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AERATOR STRUCTURE AND LEGGED DIAPHRAGM THEREFOR
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The present invention relates to novel water aerator structures for improving the aeration of a stream of water within a limited space and legged diaphragm constructions for use therein.

Reference is made to devices such as shown in my prior U.S. Patent No. 2,316,832, granted April 20, 1943, entitled "Fluid Mixing Device." These aerators have an upstream diaphragm and downstream screens, both located in a casing. The casing has an air hole in its side wall intermediate the diaphragm and the screens. Water jets are projected from the diaphragm and downstream screens, both located in a casing. The casing has an air hole in its side wall intermediate the diaphragm and the screens. Water jets are projected from the diaphragm at the screens which finely break up the water, mix it with air, and discharge it as a coherent jet laden with numerous small bubbles. A disadvantage of the device is that in event the screens become clogged, water builds up in the device and is projected out of the air holes of the device. This renders the faucet useless until the aerator is cleaned and, moreover, it may have the further disadvantage of projecting water on the clothing of people using the device.

It is an object of the invention to provide a legged diaphragm construction which maximizes the space available for the air mixing chamber inner aerator of a given outside diameter by supporting the diaphragm in a jet forming position above the mixing chamber on legs which provide added mixing space therebetween and cooperates with enlarged internal air channels in the inner wall of the outer casing to supply ample air to the mixing chamber for proper aeration.

It is an object of the invention to increase the available space for air flow from the discharge end of an aerator to the mixing chamber by a large percentage whereby the available air for mixing with water in the aerator is adequate for the formation of a bubbly non-splashing stream.

In diaphragms having a perforate skirt, the imperforate part of the skirt, (a) limits the flow of outside air into the mixing chamber, (b) decreases the overall size of the mixing chamber and (c) to a large extent restricts or may even close the air passageway in aerators having an air intake from the outlet end.

In FIGURE 1 of the present application it will be seen that the air passageway may be completely closed if a continuous annular skirt is used instead of legs as shown in the figure. It follows that replacement of the perforate skirt by a non-perforate skirt will result in a mixing chamber whether from the outlet end of the casing or through lateral slots in the casing wall. Also it has been established in actual operation that the increased space in the mixing chamber does in fact provide very substantial improvement in water aeration.

It is an object of the invention to increase the quantity of properly aerated water available at the discharge end of an aerator of given size by minimizing the obstruction to water and air flow presented by the aerator structure itself and increasing the size of the air and water channels and the size of the mixing chamber. This is accomplished in part by reducing the wall thickness of the casing except at four projections extending longitudinally of the casing body, provide inwardly extending lugs to support the screen framing and the legged diaphragm. The larger internal diameter between the ribs provides the additional space for air flow. It will be noted that the threads on the ribs are complete while the threads between ribs lack their top parts.

In carrying out some of the aforesaid objects, I provide an air space between the downstream screens and the inner side wall of the casing, and I also provide an air space between the water projected out of the downstream end of the faucet and the lower outer edge of the casing whereby in event the screens become clogged the water will overflow from the screens into the aforesaid air space and thence down and out the annular space between the main stream of water and the downstream edge of the casing.

This application is a continuation-in-part of my prior pending applications, Serial Nos. 44,162, filed July 20, 1960, allowed April 1962, now abandoned; 351,907, filed April 29, 1953, now abandoned; 500,299, filed January 20, 1955, now abandoned; 601,711, filed August 2, 1956 (Patent No. 2,998,927); 601,712, filed August 2, 1956; and 639,648, filed February 12, 1957 (Patent No. 2,998,923), which in turn are continuations-in-part of my prior application Serial No. 135,6445, filed December 29, 1949, entitled "Fluid Mixing Device." A part of the subject matter of the last named application issued into U.S. Patent No. 2,811,340, dated October 29, 1957. In the drawings:

