May 3, 1955 H. SHAMES ET AL 2,707,624

LIQUID AERATOR

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Fig. 1

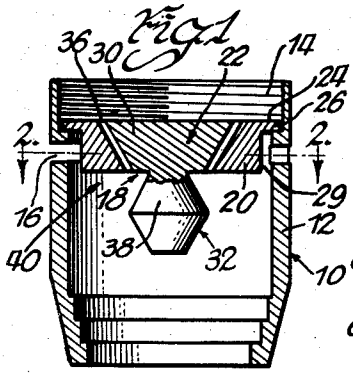



Fig. 5

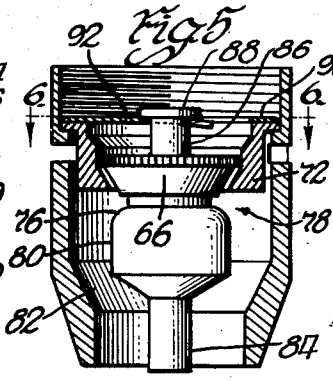



Fig. 9

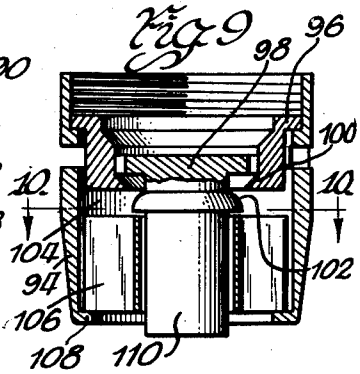



Fig. 2

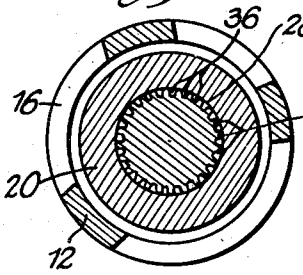



Fig. 6

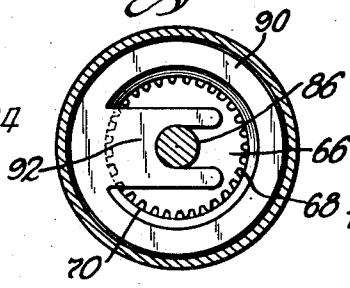



Fig. 10

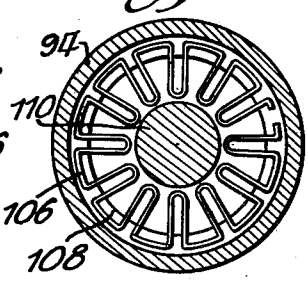



Fig. 3

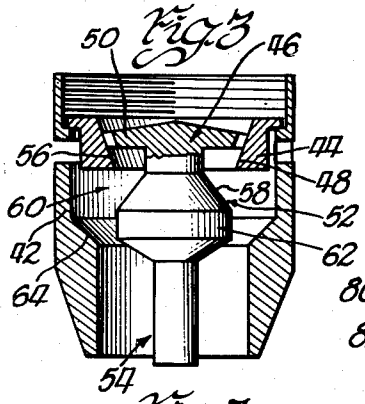



Fig. 7

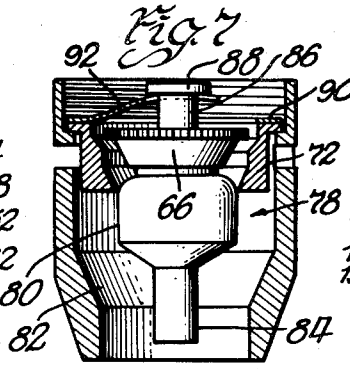



Fig. 11

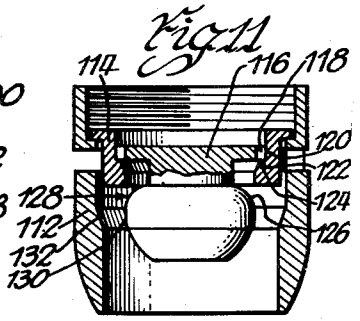



Fig. 4

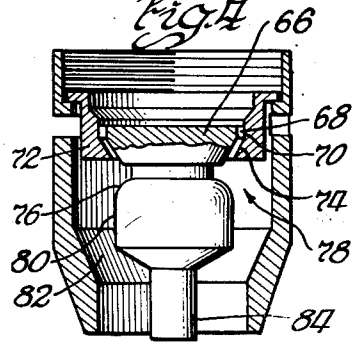
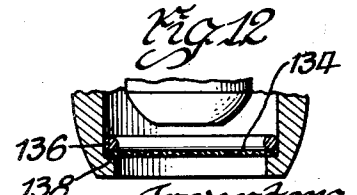



