cross-section may be preferred, it will be apparent that any other cross-section, such as circular or elliptical cross-sections, may be used in the cylindrical apertures if desired. If desired, the projections 17, 18 and 19 may be formed on the underside (rather than the upper side) of each cylindrical aperture. This

may be achieved, for example, by having the ribs or projections 17, 18 and 19 located on the underside of diaphragm 2. This will be shown, for example, by FIG. 11 by reversing the diaphragm 2 so that each aperture, such as 19, is located above each projection 15. So arranged, the relatively non-turbulent water jets traversing apertures 19, 20 and 21 may be rendered turbulent by downstream impact against the corresponding downstream projections 15, 16 and 17. Such downstream projections may be readily produced by having the concentric apertured ridges 17, 18 and 19 formed on the underside of the diaphragm 2 in the molding process for the diaphragm 2.

Hence, the chamber 10 will receive not only a plurality of turbulent jet streams of water developed by the numerous concentric projections 15, 16 and 17 and their corresponding concentric apertures 19, 20 and 21 of the diaphragm 2, but also the incoming aspirated air entering the ports 11 at the downstream end of the aerator and traveling through the peripheral openings 9 in the wall of the body 1. The incoming air will meet and commingle with the water jet streams within the chamber 10, so that the mixture of the water jets and accompanying air will be passed through the two spaced, tandem, progressively finer screens 3 and 4 to advance and increase the mixing process and then the mixture is exited from the downstream discharge port of the structure as a relatively smooth laminar, coordinated stream.

The diaphragm 2 also includes a central or axial handle 28 (see FIG. 2) which may be grasped by the fingers of the user whenever the aerator AR is to be removed from a spout or faucet FT for cleaning or other purposes. By virtue of the handle 28, the diaphragm 2 may be easily lifted bodily off the ledge 22 at the upper end of the cylindrical aerator body 1 and cleaned or otherwise treated and then reseated on the ledge 22 of the body 1 before being re-assembled and re-connected to the spout or faucet.

FIGS. 2, 6, 9 and 10 show a crush ring formation 25 which is circular and is formed atop the diaphragm 2. The crush ring 25 is brought into very intimate contact with the underside of the lower edge or internal flat ring 24 which is part of the conventional spout or faucet FT to which the aerator is connected, as shown more clearly by FIG. 9. This crush ring 25, when advanced upwardly and sealed against the flat ring 24, constitutes a significant barrier or dam which plugs the leakage of water over the rim formed by the crush ring 25 of the diaphragm 2. The seal against leakage effected by ring 25 can be firmly established by threadedly connecting the aerator AR to the faucet FT by a sufficient rotary, tight connection of the aerator against the faucet. This joinder of rings 24 and 25 is an important feature because it serves to confine the pressurized water traveling downstream to the intended established paths alongside of the groups of concentric projections such as 17. Without the barrier established by crush ring 25 and flat ring 24, water might readily be leaked out of the aerator structure via the external threads 5 of the body 1 which are mated with the internal threads of the spout or faucet FT.

FIGS. 9*a*, 9*b* and 9*c* illustrate the various shapes of the crush ring 25 as the aerator is tightened and pressed into or against flat ring 24. FIG. 9*a* shows the shape of the crush ring before the aerator is tightened. FIG. 9*b* shows the shape of the crush ring when the aerator is tightened normally against a well-formed flat ring 24. FIG. 9*c* shows the shape that the crush ring takes when the aerator is tightened more firmly to overcome either large or substantial irregularities in the mating surface of flat ring 24 or an askew condition between the threads and the plane of the mating surface, or other unusual or extraordinary conditions. The crush ring is preferably a thermo-plastic material and has a cross-section that is relatively small so that, as the aerator is tightened, it is capable of being deformed sufficiently to conform to the shape of the underside of flat ring 24. Thus, the crush ring 25 will absorb the irregularities in the flat ring 24 or any askew condition in the flat ring 24, and establishes its excellent water seal.

The body 1, as seen from FIGS. 2 and 4 and as already explained, has a plurality of parallel peripheral openings 9 through which air is drawn by aspiration into the chamber 10. These same openings 9 are also employed to develop suction so as to steer and divert into the body of the aerator any water which would pass over the barrier formed by crush ring 25 and flat ring 24. Such water is caused to travel through the spaces 26 and 27 and thereafter through the discharge opening at the downstream end of the aerator.

