A liquid aerating and spraying device is disclosed, which is selectively operable to discharge either an aerated liquid stream or a liquid spray therefrom. Shifting of a plunger in the device to one of its two operating positions causes liquid entering the device to be diverted into one set of passages therein so that the device functions as a normal aerator. Shifting of the plunger to the other of its two operating positions causes the liquid to be diverted into another set of passages so that the device functions as a liquid sprayer.

13 Claims, 10 Drawing Figures
LIQUID AERATING AND SPRAYING DEVICE

This invention relates to combination liquid aerating and spraying devices, and more particularly to a combination liquid aerating and spraying device which may be selectively rendered operable to provide either an aerated liquid stream or a liquid spray by shifting a plunger therein in opposite directions.

Various types of liquid aerating and spraying devices have been developed for providing either a soft, bubbly, coherent stream of intimately mixed air, and water, or a liquid spray resulting from the flow of water through a ring of openings in the device. Operation of the device in either of these modes is usually achieved by shifting a collar mounted on the tubular casing or housing portion of the device in opposite axial directions. Such devices, while being generally satisfactory for their intended purpose, have certain disadvantages. One such disadvantage is that after extended periods of use difficulty may be experienced in shifting the collar between its respective positions to effect operation of the device either as an aerator or as a liquid spraying device. Another disadvantage is that the associated faucet on which the device is mounted may be damaged if it becomes necessary to apply a substantial force to the shaftable collar of the device to effect movement thereof. A further disadvantage of such devices is that when the water pressure is high, the shaftable collar sometimes shifts from a retracted to an extended position without the application of any external force by a user. Consequently, the mode of operation of the device may unintentionally and undesirably change.

Accordingly, it is the general object of the present invention to provide a novel and improved combination liquid aerating and spraying device for selectively providing either an aerated liquid stream or a liquid spray.

Another object is to provide a novel combination liquid aerating and spraying device which utilizes only one movable part for rendering the device operable either as an aerator or as a spraying device.

A further object is to provide a novel combination liquid aerating and spraying device which is simple in construction, reliable in operation, and economical to manufacture.

Other objects and advantages of the invention will become apparent from the following detailed description and accompanying sheets of drawings, wherein:

FIG. 1 is a side elevational view of the outlet and of a faucet having mounted thereon a combination aerating and liquid spraying device embodying the features of the present invention and showing two different operating positions of the device in full and broken lines;

FIG. 2 is an enlarged front elevational view of the device shown in FIG. 1;

FIG. 3 is a top plan view of the device shown in FIG. 2 but with the swivel mounting portion thereof removed to show underlying details;

FIG. 4 is a bottom plan view of the device shown in FIG. 2;

FIG. 5 is a longitudinal cross sectional view taken along the line 5—5 of FIG. 3 and showing parts of the device as they would appear when positioned to provide an aerated liquid stream;

FIG. 6 is a view similar to FIG. 5 but showing the parts of the device as they would appear when positioned to provide a liquid spray;

FIG. 7 is a transverse sectional view taken substantially along the line 7—7 of FIG. 3;

FIG. 8 is a transverse sectional view taken along the line 8—8 of FIG. 5;

FIG. 9 is a transverse sectional view, with a portion thereof broken away to show underlying details, taken along the line 9—9 of FIG. 5; and

FIG. 10 is an exploded perspective view of the device.

In FIG. 1, a liquid aerating and spraying device 20 embodying the features of the present invention is illustrated. As shown in FIG. 1, the device 20 is mounted on the discharge or outlet end, indicated at 21, of a liquid supply conduit or faucet 22. In the present instance, the discharge end 21 of the faucet 22 is externally threaded to permit the device 20 to be mounted directly thereon.

However, in order to permit the device 20 to swivel with respect to the discharge end 21 of the faucet 22, a swivel assembly 23 may be provided between the end 21 of the faucet and the device 20. The swivel assembly 23 is conventional and forms no part of the present invention. However, when utilized, the swivel assembly 23 permits the device 20 to swivel about the discharge end 21 of the faucet 22 so that either an aerated liquid stream or a liquid spray may be aimed in various directions from the end 21 of the faucet. The full and broken line position of the device, respectively indicated at 20 and 20' in FIG. 1, are illustrative of two of the positions that the device 20 may occupy when the swivel assembly 23 is utilized therewith.