Fig. 8




Fig. 12




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Fig. 13

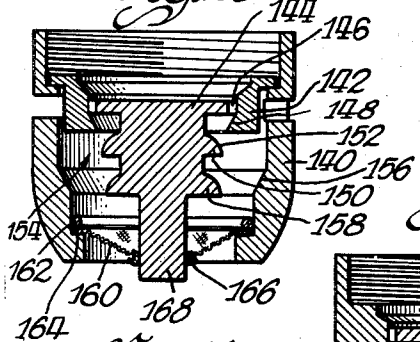



Fig. 15

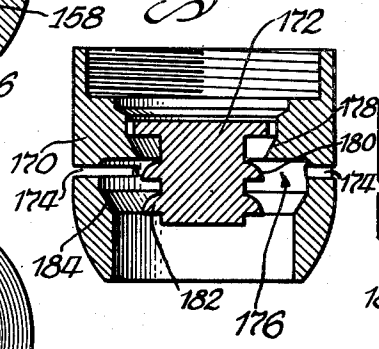



Fig. 17

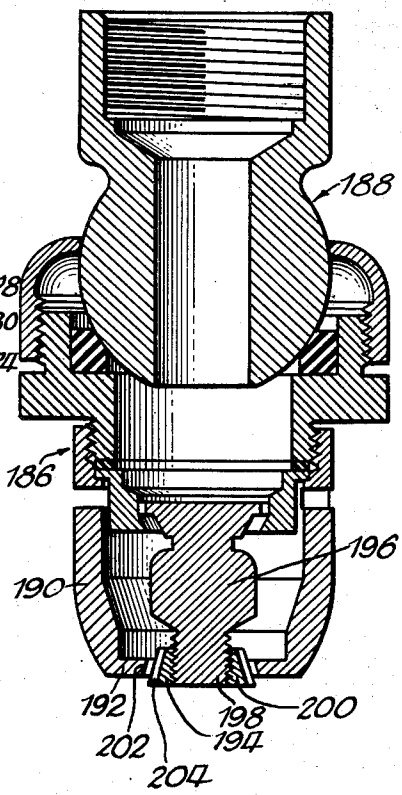



Fig. 14

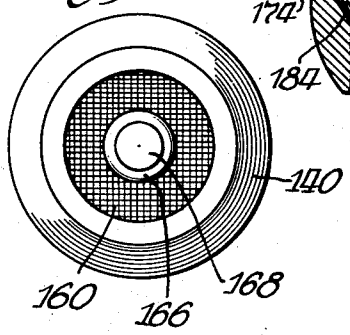
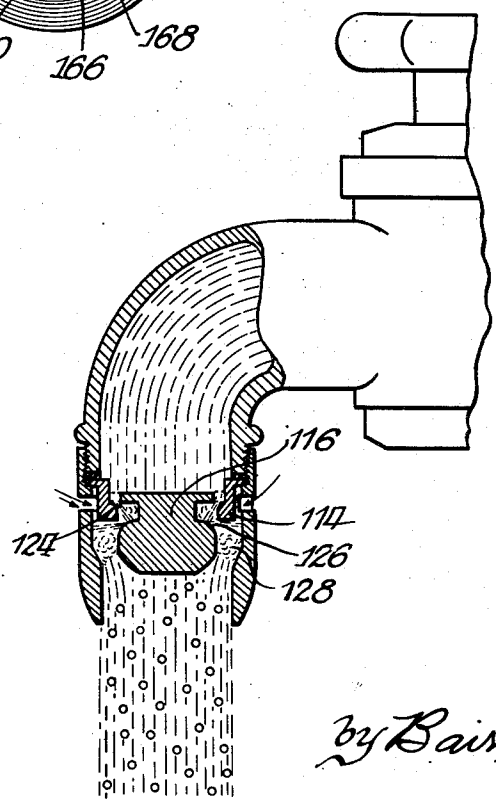



Fig. 16




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United States Patent Office

2,707,624

Patented May 3, 1955



2,707,624

# LIQUID AERATOR

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Application April 2, 1952, Serial No. 279,984

9 Claims. (Cl. 261—76)

This invention relates to a device for aerating liquids and more particularly to a water aerator.

Heretofore, liquid aerators such as household water faucet aerators have been constructed in such a manner as to spray the water either indiscriminately, or in a direction primarily downstream, axially of the aerator, into a region which is vented to the atmosphere. The reduced air pressure, in said region into which the water is sprayed, is sufficient to aspirate air into the aerator. Means are then provided downstream of the aspirating region for breaking up the water spray and for mixing the water and air into a stream of bubbles. These means are generally in the form of screens such as shown in Aghnides 2,210,846 and 2,316,832. The screens are for intimately mixing the air with the water prior to the issuing of the aerated fluid from the aerator. In Aghnides 2,316,832 additional foraminous members are positioned in the water stream upstream of the aspirating chamber.

We have found that the aspirating action which is obtained by means of streams or jets of liquid directed generally downstream, axially of the aerator, can be greatly improved by causing the liquid to be dispersed initially in directions generally transverse to the axis of the aerator. We have also found that the initial dispersal or splashing of the liquid in directions transverse to the axis of the aerator brings about an improved mixing of the liquid and air without the necessity of employing screens. We have also determined that by incorporating a flow straightening means downstream of our improved liquid-air mixer, we may achieve a very simple and inexpensive commercial aerator of reduced length.

Thus one of the objects of this invention is to provide an aerator for liquids, wherein improved aeration is obtained by dispersing the liquid primarily in directions generally transverse to the axis of the aerator.

Another object of this invention is to provide an aerator for liquids which eliminates the necessity of employing screens and the like.

A further object of this invention is to provide an aerator for liquids which has a mixing chamber in which the liquid is dispersed primarily in directions generally transverse to the axis of the aerator, and with means downstream of said mixing chamber for thereafter straightening the flow of the aerated liquid.

One of the major objections to the type of aerators heretofore developed pertains to the use of screens or perforated plates either upstream or downstream of the aspirating chamber in the aerator. These perforated plates and screens have a tendency to clog up with impurities carried by either the liquid or by the aspirated air. The clogging of the perforated plates and screens results in reduced flow of the liquid and with consequent reduced efficiency of aeration. In severe cases, the aerator is rendered entirely useless by being plugged up by the impurities.