In accordance with this invention, as described, there are two important coordinated structures in this invention for the substantial reduction and probable elimination of water leakages from the aerator as are often encountered in practice. One of these is the circular crush ring 25 at the upper or upstream end of the diaphragm 2 conforming to the shape of the flat plate 24 and providing a barrier against leakage, as shown, for example, in FIG. 9, and the other is formed by the paths 26 and 27 and the peripheral paths 9 at the lower end of the body 1. The crush ring 25 and its adjacent flat ring 24 may be viewed, as already noted, as a barrier wall or dam formed under positive pressure, while the openings 9 are regarded as aspirators or negative pressure sources acting to return the water into the proper path within the aerator. The crush ring 25 may have, for example, a width of about 0.006 inches and a longitudinal height of 0.008 inches. Any water that might flow over the rim of the crush ring 25 and then leak through the slots 26 in the diaphragm 2 and through the gaps 26 and 27 between diaphragm 2 and the internal wall of body 1 may be passed and leaked through the apertures 9, but the aspirated air flowing upstream through apertures 9 and under sufficient negative pressure will actually draw the water into the mainstream of the device to be properly discharged thereby. These mechanical and hydraulic structures eliminate a significant leakage problem.

The screens 3 and 4 are, as already noted, of different degrees of fineness and are employed for ruggedness and added strength. The upper screen 3, for example, may be made of stainless steel formed as annealed wire cloth, the wire of which has a diameter of 0.014±0.0003 inches and providing 24 by 24 meshes per square inch. The lower screen for example, may also be made of stainless steel formed as annealed wire having a diameter of 0.0085±0.0003 inches and providing 40 by 40 meshes per square inch.

Additionally, the lower screen 4, because of its finer meshes, introduces more intimate mixing of the air and water components. Furthermore, the upper screen 3 serves to reinforce and support the wall of body 1 and significantly strengthen the body 1 and hence reduce

substantially, if not eliminate, possible breakages in body **1.**

The internal diameter of the body **1** at the parallel inner wall at its upstream end may be, for example, about 0.815 inches. The internal diameter at the exit port of the body may be about 0.715 inches. The maximum exterior diameter — which is the diameter at the base of the body **1** — may be about 0.98 inches. The vertical or longitudinal length of the aerator, including the assembled disk **2** and its crush ring **25,** but excluding the handle **21,** is slightly over ½ inch. These small dimensions obviously reduce the amount of material required to manufacture the aerator and lower its cost while maintaining sturdiness and long lasting service qualities.

The diaphragm **2** may be molded of polyethylene. The body **1** may be molded of ABS material and may be metal-plated on its exterior surface. Any good alternative materials may be used in forming these components.

FIG. **10** illustrates the above-described cleanable aerator modified to embody structure to render the aerator substantially vandal-proof. This modification includes a cylindrical element **30** which is slightly spaced from, but is wrapped around, the outer cylindrical surface of the body component **1.** The cylindrical element **30** has an inturned lower rounded segment **31,** preferably of the same thickness as the element **30,** and a thinner upper segment **32** which can be inturned or bent toward the sloping shoulder **29** of the body **1.** When arranged as shown in FIG. **10** to provide a very limited gap between the outer periphery of the body **1** and the inner wall of the cylindrical element **30** and its segments **31** and **32,** the cylindrical element **30** will be freely rotatable about the body **1.** However, the outer cylindrical element **30** will be retained by the body **1** throughout any rotation of the aerator by a vandal who seeks to abscond with the aerator and the aerator will not be removable from the faucet FT (except by the use of extraordinary force or by special tools which are not usually available to the public). This modified construction is especially useful for the protection of the aerator in public installations; it is not required for use in homes.

Although two screens designated **3** and **4** have been shown and described for illustrative purposes, it will be clearly understood that any number of screens may be employed near the discharge port of the aerator but, according to this invention, the screens should be graded so that the coarsest screen will be at the most upstream position and the finest screen at the most donwstream position. One screen, if used alone, will not be as effective in providing a mixing mechanism as will be a plurality of screens. Furthermore, the noise factor, introduced by a fast-moving stream of water, is significantly reduced by the addition of two or more spaced screens.