Referring now to FIGS. 2–7, inclusive, in conjunction with FIG. 1, the liquid aerating and spraying device 20 comprises an elongated body or casing which, in the present instance, is of a generally frustoconical shape and which includes an upper valve section 26 and a lower liquid aerating and spray generating section 27 threaded onto the lower end of the valve section 26. The upper end of the valve section 26 is bored, as at 28, and the bore 28 is internally threaded as at 31 for receiving the lower threaded cap portion, indicated at 32, of the swivel assembly 23, or the externally threaded discharge end of a faucet if the swivel assembly 23 is not used. A washer 30 is provided between the lower end of the cap portion 32 and the bottom of the threaded bore 31.

Assuming the device 20 to be connected to a source of liquid under pressure, such as the discharge end 21 of the water faucet 22, water under pressure flows into the bore 28 or liquid inlet of the device and then enters at least one and preferably a pair of longitudinally extending, transversely spaced bores 33 and 34 in the upper end of the body of the device. The lower ends of the bores 33 and 34 intersect a transverse bore 36 in the valve section 26 in the manner illustrated in FIGS. 3 and 7 so that liquid under pressure is conveyed to the central portion of the transverse bore 36 when the device is in operation.

Valve means in the form of a plunger 37 that is shiftably mounted in the bore 36, serves to selectively direct liquid flowing through the inlet bores 33, 34 into one or the other of the upstream ends of first and second passage means in the body of the device 20. The upstream end of the first passage means comprises the upper ends, indicated at 40 and 41, of a pair of longitudinally extending bores 42 and 43 (FIGS. 5, 6 and 7) in the valve section 26, the bores 42 and 43 intersecting...
the plunger bore 36 and being laterally offset with respect to the axis of the bore 36. As hereinafter described in greater detail, the downstream end of the first passage means communicates with aerating means in the form of the aerating assembly 39 in the lower portion of the aerating and spray generating section 27.

The upstream end of the second passage means comprises the upper end, indicated at 44, of another longitudinally extending bore 45 in the valve section 26. The end 44 also intersects the plunger bore 36 in transversely spaced relation from the ends 40 and 41 of the bores 42 and 43, respectively.

Selective connection of the lower or downstream ends of the liquid inlet bores 33 and 34 with either the upstream ends 40 and 41 of the first passage means or with the upstream end 44 of the second passage means is provided by an annular space 51 in the plunger bore 36. The space 51 is defined by a central reduced diameter portion 52 on the plunger 37 and is of a length somewhat less than the space between the ends 40 and 41 of the bores 42 and 43 and the upstream end 44 of the bore 45. However, the length of the reduced diameter portion 52 is such that the space 51 is at all times in communication with the lower or downstream ends of the bores 33 and 34. Seals in the form of O-rings 54 may be provided in suitable grooves at each end of the reduced diameter portion 52 of the plunger 37 to prevent leakage from the annular space 51 to the exterior of the casing.

In order to facilitate shifting of the plunger 37 in its bore 36 between its respective operative positions illustrated in FIGS. 5 and 6, the plunger 37 is preferably of a length such that one end of the plunger will project beyond the outer surface of the valve section 26 when the opposite end of the plunger is shifted fully into the body of the device 20. Movement of the plunger into the valve section 26 is limited by heads 56 and 57 on the respective ends of the plunger, the heads 56 and 57 engaging recessed shoulders 58 and 59, respectively, formed by counterbores in the outer ends of the plunger bore 36.

As heretofore mentioned, the plunger 37 is effective to direct the incoming flow of liquid under pressure into the upstream end of either the first or second passage means in the body of the device. Thus, when the plunger 37 is shifted to the position thereof illustrated in FIGS. 3 and 5, liquid under pressure from the inlet bores 33, 34 flows into and through the annular space 51 and then enters the upstream ends 40 and 41 of the bores 42 and 43 of the first passage means. The lower ends of the bores 42 and 43 open in a bearing surface 60 on the underside of the valve section 26. Thus, after flowing downwardly through the bores 42 and 43, the liquid flows into a similarly sized pair of longitudinally extending bores 62 and 63 (FIGS. 8, 9 and 10) in a liquid diversion and distributing member in the form of a disk 65 engaged with the bearing surface 60.