Even in those cases where efforts have been made to eliminate the downstream screens, the problem exists with respect to the upstream screen or perforated plate through which the liquid passes, which upstream plate or screen is for the purpose of providing jets of liquid within the aerating chamber.



Thus, still another object of this invention is to provide an aerator for liquids having liquid restricting orifices formed by mating surfaces of a plurality of separable members, which orifices are maintained clear of impurities, whereby there is no reduction in the quantity of liquid flow which the aerator is adapted to accommodate.

Still a further object of this invention is to provide an aerator for liquids wherein foraminous members which are subject to clogging by impurities are eliminated.

And another object of this invention is to provide an aerator for liquids adapted to be cleaned of flow restricting impurities without disassembling said aerator or removing it from its operative environs.

And a further object of this invention is to provide a self-cleaning aerator for liquids.

Further objects and advantages of this invention will become apparent as the following description proceeds and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

Figure 1 is a cross section view of one form of our improved aerator showing one form of the means for obtaining improved dispersal and mixing of liquid and air.

Figure 2 is a cross section view taken substantially on line **2—2** of Figure 1.

Figure 3 is a cross section view of another form of our aerator showing one form of the means for obtaining improved dispersal and mixing of liquid and air, and also showing one form of the means for straightening the flow of the aerated liquid, and also providing means for the cleaning of the liquid flow restricting orifices.

Figure 4 is a cross section view of another form of our aerator which includes many of the features shown in Figure 3, and also shows a modified construction of the liquid flow controlling members.

Figure 5 is a cross section view of a modified form of our aerator similar to that shown in Figure 4, and is equipped with means affording self-cleaning of the liquid flow controlling orifices.

Figure 6 is a cross section view taken on line **6—6** of Figure 5.

Figure 7 is another view of the aerator shown in Figure 5, showing one of the flow controlling members in displaced position to afford cleaning of the flow controlling orifices.

Figure 8 is an isometric view of the spring used in the self-cleaning aerator shown in Figures 5–7.

Figure 9 is a cross section view of another modified form of our aerator showing another means for straightening the flow of the aerated liquid.

Figure 10 is a cross section view taken on line **10—10** of Figure 9.

Figure 11 is a cross section view of another modified form of our aerator.

Figure 12 is a modification of the aerator shown in Figure 11 and includes a screen at the outlet of the aerator.

Figure 13 is a cross section view of another modified form of our aerator, showing a screen at the outlet of the aerator, and with a member extending through the screen affording means for cleaning the liquid flow restricting orifices.

Figure 14 is a view looking upward into the aerator shown in Figure 13.

Figure 15 is a cross section view of another modified form of our aerator wherein the aerator is formed of only two members.

Figure 16 shows a water spout with one of our aerators (the one shown in Figure 11) attached thereto.

Figure 17 is a cross section view of an adaptation of our novel aerator to a shower head.

Referring now to the drawings, there is shown in Figure 1 an aerator generally indicated at **10**. This aerator includes a cylindrical barrel **12**, the upstream end of which is threaded as at **14** to afford connection of the aerator to the outlet end of a fluid carrying member as shown in Figure 16. The wall of cylindrical barrel **12** has a plurality of air inlets **16** therethrough. Flow controlling means generally indicated by numeral **18** are positioned within the barrel **12**. The flow controlling means includes an annular ring **20** and a plug member **22**.

The annular ring **20** has an outstanding flange **24** adapted to seat on shoulder **26** formed in the barrel **12**. The annular ring **20** also has an inwardly tapering bore **28** therethrough. The outer cylindrical wall **29** of the annular ring **20** is spaced concentrically from the inner surface of the cylindrical barrel **12** at the point generally opposite the air inlets **16** as clearly shown in Figure 1.

The plug **22** includes a flow control portion **30** and a splash portion or member **32**. The flow control portion **30** has bevel teeth **34** formed therein, adapted to mate with the wall of bore **28** to form orifices or liquid flow passageways **36**. The wall of the tapering bore **28** and the teeth **34** bound passageways which point axially inwardly and in a downstream direction.

The splash member **32** has splash surfaces **38** against which the liquid is directed as it passes through fluid passageways **36**. The water impinges against splash surfaces **38** and is reflected generally laterally outwardly, primarily in directions transverse to the axis of the aerator. This splashing takes place in the portion of the chamber generally indicated by numeral **40** and is known as the aeration chamber. It is within the aeration chamber **40** that the co-mingling of liquid and air, aspirated through air inlet **16**, takes place. Thereafter the mixed air and liquid passes out through the lower end of the barrel.

The aerator shown in Figure 3 includes a barrel **42**, and flow controlling means including annular ring **44** and central plug **46**. The annular ring **44** is similar to annular ring **20** and has a conical bore **48** therethrough. The plug member **46** includes a flow control portion **50**, a splash member **52**, and a lower depending stem **54**. It is not necessary that the teeth in the flow control member **50** extend the entire length of the conical bore **48** because after the liquid leaves the lower edges of the passageways formed between the teeth and the wall of the bore **48**, the liquid is still directed conically inwardly by the lower portion **56** of the sloping wall of bore **48**.

The liquid leaving the flow control ring **44** is directed onto the splash surfaces **58** of splash member **52** and is reflected into the aeration chamber **60** wherein the co-mingling of the splashed liquid and the aspirated air takes place.