It will also be understood that, according to this invention, any aerator may be rendered substantially leakless by embodying the two features hereinabove referred to, one of which includes a transverse apertured diaphragm having a peripheral lip on its upstream face extending throughout the rim of the diaphragm and contacting a protruding ledge or plate peripherally arranged within the faucet or conduit to which the areator is connected and making firm contact with the lip member, and a low pressure air space developed within a chamber for drawing any water that would otherwise leak past the dam-like obstruction provided by the lip segment and the contacting peripheral plate. Thus, there are two tandemly related structures for minimizing or eliminating leakage according to this invention.

While this invention has been shown and described in certain particular embodiments merely for illustration and explanation, it will be understood that the invention may have other forms as may be apparent to those skilled in the art.

What is claimed is:

1. A substantially leakless aerator for a water conduit comprising a body member joined by threads to said conduit, an apertured diaphragm supported transversely by said body member at the upstream end of the body member and having an upstream lip segment formed as a projection substantially normal to the entire peripheral surface of said diaphragm, said conduit having an inner peripheral wall member to continuously engage the upper peripheral surface of said lip segment to form a substantially continuous barrier against leakage of water through said threads joining the body member to the conduit, the apertures of said diaphragm forming separate and distinct substantially parallel streams exiting from said diaphragm, said body member having openings for introducing air into the body member to be mixed with the streams of water traversing the apertures of the diaphragm, and a plurality of spaced screens supported near the downstream end of the body member and through which the mixture of air and water is transmitted and then discharged from said body member, the openings in said body member being substantially parallel to each other and extending from the downstream end of the body member to the space between the diaphragm and said screens, said diaphragm having peripheral slots therein for diverting water leaking past the lip segment into the mainstream of the body member at reduced pressure.

2. A substantially leakless aerator according to claim **1** in which the spaced screens have meshes of different sizes, the screen of the largest meshes being positioned upstream and the screen of the smallest meshes being positioned downstream.

3. The combination of a faucet having a discharge port, a flat ring mounted and held within said discharge port of the faucet for providing a peripheral projection within said discharge port, a cylindrical aerator body threadedly connected to said discharge port, a perforated diaphragm positioned at the upstream end of the aerator body and held perpendicular to the axis of the aerator body for converting water received by the faucet into a pluraltiy of parallel independent and distinct jets of water discharged by its apertures and having a peripheral upstream lip substantially normal to and adjacent the outer rim of the diaphragm for contacting the projection within the discharge port of the faucet when the aerator body is connected to the faucet, the areator body having a plurality of peripheral openings adjacent the downstream end of the aerator body for receiving air to be mixed with the jets of water traversing the apertures of the diaphragm, the peripheral lip of the diaphragm, when contacting said projection, acting as a barrier to prevent leakage of water through the threads coupling the aerator body to the faucet, the diaphragm also having, in addition to its apertures, a plu-

rality of peripheral slots therein for diverting, under reduced pressure, water leaking past said lip into the mainstream of the aerator body to prevent leakage of said diverted water.

4. The combination of claim 3, including two flat screens spaced from each other and mounted within the aerator body, both screens additionally mixing the air and jets of water to form a laminar stream, the upstream screen mechanically reinforcing the wall of the aerator body.

5. The combination of claim 4 in which the two screens are meshed by stainless steel wire, the mesh of the downstream screen being finer than the mesh of the upstream screen.

6. An aerator comprising a substantially cylindrical body member threadedly connectable to a conduit having an internal peripheral projection and supplying pressurized water and having a plurality of substantially parallel openings in the wall of the body member for receiving air entering from the downstream end of the body member a diaphragm having a plurality of separate, independent concentric apertures through which water received from said conduit is converted into relatively high velocity distinctive substantially parallel turbulent water jets, said body member having an upper circular rim thereon for supporting said diaphragm, said diaphragm also having a continuous peripheral ring substantially normal to its upstream end and held against the internal peripheral projection of said conduit so as to provide a barrier against leakage of water from the body member, said diaphragm also having, in addition to its apertures, a plurality of peripheral slots for diverting into the mainstream of said body member the water that would otherwise leak past the peripheral ring of the diaphragm to prevent the leakage of the diverted water, and a pair of circular screens spaced from and parallel to each other and held on separate corresponding ledges of the body member near the downstream end of the body member, said screens transmitting, as a laminar aerated mainstream, a mixture of the water of the jets traversing the apertures of the diaphragm and the air received from the openings at the downstream end of the boyd member and the water diverted through the peripheral slots of the diaphragm.

