Aug. 4, 1964 F. E. BENJAMIN 3,143,299

AERATING DEVICE

Filed Aug. 14, 1963

Fig. 1.

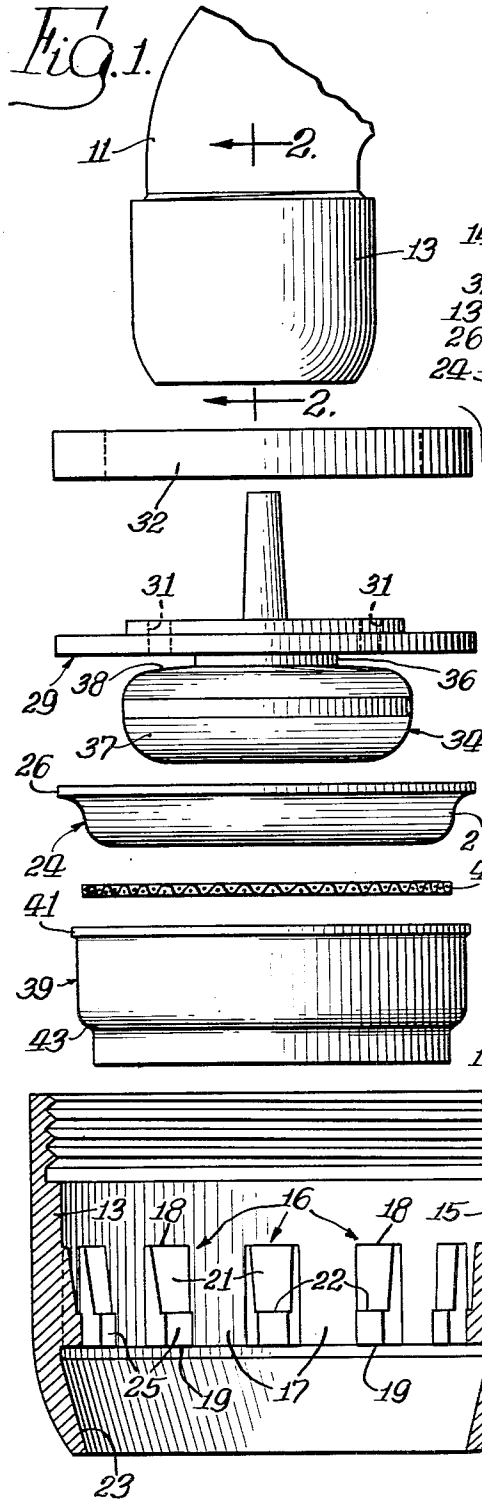


Fig. 2.

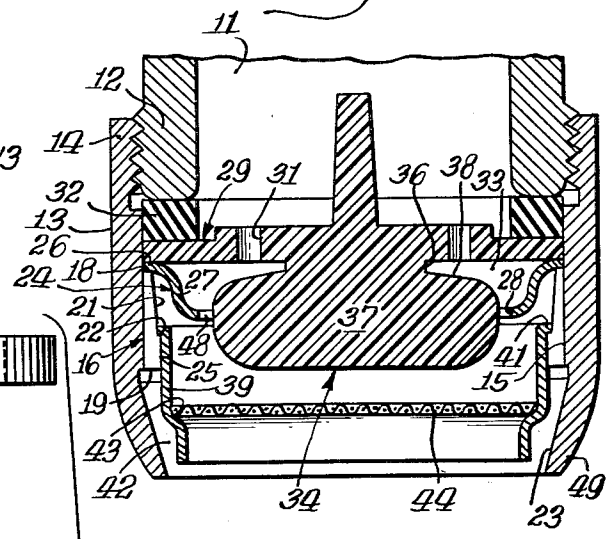
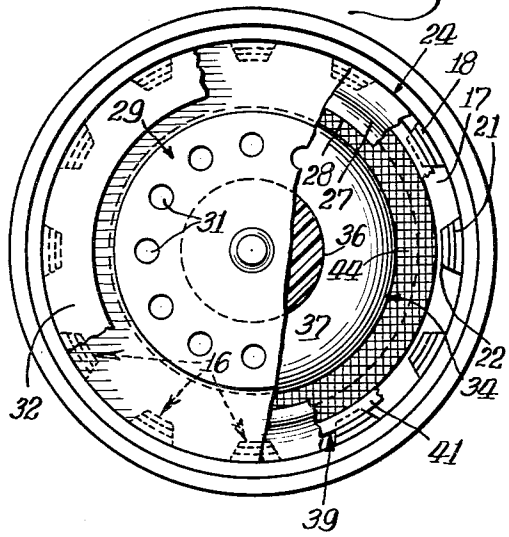