Thereafter as the flow passes downstream through the aerator it is straightened out by reason of certain structural features shown in Figure 3. This is achieved by first constricting a portion of the flow passageway downstream of the aeration chamber **60** and then permitting the downstream portion of the flow passageway to enlarge. To achieve this end, the plug member **46** is provided with a cylindrical portion **62** extending downstream of the lower edge of the splash surface **58** while the inner wall of the surrounding portion of barrel **42** is tapered inwardly over a portion of its axial length as shown at **64**. Thereafter, the plug member **46** is reduced in diameter to form the downwardly depending stem **54** which lies concentrically within the barrel **42**.



The cylindrical portion **62** of the center plug **46** and the inwardly tapering wall **64** of the surrounding portion of the barrel **42** cooperate to provide an annular passageway which, extending downstream from the aeration chamber **60**, first becomes constricted and then later expands. It is by this simple expedient that straightening of the flow of aerated liquid is obtained as the liquid leaves the aeration chamber **60**.

The downwardly depending stem **54** extends below the lower edge of the barrel **42** and is adapted to be manipulated by a person's finger so as to be displaced upwardly to separate the teeth of flow control member **50** from the wall of bore **48**. This results in greatly enlarging the passageways between these two members and permits flushing out the impurities which may clog the liquid flow passageways.

In the aerator shown in Figure 4, many of the features are similar to those shown in Figure 3. However, in the form shown in Figure 4, the central plug **66** is equipped with cylindrical teeth **68** and the portion **70** of the bore in the annular ring member **72** is also formed cylindrical. Downstream of the portion **70**, the portion **74** of the ring is conical and tapers axially inwardly. The teeth **68** of the central plug **66** engage the upper edge of conical portion **74** of the ring **72**, and in that way the plug is prevented from passing downstream through the ring.

In Figure 4, as in the higher numbered figures described hereinafter, the downstream edge of the teeth **68** and the conical surface portion **74** of the ring member **72** cooperate to define, in the conical plane that lies perpendicular to said conical surface **74**, the minimum cross-section area through which the liquid passes, and, therefore, serves as the metering means for the liquid. This minimum, or metering, cross-section area through which the liquid passes is less than the upstream cross-section area of the axially extending flow passageways defined between the cylindrical teeth **68** and the cylindrical wall **70** of the annular ring **72**, thereby permitting the upstream ends of said axially extending flow passageways to become partially plugged with dirt or debris without effecting the flow capacity of said metering means.

The inwardly tapered portion **74** of the ring serves to direct the fluid onto the splash surfaces of the plug positioned therebelow. The splash surfaces **76** of the plug are curved convexly and the fluid striking the splash surfaces **76** is directed primarily in directions transverse to the axis of the aerator into the aerating chamber generally indicated at **78** where mixing of the splashed liquid and air takes place. Thereafter the mixture of liquid and air in passing downstream through the aerator passes through a constricted passageway formed between the cylindrical portion **80** of the center plug and the inwardly tapering wall **82** of the aerator barrel in a manner as set forth in the description of Figure 3. The downwardly depending stem **84** of the center plug affords means for unseating the plug **66** from the ring **72** so as to permit flushing of the liquid passageways formed between the teeth **68** and the bore wall **70**.

In the aerator shown in Figure 5, the center plug is provided with an upstanding stud **86** with an enlarged head **88** thereon. A spring member **90** having a bifurcated cantilevered arm **92** engaging the under side of head **88** provides means for automatically lifting the plug member away from its seat in the annular ring **72**, so that flushing out of the liquid flow passageways is achieved. The spring is so designed that when a predetermined liquid pressure is imposed on the upstream surfaces of the center plug, then the center plug is seated in the operating position shown in Figure 5, and when the liquid pressure is removed from the center plug, then the center plug is lifted to the position shown in Figure 7. By this simple arrangement, the aerator is self-cleaning because when the flow of liquid is shut down the cen-

ter plug is always moved to a position where flushing out of the passageways will take place.

In the aerator shown in Figure 9, the straightening out of the flow of aerated liquid is achieved by means of a corrugated member positioned in the barrel of the aerator downstream of the aerating chamber. In Figure 9, the barrel is indicated at **94**, the annular ring is **96** and the center plug is **98**. The flow of liquid is directed by surface **100** of the annular ring **96** onto the splash surfaces **102** of the center plug **98**. The splashed fluid is directed into aeration chamber **104** where aeration takes place. Downstream of the splash surfaces **102**, there is positioned a member **106** which has portions thereof bent back upon themselves to form a plurality of radially disposed walls which extend axially within the barrel and divide the flow passageway into a plurality of axially extending segments. The axially extending walls of member **106** serve to straighten the flow.

The lower edge of barrel **94** is provided with a lip **108** for supporting member **106** in position. The plug member **98** is provided with a downwardly depending stem **110** which extends below the lower edge of the barrel **94** to afford lifting of the center plug **98** from its seated position in annular ring **96** to permit flushing out of the liquid flow passageways.

In the aerator illustrated in Figure 11, there is shown a barrel **112**, an annular ring **114**, and a center plug **116**. The upper portion of center plug **116** is disc-shaped and has teeth **118** formed therein, in the edge of the disc-shaped portion, which cooperate with a portion **120** of the bore through annular ring **114** to provide liquid flow passageways. As shown in Figure 11, the center plug **116** also includes a reduced neck portion beneath the disc-portion, and a ball-shaped member, of greater dimension than said neck portion, at the lower end of said neck portion. An inwardly extending shoulder **122** is formed in annular ring **114** and is adapted to engage the under side of the teeth **118** to form a fairly substantial seat for the plug member **116**. The guide surface portion **124** of the ring **114** downstream of the shoulder **122** tapers inwardly and in a downstream direction and serves to direct the fluid passing through the liquid flow passageways.