FIGURE 1 is a cross-sectional view of one form of the invention.
FIGURE 2 is a sectional view taken along the line 2—2 of FIGURE 1; and
FIGURE 3 is a sectional view of another form of the invention, taken along line 3—3 of FIG. 4.
FIGURE 4 is a plan view of the casing of FIGURE 3 with the diaphragm and screens removed for clarity.
In FIGURE 1 casing 10 has an intumned lip 11 at its downstream end upon which all of the operating parts of the aerator are directly or indirectly supported. Internal threads at the upstream end of the casing enable it to be attached to a faucet containing water under pressure. Two screens 12 are respectively contained in two ring-shaped frames 13. These frames have metal projecting pins 14 extending radially therefore and the pins on the lower one of the two frames 13 rest upon the lip 11 and thereby support the lower screen 12 together with its frame. The upper screen 12, together with its frame and pins is supported by the lower one of the frames, and in turn supports the plastic disc 15 which is constructed according to the principles set forth in my prior application, filed February 18, 1957, Serial No. 640,885, (Patent No. 2,998,929), entitled "Water Aerators." The plastic element 15 has a multiplicity of passageways 16 through which water is projected upon the screens 12. The plastic element also includes, above each passageway, a bridge 17 which causes the water discharged from the disc 15 to have a preliminary division, which aeration is increased and modified by virtue of the screen 12. As a result the device discharges a whitish coherent jet laden with numerous small bubbles. The plastic disc 15 has spaced legs 18 which rest upon the upper frame 13 and allows air to enter the mixing space through the spaces between the legs. The air enters originally through the space between the lip 11 and the frame 13 and then passes in the spaces between pins 14 of the lower frame 13. Air continues in a vertical direction between the pins 14 of the upper frame 13 and thence through the spaces between legs 18 to the mixing area.
In the event one or both of the screens become clogged, water overflows from the top screens and passes between the pins 14 of the frames and out the space between the lip 11 and the lower frame 13. It thus is not projected in the direction of the person using the faucet. It does,
however, appear as a different type of stream from that normally produced by the aerator and thus puts the user on notice that the aerator requires cleaning.

The legged diaphragm or disc 15 of FIGURE 1 function advantage with the structure of the casing 40 of FIGURES 3 and 4. Casing 40 is thredded as at 41 for attachment to the discharge end of a faucet and is provided with three or four inturned legs 42 for supporting framings 43 and legged diaphragm 15. Casing 40 has a straight inner wall 44 in which threads 41 are formed on the downstream rib wall portion 45 of smaller diameter positions framings 43 centrally in casing 40 and carries inturned legs or tongues 42 which support the inner assembly.

Lugs or tongues 42 are three or four in number and exist only at the downstream end of ribs 45 which are formed by cutting away the inner walls of casing 40 as shown at 46, increasing the width of air passageway 47 and cutting off the crests of the threads 41 between the ribs 45 as shown at 48.

A comparison of the clearance 49 between the ribs 45 and the width of air passage 47 provides a measure of the greatly increased air flow made possible by the present construction. The space added to mixing chamber 50 by the material removed between legs 18 is a substantial aid in improving aeration of the jet streams produced by passages 16 in diaphragm 15.

The space 47 is also helpful in providing passage for air into mixing chamber 50 when the casing 40 is slotted as indicated at S in that the legs 18 of diaphragm are not able to obstruct air flow into mixing chamber 50 by blocking off the slots S.

It will be seen that the perfect threads 41 are sufficient to hold the casing 40 firmly on the faucet which is formed against the flat surface 51 of plastic legged diaphragm 15 which functions as a washer and confines the water flow to the space above diaphragm 15 within the annular collar 52. In this way the water is not able to flow down the opening 53 and the space 47.

While there have been described above what are presently believed to be the preferred forms of the invention, variations thereof will be obvious to those skilled in the art and all such changes and variations which fall within the spirit of the invention are intended to be covered by the generic terms in the appended claims, which are variably worded to that end.

I claim:

1. An aerator comprising a one piece casing conduit for receiving water under pressure at one end and discharging the water from its other end, jet forming means in the casing for increasing the velocity while decreasing the cross-section of the water, mixing means supported by the conduit adjacent its downstream end for finely breaking up the water and mixing it with air to produce a coherent stream laden with numerous small bubbles, said jet forming means being part of an element having integrally included widely spaced relatively narrow legs extending downstream from the element and resting on the mixing means whereby to support the jet forming means in spaced relation with the mixing means, thereby to provide a mixing space, the spaces between said relatively narrow legs being in communication with air outlets for the provision thereby to provide an air passageway to said mixing space, and maximize the volume of said mixing space, said conduit having a single, narrow, integral, imperforate, inturned ledge at its downstream end extending completely around the inside wall of the conduit and serving as the sole support of said jet forming means and said mixing means, said mixing means having spaced projections extending outward therefrom and resting on said ledge, said projections leaving air passages therebetween for air to enter said casing conduit and then pass through the spaces between said legs and into the space between said jet forming means and said mixing means.