Fig. 4.

Fig. 3.



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AERATING DEVICE

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6 Claims. (Cl. 239—427)

This invention relates to improvements in aerating devices of the type adapted to be connected to water faucets and the like. This application is a continuation in-part of my copending application Serial No. 91,988, filed February 27, 1961, now abandoned.

Aerating devices for mixing water and air are now widely known and used on faucets and other water outlets. Such devices are highly useful and advantageous since in their preferred form they produce a soft, bubbly, coherent stream which is non-splashing and which contains large amounts of entrained air. Various structures have been proposed for such devices, e.g. as shown in U.S. Patent No. 2,761,662 wherein the device has a tubular casing provided with lateral air inlet ports or slots, an apertured disk for forming jets of water within the casing, a breakup plug against which the jets impinge, and means at the outlet of the casing for coalescing the water and entrained air.

The customary provision of lateral air inlet ports or slots in the wall of the aerator casing permits undesirable lateral discharge of water therethrough in the event that the bottom outlet from the casing is obstructed or clogged. Moreover, such slots in the casing wall afford ledges for the accumulation of dirt and debris, thereby interfering with proper intake of air and also presenting a significant sanitary problem. I am aware that others have proposed the use of vertical passages or bottom air inlet arrangements in order to avoid the disadvantages of lateral slots or openings in the casing. However, all such modified aerating devices heretofore proposed have been characterized by complicated structures such that the manufacturing cost is prohibitive, or in many instances the capacity and aerating efficiency of such devices are inferior as compared with a conventional aerating device of similar dimensions having air inlet slots in the casing wall.

Accordingly, a primary object of the invention is to provide a novel and improved aerator in which the usual lateral air inlet ports or slots in the casing have been eliminated.

A further object of the invention is to provide a novel and improved aerator having a bottom air inlet without any appreciable sacrifice in the size of the effluent aerated stream or in the aerating efficiency of the device.

Another object of the invention is to provide an aerating device having novel and improved bottom-opening air intake structure.

An additional object of the invention is to provide an aerating device having a novel, casing construction for supporting and locating the internal structure of the device in the casing.

A still further object of the invention is to provide a novel aerating device of the foregoing character which employs splines or ribs on the inner peripheral wall of the casing.

Other objects and advantages of the invention will become evident from the subsequent detailed description taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a side elevational view of a faucet outlet having mounted thereon an aerator comprising one specific embodiment of the invention;

FIG. 2 an enlarged longitudinal sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged top plan view of the aerator with portions broken away to reveal the interior structure; and

FIG. 4 is an exploded view showing the various parts of the aerator.