The ball-shaped portion of the center plug is provided with splash surfaces **126**. The flow directed by surface **124** impinges against splash surfaces **126** and is reflected therefrom, and entrains air within the aeration chamber **128**. Thereafter the flow of aerated liquid passing downstream goes through a passageway which is constricted. The constriction in the passageway for the aerated liquid is obtained by positioning a cylindrical portion of the ball-shaped portion of the plug **130** concentrically within a tapered portion **132** of the inner wall of the barrel **112**. Thereafter, the diameter of the ball-shaped portion of the plug reduces sharply so as to provide an expansion of the flow passageway downstream of the constriction. In Figure 11, the metering cross-section area through which the liquid flows is defined between the downstream edge of the teeth **118** and conical surface **124**, and the annular space defined between ring **114** and the neck of center plug **116**, and surrounding the neck of center plug **116**, being of much greater area than said metering cross-section, is never filled with liquid.

The modified form shown in Figure 12 shows the inclusion of an anti-splash screen **134** at the outlet end of the barrel. The anti-splash screen does not operate to effect any aeration, or mixing with air, of the liquid passing therethrough. This screen is retained in position by means of a ring or spring **136** which is retained in position by friction, and which clamps the screen **134** against a shoulder **138** formed at the downstream end of the barrel.

In the aerator illustrated in Figure 13, there is a barrel **140**, an annular ring **142**, and a center plug **144**. The annular ring **142** and the upper portion of the center plug **144** are similar in many respects to the annular ring and the corresponding part of the center plug illustrated in Figure 9. The center plug **144** is provided with teeth **146** which cooperate with adjacent surfaces of the annular ring to form flow passageways, and the annular ring **142** is provided with fluid directing surfaces **148** located downstream of said flow passageways.

The lower portion of the center plug in Figure 13 is different than the lower portions of the center plugs of any of the aerators previously described. The center plug **144** includes an upper umbrella-shaped portion **150** having a convexly curved surface **152** which serves as a splash surface. The liquid directed by the surfaces **148** impinge upon and are reflected from the splash surfaces **152** into the aerating chamber or region **154** where mixing of the liquid and air takes place. Thereafter, as the aerated liquid passes downstream it passes a constriction formed by the tapering inner surface **156** of the barrel and a lower umbrella-shaped portion **158** formed integral with the center plug. After the aerated liquid passes the constriction in the flow passageway, the flow passageway enlarges in area as in the other forms hereinbefore described.

The aerator shown in Figure 13 is also equipped with an anti-splash screen **160**, of the same general type and function as shown in Figure 12, at the outlet end of the barrel which is secured in position by means of a ring **162** which clamps the screen against a shoulder **164** formed at the outlet end of the barrel. The screen **160** has a central aperture **166** therein through which extends the downwardly depending stem **168** of the center plug **144**. The downwardly depending stem extends below the lower end of the aerator barrel and affords means for manipulating the center plug **144** upwardly so as to unseat the teeth **146** from the annular ring **142**, thus enlarging the flow passageways formed therebetween, so as to permit flushing out of any impurities which may tend to clog said flow passageways.

The screen **160** slopes downwardly toward its central portion so that dirt and other impurities that do not pass through the screen fall downhill toward the central aperture **166** through which they may pass.

In the aerator shown in Figure 15, the number of parts are reduced by reason of making the annular ring integral with the barrel of the aerator. The aerator shown in Figure 15 has but two parts—the barrel **170** and the center plug **172**. The barrel **170** is a member which is formed with shoulders and tapering surfaces which perform the identical function that the annular ring performed in the aerators previously described. In the particular form shown in Figure 15, the air inlets **174** in the barrel **170** are located somewhat lower than they previously were located and lead directly into the splash chamber **176** wherein the mixing of the liquid and the air takes place. The barrel **170** has tapering surfaces **178** which direct the liquid onto the splash surfaces **180** of the center plug. Downstream of the splash surfaces there is a second umbrella-shaped member **182**, formed similar to that shown in Figure 13, and this umbrella cooperates with a tapering inner surface **184** in the barrel for the purpose of providing a constriction in the flow passageway downstream of the mixing chamber **176**.

Figure 16 illustrates a typical connection of one of the aerators described herein and above, particularly the one shown in Figure 11, to the outlet of a faucet. The liquid passing through the passageways formed between the center plug **116** and the annular ring **114** is directed by tapering surfaces **124** onto the splash surface **126** of the center plug. Aeration takes place in the mixing or splash chamber **128**, which aeration is indicated by the turbulence lines shown in the drawing. Thereafter as the aerator fluid passes downstream it passes a constriction in the flow passageway, hereinabove described, and thereafter the flow is straightened out as indicated in the drawing

by the streamlines which are shown originating adjacent the constriction in the flow passageway.

In Figure 17 there is illustrated an adaptation of our novel aerator to a shower head. The shower head is generally indicated at **186** and has a ball connection to a source of fluid generally indicated at **188**, which ball connection permits pivoting of the shower head in a multitude of directions. The aerator portion shown in Figure 17 is similar to that illustrated in Figure 4, except that the downstream end of the barrel **190** is partially closed off by a flange member **192** and by flow directing member **194** which is attached to the center plug **196** of the aerator. The center plug **196** of the aerator has a downwardly depending stem **198** which is threaded as at **200**.