2. In combination a single piece casing for water aerators comprising a cylindrical body having threads adjacent the upstream end of said casing and an inturned segmented ledge at its downstream end, said casing having a plurality of longitudinal channels on the inner wall thereof and forming relatively wide areas of decreased thickness of the single piece said casing having both a substantial increase in available space for the admixture of air and water within said casing and a plurality of air passages from adjacent the outlet end of said casing to an area within said casing surrounding a mixing space, said channels having the segments of said ledge therebetween whereby air will admixture with water within said casing is increased to form a bubbly coherent stream, mixing means resting on said ledge for finely breaking up the water and mixing it with air to produce a white coherent aerated stream of water, and jet forming means having spaced legs supporting the same above the mixing means.

3. The combination set forth in claim 2, said internal channels extending substantially the full length of said casing, the portions of said internal thread between said channels being substantially perfect threads, the portions of said threads within said channels being left unthreaded, said channels removed whereby said casing can be provided with said channels at a minimum of expense and the available space for the passage of ambient air is maximized without reducing the space available for the flow of water and the available output of properly aerated water is maximized.

4. A water aerator comprising a casing, a legged diaphragm jet forming means and screens within said casing, said casing having a segmented internal ledge for support of said screens, said diaphragm means being spaced from said screens by the legs thereof to form a mixing area within said casing, said diaphragm means comprising a disc shaped body member having jet forming means for increasing the velocity while decreasing the water cross-section and conditioning the water for mixing with air, said disc shaped body member having integral widely spaced relatively narrow legs extending downstream from the body, said legs having a length such that they position the said disc shaped body member to form a mixing chamber space immediately downstream of said body member the width and thickness of said legs being adequate to prevent crushing said disc shaped body member, to condition the water for mixture with air in said mixing chamber space to provide an enlarged mixing chamber space resulting from the absence of material between adjacent legs, said enlarged space having the double functions of adding substantially to the effective volume of said mixing chamber space and providing a passage for ambient air into said mixing chamber space in sufficient quantity so that full aeration of the water can be achieved.

5. A water aerator comprising a casing, a legged diaphragm jet forming means and screens within said casing, said casing having a segmented internal ledge for support of said screens, said diaphragm means being spaced from said screens by the legs thereof to form a mixing area within said casing, said diaphragm means comprising a disc shaped body member having jet forming means for increasing the velocity while decreasing the water cross-section and conditioning the water for mixing with air, said disc shaped body member having integral widely spaced relatively narrow legs extending downstream from the body, said legs having a length such that they position the said disc shaped body member to form a mixing chamber space immediately downstream of said body member with a downstream dimension substantially determined by the effective length of said legs, the width and thickness of said legs being adequate to prevent crushing said disc shaped body member, to condition the water for mixture with air in said mixing chamber space and to provide an enlarged mixing chamber space resulting from the absence of material between adjacent legs, said enlarged space having the double functions of adding substantially to the effective volume of said mixing chamber space and
providing a passage for ambient air into said mixing chamber space in sufficient quantity so that full aeration of the water can be achieved, said casing comprising a cylindrical body having internal threads adjacent the upstream end of said casing and said internal segmented ledge at its downstream end, said casing having a plurality of longitudinal channels on the inner wall thereof and forming relatively wide areas of decreased thickness of the single piece casing, said channels providing both a substantial increase in available space for the admixture of air and water within said casing and a plurality of air passages from adjacent the outlet end of said casing to an area within said casing surrounding a mixing space, said channels having the segments of said ledge therebetween whereby the supply of ambient air for admixture with water within said casing is increased to form a bubbly coherent stream.

6. The combination set forth in claim 5, said internal channels being as deep as the structural strength of said casing in operation safely permits and extending substantially the full length of said casing, the portions of said internal thread between said channels being substantially perfect threads, the portions of said threads within said channels having their tops removed whereby said casing can be provided with said channels at a minimum of expense and the available space for the passage of ambient air is substantially increased without reducing the space available for the flow of water and the available output of properly aerated water is maximized.

7. In combination a single piece casing for water aerators comprising a cylindrical body having threads adjacent the upstream end of said casing and an integral turned segmented ledge at its downstream end, said casing having a plurality of longitudinal channels on the inner wall thereof and forming relatively wide areas of decreased thickness of the single piece casing, said channels providing both a substantial increase in available space for the admixture of air and water within said casing and a plurality of air passages from adjacent the outlet end of said casing to an area within said casing surrounding a mixing space, said channels having the segments of said ledge therebetween whereby the supply of ambient air for admixture with water within said casing is increased to form a bubbly coherent stream, screen means resting on said ledge and covering the internal cross-section of said casing except for said channels, said channels starting from the downstream end of the casing and extending straight to a level above the screen means, and jet forming means upstream the screen means.

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