Referring to FIGS. 1–4 of the drawing, the aerating device of the present invention is mounted on the end of a fluid supply conduit or faucet shown fragmentarily at 11 and having an externally threaded open end portion 12. The aerating device itself has a cylindrical or tubular casing 13 with an internally threaded upper or inlet end portion 14 adapted to be screwed onto the externally threaded end 12 of the conduit 11. The inner wall surface, indicated at 15, of the casing 13 is formed with a plurality of vertical ribs or splines, designated generally at 16, which are circumferentially spaced so as to provide a plurality of grooves 17 between adjacent ribs. Each rib 16 has a flat upper end 18 spaced axially below the inlet end of the casing 13 and a lower end 19 spaced axially above the outlet end of the casing 13. The innermost edge of each rib 16 includes a portion 21 (FIG. 2) which tapers downwardly and inwardly from the upper end 18 to a narrow shoulder or ledge 22. The shoulders or ledges 22 of the ribs 16 lie in a common plane perpendicular to the axis of the casing 13 for the purpose hereinafter described. Below the shoulders 22 the ribs 16 have vertical or straight edge portions 25 which are parallel to the axis of the casing 13. Below the lower ends 19 of the ribs 16, the inner wall surface 15 of the casing 13 tapers inwardly, as at 23, to the outlet end of the casing.

The circumferentially spaced upper ends 18 of the ribs 16 define a series of shoulders which lie in a common plane perpendicular to the axis of the casing 13 and upon which is supported an annular baffle 24 having its upper end 26 flared outwardly into tight frictional engagement with the casing 13 and overlying the rib ends 18. The baffle 24 also has a depending skirt portion 27 and a lower inturned lip portion 28. A disk 29 having a plurality of perforations 31 is seated on the outwardly flared rim 26 of the baffle 24 and has a slightly loose fit in the upper end of the tubular casing 13 so as to be readily removable. When the threaded casing 13 is in fully tightened position on the end of the faucet, a gasket 32 of rubber or the like is clamped between the disk 29 and the end of the conduit 11 thereby providing a fluid-tight seal so that water under pressure from the conduit 11 is forced through the perforations or apertures 31 to provide a multiplicity of substantially independent or discrete jets which are surrounded by air, as hereinafter described, in an internal mixing zone 33 within the aerator.

A depending breakup or splash plug 34 is suspended centrally from the disk 29 and is so shaped that the plurality of fine jets from the apertures 31, which entrain air in passing through the zone 33, impinge upon the plug and are broken up and mixed with the entrained air. The illustrated shape of the plug 34, which is more or less like that of a mushroom, has been found to give highly effective results. The plug 34 has a restricted neck portion 36 immediately below the apertured disk 29 and then an abrupt radially extending enlargement or button portion 37 which provides the primary water jet breakup function of the device. The enlargement 37 has a sloping shoulder portion 38 disposed beneath the apertures 31 so that the liquid jets may impinge thereon and be diverted in many different directions. The enlarged portion 37 of the breakup plug 34 may be said to have a generally toroidal or oblate spheroidal shape. As illustrated, the perforated disk 29—31 and the depending plug 34 are integrally molded from a suitable resinous or plastic material, but it will be understood that the disk and plug may also be made of metal as separate

pieces which are suitably connected to form a unitary member.

Concentrically mounted at the lower or outlet end of the casing **13** is a tubular partition **39** having an outwardly turned rim **41** seated on the ledges or shoulders **22** and in tight frictional engagement with the sloping edge portions **21** of the rib **16**. Below the rim **41**, the tubular partition **39** has an upper portion of uniform diameter which frictionally engages the vertical edge portions **25** of the ribs **16**. The tubular partition **39** extends downwardly below the lower ends **19** of the ribs **16** in annularly spaced relation from the inner wall of the casing **13** so as to provide an enlarged and unobstructed annular air inlet passage or zone **42** having an opening at the bottom of the aerator. The lower end portion of the partition **39** has a slightly restricted diameter so as to provide an annular shoulder or support **43** for a foraminous member, in this instance a disk-like screen **44** which extends transversely across the partition **39**. Thus the screen **44** at the lower part of the tubular partition **39** provides a flow retarding action, as hereinafter described.