7. An aerator according to claim 6 in which the diaphragm includes a plurality of projections adjacent its apertures so as to turbulate the water flowing downstream through said apertures as parallel jets.

8. A substantially leakless aerator for a water conduit comprising a body member joined by threads to said conduit, an apertured diaphragm supported transversely by said body member at the upstream end of the body member and having an upstream lip segment formed as a projection substantially normal to the entire peripheral surface of said diaphragm, said conduit having an inner peripheral wall member to continuously engage the upper peripheral surface of said lip segment to form a substantially continuous barrier against leakage of water through said threads joining the body member to the conduit, the apertures of said diaphragm forming separate and distinct substantially parallel streams exiting from said diaphragm, said body member having openings for introducing air into the body member to be mixed with the streams of water traversing the apertures of the diaphragm, and a plurality of spaced screens supported near the downstream end of the body member and through which the mixture of air and water is transmitted and then discharged from said body member, the spaced screens having meshes of different sizes, the screen of the largest meshes being positioned upstream and the screen of the smallest meshes being positioned downstream, the openings in the body member being peripherally arranged to be substantially parallel to each other and to extend from the downstream end of the body member to the space between the diaphragm and the upstream screen, and spaces being provided between the rim of the diaphragm and the body member so that said openings and said spaces together divert into the mainstream of the body member any water that leaks past the lip segment.

9. A substantially leakless aerator according to claim 8, including a skirt member surrounding and spaced slightly from the body member to render the areator vandal-proof.

10. The combination of a faucet having a discharge port, a flat ring mounted and held within said discharge port of the faucet for providing a peripheral projection within said discharge port, a cylindrical aerator body threadedly connected to said discharge port, a perforated diaphragm positioned at the upstream end of the aerator body and held perpendicular to the axis of the aerator body for converting water received by the faucet into a plurality of parallel independent and distinct jets of water discharged by its apertures and having a peripheral upstream lip substantially normal to and adjacent the outer rim of the diaphragm for contacting the projection within the discharge port of the faucet when the aerator body is connected to the faucet, the aerator body having a plurality of peripheral openings adjacent the downstream end of the aerator body for receiving air to be mixed with the jets of water traversing the apertures of the diaphragm, the peripheral lip of the diaphragm, when contacting said projection, acting as a barrier to prevent leakage of water through the threads coupling the aerator body to the faucet, two flat screens spaced from each other and mounted within the aerator body, both screens additionally mixing the air and jets of water to form a laminar stream, the upstream screen mechanically reinforcing the wall of the aerator body, the two screens being meshed by stainless steel wire, the mesh of the downstream screen being finer than the mesh of the upstream screen, and means for rendering the aerator vandal-proof, said means including a shell spaced from the aerator body and encircling the aerator body so that any rotation of the shell will not connect the aerator body to or disconnect it from the conduit.

11. An aerator comprising a substantially cylindrical body member threadedly connectable to a conduit having an internal peripheral projection and supplying pressurized water and having a plurality of substantially parallel openings in the wall of the body member for receiving air entering from the downstream end of the body member, a diaphragm having a plurality of separate, independent concentric apertures through which water received from said conduit is converted into relatively high velocity distinctive substantially parallel turbulent water jets, said body member having an upper circular rim thereon for supporting said diaphragm, said diaphragm also having a continuous peripheral ring substantially normal to its upstream end and held against the internal peripheral projection of said conduit so as to provide a barrier against leakage of water

from the body member, and a pair of circular screens spaced from and parallel to each other and held on separate corresponding ledges of the body member near the downstream end of the body member, said screens transmitting, as a laminar aerated stream, a mixture of the water of the jets traversing the apertures of the diaphragm and the air received from the openings at the downstream end of the body member, the diaphragm including a plurality of projections adjacent its apertures so as to turbulate the water flowing downstream through said apertures as parallel jets, and an enveloping shell positioned externally about the body member and spaced from, but retained by, the body member and rotatable about the body member without connecting the aerator to or disconnecting the aerator from the conduit.

12. An aerator according to claim **11** in which the screens are meshed by stainless steel annealed wire cloth, the upstream screen having 24 × 24 meshes and the downstream screen having 40 × 40 meshes (per square inch).