After flowing downwardly through the bores 62 and 63 in the disk 65, liquid under pressure discharges into a space 72 defined by a circular recess 73 in the lower end face of the disk 65. From the space 72 the liquid enters the aerating assembly 39 of the device, which is mounted in a depending tubular extension 82 of the aerating and spray generating section 27. The bores 62 and 63 in the disk 65 thus comprise a path therein for directing liquid to an aerating means, in this instance the aerating assembly 39.

The aerating assembly 39 is generally of the same type and construction as is described and claimed in the copending George W. Jatho and Louis F. Kint application Ser. No. 56,038 filed on May 11, 1970, which is a continuation of their prior application Ser. No. 709,992, filed on Mar. 4, 1968, now abandoned. Accordingly, only a brief description of the aerating assembly 39 of the device 20 will be included.

Thus, the aerating assembly 39 includes a perforated disk 83 that is supported adjacent the upper end of the tubular portion 82 by a ring 84. The ring 84 is in turn supported on the upper end of a tubular cage 86 (FIGS. 5, 6 and 10) having a plurality of axially extending, circumferentially spaced ribs 87 therearound which cooperate with the inner surface, indicated at 88, of the tubular portion 82 to define a plurality of axially extending, arcuate air passages 90 therebetween. The lower end of the cage 86 is supported on an annular inturned flange 91 of the lower end of the tubular portion 82, and the lower ends of the passages 90 communicate with the atmosphere through circumferential gaps between the flange 91 and the outer surface of the cage 86 between the ribs 87. The upper ends of the passages 90 communicate with chambers, indicated at 92 and 93 (FIGS. 5 and 6), in the aerating assembly 39 through circumferentially extending slots 94 at the upper end of the cage 86. The chambers 92 and 93 are defined above and below a conventional break-up and mixing plug 95 which depends from the undersurface of the disk 83. The plug 95 serves to break up the jets of liquid discharging downwardly thereon from a ring of holes or perforations 96 in the disk 83. A circular screen 97 is supported at the lower end of the cage 86 below the plug 95 on an annular inturned flange 98, the screen 97 serving to retard and coalesce the flow of aerated liquid and thereby reduce splashing of the aerated stream. An annular gasket 99 is interposed between the aerating assembly 39 and the liquid diverting and distributing disk 65, the gasket 99 having an internal diameter greater than the diameter of the ring of holes 96 in the disk 83.

The first passage means in the device 20 thus comprises the longitudinal bores 42 and 43 (FIG. 7) in the valve section 26, the aligned bores 62 and 63 in the liquid diverting and distributing disk 65, the space 72 defined by the recess 73 in the underside of the disk 65, the ring of holes 96 in the disk 83, chambers 92 and 93 in the aerating assembly 39 and the open lower end, indicated at 98, of the cage 86 through which the aerated liquid stream discharges. The liquid and air flow paths through the device 20 when the device is functioning as an aerator are shown by arrows in FIG. 5.

As heretofore mentioned, the valve section 26 of the device 20 is provided with second passage means for directing liquid under pressure to a ring of openings 46 in the bottom of the aerating and spray generating section 27 so that a diverging spray of liquid is discharged from the device. Such second passage means includes the longitudinal bore 45 (FIGS. 5 and 6) in the valve section 26, the lower end of which opens in the bearing surface 60 of the valve section 26 and registers with a cavity 103 (FIGS. 8 and 10) in the upper end face, in-
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dicated at 104, of the diverting and distributing disk 65. The cavity 103 communicates with the upper ends of a plurality of axially extending circumferentially spaced bores 106 in the disk 65 by means of a plurality of radiating grooves 107 in the end face 104. Thus, liquid flowing downwardly in the bore 45 and into the cavity 103 flows through the grooves 107 and bores 106 into an annular space 108 below and partially surrounding the disk 65. From the space 108 the liquid flows downwardly through the ring of openings 46 in the bottom of the section 27 to discharge as a spray. The cavity 103, grooves 107, and bores 106 in the disk 65 thus comprise another path therein for directing liquid from the liquid from the inlet bores 33 and 34 to the ring of openings 46 or spray outlet of the device 20. The course of the liquid flow from the inlet bores 33 and 34 to the spray openings 46 is shown by arrows in FIG. 6.