Assembly of the various parts of the aerating device is greatly facilitated by the provision of the ribs **16** around the inner wall **15** of the casing **13**. Thus, the first assembly step is to press-fit the tubular partition **39** into the casing **13** so that the outwardly turned rim **41** thereof is seated on the ledges or shoulders **22** and the outer peripheral surface of the partition **39** adjacent the rim **41** frictionally engages the straight or non-tapered edge portions **25** of the ribs **16** in the manner illustrated in FIG. 2.

One of the advantages of the present structure is that the internal tubular partition **39** is an uncomplicated element which can be fabricated by simple drawing operations from ordinary imperforate thin-walled tubular stock. However, axial pressure must be exerted on the tubular partition **39** in order to force it into the ribbed casing, and because of the relative thinness of the tubular wall it is desirable to utilize a suitable fixture or mandrel. While various types of fixtures could be used, it is preferable to employ one which extends in close-fitting relation into the upper end of the tubular partition **39** in order to support the side wall and which is provided with an annular radially outwardly extending shoulder for engaging and exerting axial pressure against the rim **41** at the end of the tubular partition. The flange or rim **41** thus provides an additional area for transmitting the force of the fixture to the partition.

The tapered edge portions **21** of the ribs **16** greatly facilitate the aforementioned press-fit operation by providing an important guide action as the partition is pressed into place by means of the fixture or mandrel. The outer diameter of the rim or flange **41** is slightly less than the diametric spacing between the inner edge of the ribs **16** at the upper portions of the latter, and as the partition **39** is pressed into the casing the rim **41** eventually engages the shoulders **22** of the ribs **16**, the latter thereby functioning as stops to limit downward movement of the partition and assure its accurate final positioning in the casing **13**. Such accurate alignment is essential to the effective operation of the aerator as even minor dimensional inaccuracies greatly affect its performance.

After the tubular partion **39** has been press-fitted into place, the screen **44** may be inserted therein if it was not previously installed in the partition. Thereafter, the baffle **24** is press-fitted into the casing with the outwardly flaring upper end **26** of the baffle tightly engaging the inner wall **15** of the casing and abutting the upper ends **18** of the ribs **16**. Thus, the ribs **16** also perform a stop function to insure proper positioning of the baffle **24** relative to the casing **13** and the other structure.

With the baffle **24** mounted in the casing **13**, the disk and plug assembly **29–34** and the gasket **32** are readily inserted into the upper end of the casing. The aerator is then ready for installation, such as on the faucet **11**.

Assuming that the aerator has been mounted on the faucet **12**, its operation is as follows.

Water under pressure enters the upper or inlet end of the casing **13** and is forced through the apertures **31** in the disk **29** thereby creating a multiplicity of fine separate jets of water below the disk **29**. Because of their discrete or relatively independent nature, these jets are entirely surrounded by air which freely enters the space **33** by passing upwardly through the annular passageway **42** and the grooves **17** and thence through the annular opening, designated at **48**, between the plug body **37** and the baffle lip **28**. As the water jets pass downwardly through the space **33** while surrounded by air, the air becomes entrained in the jets and the latter then impinge with considerable force against the shoulder portion **38** of the plug **34**.

The violent impingement of the water jets against the surface **38** causes considerable splashing and breakup of the jets in all directions thereby further intimately mixing the water and the air within the space **33** defined between the disk **29**, the plug **34**, and the baffle **24**. Obviously, some of the water will be thrown back against the underside of the disk **29** and some will also be thrown outwardly against the skirt **27**. The splashing water may be in the form of sprays or separate droplets depending upon the degree of breakup. Furthermore, some of the water will adhere to the plug **34** as a thin film and pass downwardly along the curved outer surface of the plug to the relatively flat bottom surface thereof. In accordance with the known requirements for proper aerator operation, the annular opening **48** must have a greater area than the combined area of the openings **31** in the disk **29**. By means of this relationship, there is no tendency for the incoming water to collect in and fill up the space **33** and inlet air has free access to the space **33**. Consequently, proper impingement and breakup of the individual water jets and entrainment of air therein are realized because of the absence of restrictions to fluid flow downstream from the openings **29**.