13. A substantially leakless aerator for a water conduit comprising a body member, engaging threads on the conduit and the body member for connecting the body member to the conduit, a diaphragm supported at its periphery at the upstream end of the body member, said diaphragm having a plurality of distinct disconnected apertures through which incoming water is converted into substantially parallel turbulent jets, said diaphragm having a lip segment formed as a substantially normal projection extending along and throughout the upper surface of said diaphragm, the conduit having an internal wall segment to engage the upper end of the lip segment throughout the periphery of the lip segment to form a substantially continuous barrier against leakage of water through said threads, said body member having openings extending from the downstream end of said body member to an intermediate region of the body member so as to receive air to be mixed with the water jets traversing the diaphragm and for producing a reduced air pressure within the body member to aspirate water which leaks past the lip segment and to direct the leaked water downstream so that the leaked water may be diverted into the mainstream of the body member, and screen means for discharging the water from the downstream end of the body member.

14. A substantially leakless aerator for a water conduit according to claim **13,** in which the screen means includes a first screen positioned on a ledge of the body member adjacent the upstream ends of the openings in the body member for reinforcing the wall of the body member, and a second screen of a mesh which is finer than the mesh of the first screen and which is positioned on a ledge downstream of the ledge supporting the first screen.

15. A substantially leakless aerator according to claim **14** in which the first and second screens are meshed by stainless steel wires.

16. A substantially leakless aerator according to claim **15,** including a shell positioned about the body member and spaced therefrom so as to be freely movable about the body member without disengaging the body member form the conduit.

17. A substantially leakless aerator comprising a substantially cylindrical body member having two peripheral circular ledges spaced from each other near the downstream end thereof, two screens having meshes of different fineness, the coarser screen being supported by the upstream ledge and the finer screen by the downstream ledge, the body member having a plurality of substantially peripheral parallel air openings each of which extends from the downstream end of the body member and reaches above the upstream screen, and a circular diaphragm seated along the upstream end of the body member so as to provide a mixing chamber between its downstream end and the upstream screen, said diaphragm having a plurality of distinct non-connected apertures and associated barriers for converting received pressurized water into a plurality of substantially parallel turbulent jet streams emitted by said apertures, the diaphragm also having a peripheral ring formed on its upstream end as a barrier substantially normal thereto for providing a dam-like obstruction for blocking the leakage of water via a path between the peripheral ring on the diaphragm and any openings in the body member, air being aspirated upwardly through the parallel openings in the body member into the chamber to mix with the parallel jets of water traversing the diaphragm, the aspirated air reducing the pressure within the chamber for drawing water that would leak past the peripheral ring on the diaphragm into the chamber so that the drawn water will be discharged through the screens and then through the discharge port of the aerator.

18. A substantially leakless aerator according to claim **17,** in which the screens are meshed by stainless steel annealed wire cloth and have different sized meshes.

19. An aerator for a faucet, comprising external threads on the aerator to mesh with internal threads within the faucet, a diaphragm positioned laterally at the upstream end of the aerator and having apertures for converting water received by the aerator from the faucet into a plurality of turbulent jets, a pair of spaced screens positioned laterally across the aerator and located near the downstream end of the aerator, a plurality of substantially equal and parallel openings within the aerator extending from the downstream end of the aerator to positions between the diaphragm and the upstream screen for receiving air to be mixed with the jets of water, means for preventing leakage comprising a peripheral lip extending along the entire upstream surface of the diaphragm, and a flat peripheral ring positioned along the internal wall of the faucet for contacting the lip along the diaphragm throughout its peripheral length, the openings in the aerator being proportioned to establish a reduced pressure within the aerator for aspirating any water passing the lip on the diaphragm, such water being drawn under the influence of the reduced air pressure into the mainstream of the aerator to be discharged through the downstream discharge port of the aerator.

20. An aerator to be threadedly connected to the inner wall of a faucet, comprising a first leakage protection means, said first means including a peripheral ring mounted within the faucet upstream of the threads within the faucet to which the aerator is to be connected, a diaphragm mounted transversely across the upper periphery of the aerator, a peripheral lip mounted as a cylinder normal to the upstream side of the diaphragm and in contact with the peripheral ring in the faucet to block leakage through the threads connecting the aerator to the faucet, and a second leakage protection means, said second means including a plu-

rality of openings in the wall of the aerator and peripherally arranged substantially parallel to each other along the downstream end of the aerator for receiving air, the received air producing a reduced pressure within the aerator so as to draw water traversing the ring within the faucet and the lip on the diaphragm so that such water will not be leaked out of the aerator but will be drawn into the mainstream of the aerator.

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