The end flange **192** is provided with a tapering edge **202**; and flow directing member **194** is provided with cooperating bevel teeth **204**. The bevel teeth **204** cooperate with the tapered edges **202** to form shower stream flow passageways therebetween. The tapering of the edge **202** and the bevel teeth **204** provide direction to the aerated stream as it leaves the shower head. The stream is aerated prior to its passing the passageways formed between surface **202** and teeth **204**. The flow directing member **194** is formed separate from the center plug **196** so that the entire arrangement may be assembled. Flow directing member **194** is threaded to stem **198**, and it can be seen that adjustment in the size of the shower stream may be provided by adjusting the axial position of member **194** on stem **198**.

The aerating shower head shown in Figure 17 may be constructed with any of the additional features shown and described in the other modified forms illustrated in this specification. For example, it is very desirable to have a self-cleaning aerating shower head. By simply adding the stud and head thereon to the center plug **196**, and by adding the cooperating spring, shown in Figures 5–8, the shower head in Figure 17 may be modified in the same manner as the aerator in Figure 4 was modified to achieve the form shown in Figure 5.

Suitable modifications may be made in the flow directing member **194** and flange **192** such as increasing the clearance therebetween or by varying the slope of the cooperating edges therebetween, to accommodate the axial movement of the center plug in the shower head. It is also contemplated, as a modification of the structure shown, that the edge of the flange **192** be provided with teeth which cooperate with the cylindrical or conical surface of member **194** to form the shower stream flow passageways therebetween.

The teeth which are formed in the center plug in the aerators described hereinabove, which teeth cooperate with adjacent surfaces in the annular ring or barrel to form liquid flow passageways, may be made of different pitch as desired to vary the size of the flow passageways and consequently to vary the liquid flow capacity of the aerator. In the particular form shown in Figure 11, an additional element, which may be varied in production as desired, controlling the flow capacity of the aerator is the shoulder **122** which partially blocks the outlet end of the flow passageways while also serving as a seat for the center plug.

Furthermore, by varying the size of the liquid flow passageways, such as by varying the pitch of the teeth, or their number, or size, or by controlling the size of the supporting shoulder **122**, or by variations of any combination of these elements, the aerator can be modified to aerate liquids of various viscosities. This latter feature is of great importance when using the aerator for aerating machine tool coolants of different viscosity.

It can be seen that we have provided an aerator for liquids wherein improved aeration is obtained by dispersing the liquid primarily in directions generally transverse to the axis of the aerator and thereby eliminating screens and the like which had previously been used for obtaining aeration of the liquid. It will also be seen that by eliminating screens and the like from aerators, the possible clogging of the screens and reduction of flow therethrough is substantially eliminated. It will further be seen that we have provided an aerator which is adapted for easy cleaning thereof without the necessity of dismantling the aerator.

Some changes may be made in the construction and arrangement of the parts of our device without departing from the real spirit and purpose of our inventiton, and it is our intention to cover by our claims any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

We claim as our invention:

1. A liquid aerator comprising a barrel having its upstream end adapted for connection to a source of liquid, said barrel having air inlets therein, and means within said barrel for breaking up the flow of liquid and for mixing the liquid with air ingested through said air inlets, whereby the liquid issuing from the downstream end of the barrel has small bubbles disseminated throughout, said means including an annular member positioned in said barrel, a plug member positioned in the central aperture of said annular member, said annular member and plug member having axially extending adjacent cylindrical edges, said edge of the plug member being grooved, said adjacent cylindrical edges of both members cooperating to form flow passageways, a portion of said annular member being positioned downstream of said plug and engaging said plug adjacent its grooved edge, said last mentioned portion of the annular member extending radially inwardly of said grooved edge of the plug and having conical surfaces extending downstream of the downstream ends of said flow passageways for directing the liquid issuing from said passageways in convergingly directed streams, said grooved edge of the plug and said conical surfaces of the annular member cooperating to provide means for defining the limiting size of said convergingly directed streams, which convergingly directed streams are smaller in size than the size of said flow passageways, thus allowing said flow passageways to become partially blocked without affecting the maximum flow of liquid which may pass through said aerator, and a splash member within said barrel downstream of said flow passageways positioned to have said convergingly directed streams impinge thereagainst.

2. A liquid aerator comprising, in combination: a tubular barrel having its upstream end adapted for connection to a supply of liquid under pressure and having lateral air inlets therein; an annular ring in said barrel extending inwardly from the inner wall of said barrel and providing an inner ring surface which includes an upstream cylindrical surface portion, and a flow-directing conical surface portion located downstream of said cylindrical surface portion and being sloped to converge downstream, and the greatest diameter of said conical surface portion being no greater than the diameter of said cylindrical surface portion; and a plug member removably supported in said annular ring comprising a cylindrical liquid-dividing disc and a splash member, said cylindrical liquid-dividing disc having a plurality of axially extending grooves formed in the periphery thereof, the maximum diameter of said cylindrical disc being substantially the same as the diameter of said cylindrical surface portion, so that said ring and grooved disc cooperate to define therebetween a plurality of axially extending flow passageways, the downstream edge of said liquid-dividing disc cooperating with said conical surface portion to define metering means for the liquid, the metering cross-section area of which is less than the upstream cross-section area of said axially extending flow passageways, thereby permitting the upstream ends of the flow passageways to become partially blocked without affecting the flow capacity of said metering means, and said splash member being located downstream of said metering means and positioned to have the liquid which is

directed by said converging conical surface portion directed thereagainst to effect break-up of said liquid within said barrel and to cause aeration of said liquid within said barrel with air aspirated thereinto through said air inlets.