The disperse mixture of commingled air and water passes downwardly through the annular space **48** into the upper end of the tubular partition **39**, it being noted that the internal diameter of the annular lip **28** is substantially less than the internal diameter of the tubular partition **39** which is disposed in coaxial alignment with and in axially spaced relation below the baffle **24**. Thus, the intimate mixture of air and water which is discharged through the opening **48** is directed or diverted into the relatively enlarged upper end of the tubular partition **39** by reason of the relatively smaller diameter baffle lip **28**. The aerated mixture passes downwardly through the tubular partition **39** while at the same time air may pass upwardly in countercurrent concentric relation through the annular passage **42** and the spaced grooves **17**. As the aerated mixture passes through the opening **48** its velocity is increased, but as the mixture enters the tubular partition **39** its velocity is diminished partly by reason of the enlarged diameter of the partition **39** and partly by the flow retarding effect of the screen **44**. Thus, the tubular partition **39** and the screen **44** cooperate to effect coalescence or forming of the aerated mixture into a unitary coherent stream for discharge from the aerator outlet. In addition, the screen **44** also tends to give a somewhat "softer" flow which assists in imparting non-splashing characteristics to the effluent aerated stream.

As heretofore mentioned, the lower ends **19** of the ribs **16** terminate above the outlet end of the casing **13** and, as seen in FIG. 2, are disposed at a point somewhat above the axial or longitudinal mid-point of the tubular partition **39**. Such relationship provides several impor-

tant advantages. First, such termination provides the enlarged air inlet space **42** between the casing **13** and the partition **39**, and there is therefore less tendency for the inlet space to become clogged or obstructed by dirt and mineral deposits. More importantly, however, the enlarged air inlet space **42** results in a reduction in the inlet velocity of the annular air stream entering the lower end of the casing **18** as compared with the higher air velocity through the restricted grooves **17** upstream from the inlet zone **42**. Consequently, there is a substantial reduction in the aspirating action of the air stream tending to suck water from the central aerated stream discharging from the aerator.

If the ribs **16** extended to the lower end of the casing **13**, or substantially that far, the inlet velocity of the air entering the outlet end of the aerator would be appreciably higher and water along with air would be drawn into the grooves **17** because of the strong suction effect. This is highly undersirable since, even under the most favorable conditions, continued flow of entrained water through the grooves **17** would cause a build-up of mineral deposits in these restricted passages and eventual obstruction of air flow. In addition, the aspiration of water from the periphery of the effluent aerated stream would impart an undesirable ragged appearance to the discharge stream. Also, some loss in aerating efficiency could be expected due to a reduction in the quantity of air flowing into the aerator.

In addition to the foregoing operational advantages resulting from the termination of the lower ends **19** of the ribs **16** above the lower end of the casing **13**, the absence of ribs at this point also makes it possible to provide the lower end of the casing **13** with the inward taper **23** so that the exterior of the casing can be curved or rounded, as at **49**, for styling and a more attractive appearance.

While only one embodiment of the invention has been herein illustrated and described, it will be understood that modifications and variations thereof may be effected without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. In an aerating device having a tubular casing with upper and lower ends defining a fluid inlet and outlet, respectively, an apertured disk extending across said casing adjacent said inlet, and a breakup and mixing body depending from said disk; the improvement comprising a plurality of axially extending ribs projecting radially inwardly from the inner surface of said casing and spaced circumferentially around the interior of said casing whereby to provide a plurality of axially extending grooves between said ribs, said ribs having lower ends terminating substantially above said outlet, and an imperforate tubular partition supported concentrically within said casing for discharging a central aerated stream from said outlet, said tubular partition having an upper end portion of uniform diameter engaging the inner edges of said ribs, said partition also having a lower end portion extending below said lower ends of said ribs and terminating adjacent said outlet in concentric inwardly spaced relation from the lower end of said casing whereby to define an enlarged annular air inlet zone therebetween for the entry of air upwardly in countercurrent relation with respect to the effluent aerated stream from said tubular partition, and said grooves communicating at their lower ends with said air inlet zone for the passage of air upwardly through said grooves between said casing and said upper end portion of said tubular partition into the space around said body and below said disk.

2. In an aerating device having a tubular casing with upper and lower ends defining a fluid inlet and outlet, respectively, an apertured disk extending across said casing adjacent said inlet, and a breakup and mixing body depending from said disk; the improvement comprising a plurality of axially extending ribs projecting radially inwardly from the inner surface of said casing and spaced circumferentially around the interior of said casing whereby to provide a plurality of axially extending grooves between said ribs, said ribs having lower ends terminating substantially above said outlet, each of said ribs having a shoulder formed therein, said shoulders being disposed above the lower ends of said ribs and lying in a common plane perpendicular to the axis of said casing, and an imperforate tubular partition disposed concentrically within said casing for discharging a central aerated stream from said outlet, said tubular partition having an upper end portion of uniform diameter engaging the inner edges of said ribs with upper flange means engaging said shoulders, said partition also having a lower end portion extending below said lower ends of said ribs and terminating adjacent said outlet in concentric inwardly spaced relation from the lower end of said casing whereby to define an enlarged annular air inlet zone therebetween for the entry of air upwardly in countercurrent relation with respect to the effluent aerated stream from said tubular partition, and said grooves communicating at their lower ends with said air inlet zone for the passage of air upwardly through said grooves between said casing and said upper end portion of said tubular partition into the space around said body and below said disk.

3. The device of claim 2 further characterized in that the outer diameter of said upper flange means of said partition is slightly less than the diametric spacing between the inner edges of said ribs at the upper end portions thereof, and the inner edges of said ribs include portions which taper downwardly and inwardly from said upper end portions to said shoulders.

4. The device of claim 3 further characterized in that said ribs also have straight inner edge portions extending between said shoulders and said lower ends, and said upper end portion of said tubular partition engages said straight inner edge portions of said ribs.

5. An aerating device comprising a tubular casing having upper and lower ends defining a fluid inlet and outlet, respectively, a plurality of axially extending ribs projecting radially inwardly from the inner surface of said casing and spaced circumferentially around the interior of said casing whereby to provide a plurality of axially extending grooves between said ribs, said ribs having upper ends terminating below said inlet and defining a first series of circumferentially spaced shoulders lying in a plane perpendicular to the axis of said casing, said ribs having lower ends terminating substantially above said outlet, an apertured disk supported by said first series of shoulders and extending across said casing adjacent said inlet, a breakup and mixing body depending centrally from said disk, said ribs also having another series of circumferentially spaced shoulders disposed below said first mentioned shoulders and lying in a plane parallel thereto, and an imperforate tubular partition disposed concentrically within said casing for discharging a central aerated stream from said outlet, said partition having a uniform diameter upper end portion engaging the inner edges of said ribs with upper flange means seated on said last mentioned shoulders and said partition also having a lower end portion extending below the lower ends of said ribs, said lower end portion of said partition being spaced concentrically inwardly from the lower end of said casing whereby to define an enlarged annular air inlet zone therebetween for the entry of air from the lower end of said casing in countercurrent relation with respect to the effluent aerated stream from said partition, and said grooves communciating with said air inlet zone for the passage of air upwardly through said grooves between said casing and said upper end portion of said tubular partition into the space around said body and below said disk.

6. The device of claim 5 further characterized by the provision of an annular skirt having an outwardly turned

upper flange portion seated on said first series of shoulders with said disk supported on said flange portion, said skirt extending downwardly from said flange portion in concentrically spaced relation between said ribs and said body, and said skirt having a lower inturned lip portion spaced from said body with said body depending below said lip portion.

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