3. A liquid aerator comprising, in combination: a tubular barrel having its upstream end adapted for connection to a supply of liquid under pressure and having lateral air inlets therein; an annular ring in said barrel extending inwardly from the inner wall of said barrel and providing an inner ring surface which includes an upstream cylindrical surface portion, and a flow-directing conical surface portion located downstream of said cylindrical surface portion and being sloped to converge downstream, and the greatest diameter of said conical surface portion being no greater than the diameter of said cylindrical surface portion; and a plug member removably supported in said annular ring comprising a cylindrical liquid-dividing disc and a splash member, said cylindrical liquid-dividing disc having a plurality of axially extending grooves formed in the periphery thereof, the maximum diameter of said cylindrical disc being substantially the same as the diameter of said cylindrical surface portion, so that said ring and grooved disc cooperate to define therebetween a plurality of axially extending flow passageways, the downstream edge of said liquid-dividing disc cooperating with said conical surface portion to define metering means for the liquid, the metering cross-section area of which is less than the upstream cross-section area of said axially extending flow passageways, thereby permitting the upstream ends of the flow passageways to become partially blocked without affecting the flow capacity of said metering means, said splash member being located downstream of said metering means and positioned to have the liquid which is directed by said converging conical surface portion directed thereagainst to effect break-up of said liquid within said barrel and to cause aeration of said liquid within said barrel with air aspirated thereinto through said air inlets, and the maximum dimension of said splash member being smaller than the minimum diameter of said conical surface portion.

4. A liquid aerator comprising, in combination: a tubular barrel having its upstream end adapted for connection to a supply of liquid under pressure and having lateral air inlets therein; an annular ring in said barrel extending inwardly from the inner wall of said barrel and providing an inner ring surface which includes an upstream cylindrical surface portion, and a flow-directing conical surface portion located downstream of said cylindrical surface portion and being sloped to converge downstream, and the greatest diameter of said conical surface portion being no greater than the diameter of said cylindrical surface portion; and a plug member removably supported in said annular ring comprising a cylindrical liquid-dividing disc and a splash member, said cylindrical liquid-dividing disc having a plurality of axially extending grooves formed in the periphery thereof, the maximum diameter of said cylindrical disc being substantially the same as the diameter of said cylindrical surface portion, so that said ring and grooved disc cooperate to define therebetween a plurality of axially extending flow passageways, the downstream edge of said liquid-dividing disc cooperating with said conical surface portion to define metering means for the liquid, the metering cross-section area of which is less than the upstream cross-section area of said axially extending flow passageways, thereby permitting the upstream ends of the flow passageways to become partially blocked without affecting the flow capacity of said metering means, said splash member being located downstream of said metering means and positioned to have the liquid which is directed by said converging conical surface portion directed thereagainst to effect break-up of said liquid within said barrel and to cause aeration of said liquid within said barrel with air aspirated thereinto through said air inlets, and a screen positioned across the downstream end of said barrel.

5. A liquid aerator comprising, in combination: a tubular barrel having its upstream end adapted for connection to a supply of liquid under pressure and having lateral air inlets therein; an annular ring in said barrel extending inwardly from the inner wall of said barrel and providing an inner ring surface which includes an upstream cylindrical surface portion, and a flow-directing conical surface portion located downstream of said cylindrical surface portion and being sloped to converge downstream, and the greatest diameter of said conical surface portion being no greater than the diameter of said cylindrical surface portion; and a plug member removably supported in said annular ring comprising a cylindrical liquid-dividing disc and a splash member, said cylindrical liquid-dividing disc having a plurality of axially extending grooves formed in the periphery thereof, the maximum diameter of said cylindrical disc being substantially the same as the diameter of said cylindrical surface portion, so that said ring and grooved disc cooperate to define therebetween a plurality of axially extending flow passageways, the downstream edge of said liquid-dividing disc cooperating with said conical surface portion to define metering means for the liquid, the metering cross-section area of which is less than the upstream cross-section area of said axially extending flow passageways, thereby permitting the upstream ends of the flow passageways to become partially blocked without affecting the flow capacity of said metering means, said splash member being located downstream of said metering means and positioned to have the liquid which is directed by said converging conical surface portion directed thereagainst to effect break-up of said liquid within said barrel and to cause aeration of said liquid within said barrel with air aspirated thereinto through said air inlets, said barrel bounding a mixing passageway for said liquid and air which extends downstream from the downstream end of said annular ring, said mixing passageway having a region of minimum cross-section area spaced downstream from the downstream end of said annular ring and spaced upstream of the downstream end of said barrel, and the cross-section area of said mixing passageway at the downstream end of the barrel being greater than said minimum cross-section area.

6. A liquid aerator comprising, in combination: a tubular barrel having its upstream end adapted for connection to a supply of liquid under pressure and having lateral air inlets therein, and a support shoulder formed in the inner wall of said barrel between said upstream end of the barrel and said air inlets; an annular ring removably supported on said shoulder in said barrel and extending inwardly from the inner wall of said barrel and providing an inner ring surface which includes an upstream cylindrical surface portion, and a flow-directing conical surface portion located downstream of said cylindrical surface portion and being sloped to converge downstream, and the greatest diameter of said conical surface portion being no greater than the diameter of said cylindrical surface portion; and a plug member removably supported in said annular ring comprising a cylindrical liquid-dividing disc and a splash member, said cylindrical liquid-dividing disc having a plurality of axially extending grooves formed in the periphery thereof, the maximum diameter of said cylindrical disc being substantially the same as the diameter of said cylindrical surface portion, so that said ring and grooved disc cooperate to define therebetween a plurality of axially extending flow passageways, said conical surface portion being positioned to receive and to turn and direct the flow of liquid issuing from said flow passageways for movement downstream along said conical surface portion, and said splash member being located downstream of said conical surface portion and positioned to have the liquid, which is directed by said converging conical

surface portion, directed thereagainst to effect break-up of said liquid within said barrel and to cause areation of said liquid within said barrel with air aspirated thereinto through said air inlets.

7. A liquid aerator comprising, in combination: a tubular barrel having its upstream end adapted for connection to a supply of liquid under pressure and having lateral air inlets therein; an annular ring integral with said barrel extending inwardly from the inner wall of said barrel, said annular ring joining the barrel wall at a point between the upstream end of the barrel and the air inlets, said annular ring providing an inner ring surface which includes an upstream cylindrical surface portion, and a flow-directing conical surface portion located downstream of said cylindrical surface portion and being sloped to converge downstream, and the greatest diameter of said conical surface portion being no greater than the diameter of said cylindrical surface portion; and a plug member removably supported in said annular ring comprising a cylindrical liquid-dividing disc and a splash member, said cylindrical liquid-dividing disc having a plurality of axially extending grooves formed in the periphery thereof, the maximum diameter of said cylindrical disc being substantially the same as the diameter of said cylindrical surface portion, so that said ring and grooved disc cooperate to define therebetween a plurality of axially extending flow passageways, the downstream edge of said liquid-dividing disc cooperating with said conical surface portion to define metering means for the liquid, the metering cross-section area of which is less than the upstream cross-section area of said axially extending flow passageways, thereby permitting the upstream ends of the flow passageways to become partially blocked without affecting the flow capacity of said metering means, and said splash member being located downstream of said metering means and positioned to have the liquid which is directed by said converging conical surface portion directed thereagainst to effect break-up of said liquid within said barrel and to cause aeration of said liquid within said barrel with air aspirated thereinto through said air inlets.

8. A liquid aerator comprising, in combination: a tubular barrel having its upstream end adapted for connection to a supply of liquid under pressure and having lateral air inlets therein; an annular ring in said barrel extending inwardly from the inner wall of said barrel and providing an inner ring surface which includes an upstream cylindrical surface portion, and a flow-directing conical surface portion located downstream of said cylindrical surface portion and being sloped to converge downstream, and the greatest diameter of said conical surface portion being no greater than the diameter of said cylindrical surface portion; and a plug member removably supported in said annular ring comprising a cylindrical liquid-dividing disc and a splash member, said cylindrical liquid-dividing disc having a plurality of axially extending grooves formed in the periphery thereof, the maximum diameter of said cylindrical disc being substantially the same as the diameter of said cylindrical surface portion, so that said ring and grooved disc cooperate to define therebetween a plurality of axially extending flow passageways, the downstream edge of said liquid-dividing disc cooperating with said conical surface portion to define metering means for the liquid, the metering cross-section area of which is less than the upstream cross-section area of said axially extending flow passageways, thereby permitting the upstream ends of the flow passageways to become partially blocked without affecting the flow capacity of said metering means, said splash member being located downstream of said metering means and positioned to have the liquid which is directed by said converging conical surface portion directed thereagainst to effect break-up of said liquid within said barrel and to cause aeration of said liquid within said barrel with air aspirated thereinto through said air inlets; and a plurality of substantially radially extending members in said barrel downstream of said annular ring and said plug member for straightening the flow of aerated liquid prior to its issuance from the downstream end of said barrel.

9. A liquid areator comprising, in combination: a tubular barrel having its upstream end adapted for connection to a supply of liquid under pressure and having lateral air inlets therein; an annular ring in said barrel extending inwardly from the inner wall of said barrel and providing an inner ring surface which includes an upstream cylindrical surface portion, and a flow-directing conical surface portion located downstream of said cylindrical surface portion and being sloped to converge downstream, the greatest diameter of said conical surface portion being the same size as the diameter of said cylindrical surface portion and the downstream edge of said cylindrical surface portion coinciding with the upstream edge of the conical surface portion; and a plug member removably supported in said annular ring comprising a cylindrical liquid-dividing disc and a splash member, said cylindrical liquid-dividing disc having a pluralty of axially extending grooves formed in the periphery thereof, the maximum diameter of said cylindrical disc being substantially the same as the diameter of said cylindrical surface portion so that said ring and grooved disc cooperate to define therebetween a plurality of axially extending liquid flow passageways, the downstream edge of said liquid-dividing disc engaging said conical surface portion to support said plug member in said annular ring and cooperating with said conical surface portion to define metering means for the liquid, the metering cross-section area of which is less than the upstream cross-section area of said axially extending flow passageways, thereby permitting the upstream ends of the flow passageways to become partially blocked without affecting the flow capacity of said metering means, and said splash member being located downstream of said metering means and positioned to have the liquid which is directed by said converging conical surface portion directed thereagainst to effect break-up of said liquid within said barrel and to cause aeration of said liquid within said barrel with air aspirated thereinto through said air inlets.

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