Thus, the second passage means in the device 20 comprises the longitudinal bore 45 in the valve section 26, the cavity 103 and connecting grooves 107 in the upper end face 104 of the liquid diverting and distributing disk 65, the axial bores 106 through the disk 65, and the annular space 108 surrounding the disk 65 which communicates with the upper ends of the spray holes 46.

In order to assure accurate alignment between the longitudinal bores 42, 43 and 45 in the valve section 26 and the axial bores 62 and 63 and cavity 103 in the disk 65, indexing means is provided. As shown, such indexing means comprises at least one and preferably a pair of upstanding, laterally spaced posts 112 and 113 on the end face 104 of the disk 65, the posts 112 and 113 preferably being circular in cross section and of different diameters. The posts 112 and 113 extend into a similarly positioned and complementary pair of openings 114 and 115, respectively, in the bearing surface 60 on the underside of the valve section 26. Thus, when the posts 112 and 113 are positioned in their respective openings 114 and 115, in the manner illustrated in FIGS. 5 and 6, the disk 65 is correctly positioned with respect to the valve section 26.

From the foregoing it will be apparent that the device 20 may be readily converted for operation either as a liquid aerating or a liquid spraying device, merely by shifting the plunger 37 between the respective positions thereof shown in FIGS. 5 and 6. Moreover, since the plunger 37 is shiftable in a direction generally transverse to the direction of the flow of liquid through the valve section 26 and is in hydrostatic and hydrodynamic balance, the plunger has no tendency to shift in its bore and cause an undesired change in the mode of operation of the device. In addition, since the plunger is shiftable transversely in the body of the device, rather than axially thereof, there is less chance that large forces will be imposed on an associated faucet on which the device is mounted during manipulation of the plunger. Further, since the plunger 37 is the only moving part of the device, the cost thereof is reduced and the life expectancy of the device is extended.

In keeping with the low cost and extended life expectancy of the device 20, the parts thereof are preferably made of a plastic material which is strong, temperature resistant, easily formed such as by injection molding and capable of being plated with metal. An example of one such plastic material is the ABS thermoplastic resin sold under the trademark "Cycolac."

I claim:

1. A liquid aerating and spraying device, comprising a body having a liquid inlet adapted to be connected to a source of liquid under pressure, an air inlet, an aerated liquid outlet, and at least one liquid spray outlet, said body also having first passage means connecting said liquid inlet with said aerated liquid outlet and having aerating means therein adapted to intimately mix liquid from said source with air, said first passage means also including a branch passage extending between said air inlet and said aerating means, second passage means in said body connecting said liquid inlet with said spray outlet, and a valve member shiftably mounted in said body and operable when shifted to one position in said body to permit flow through said first passage means and to prevent flow through said second passage means so that a stream of aerated liquid is discharged from said aerated liquid outlet, said valve member being operable when shifted to another position in said body to permit flow through said second passage means and to prevent flow through said first passage means so that liquid is discharged as a spray through said spray outlet.

2. The liquid aerating and spraying device of claim 1, further characterized in that said body is elongated and has a transverse bore therein disposed upstream from said aerated liquid and spray outlets, said first passage means includes at least one bore in said body connected to said transverse bore and communicating with said aerating means, said second passage means includes at least one other bore in said body spaced transversely from said one bore, said one other bore being connected to said transverse bore and communicating with said spray outlet, and said valve member is positioned in said transverse bore and operable when in said one position to connect said liquid inlet with said one bore and to disconnect said liquid inlet from said other bore, said valve member being operable when in said other position to connect said liquid inlet with said other bore and to disconnect said liquid inlet from said one bore.

3. The liquid aerating and spraying device of claim 2, further characterized in that said body includes at least one inlet bore extending between said liquid inlet and said transverse bore, said inlet bore being connected to said transverse bore between the connections of said one bore of said first passage means and said other bore of said second passage means.

4. The liquid aerating and spraying device of claim 3, further characterized in that said valve member comprises a plunger having a reduced diameter portion thereon defining an annular space in said transverse bore in continuous registry with said inlet bore and alternately registrable with said one bore of said first passage means and said other bore of said second passage means.

5. A liquid aerating and spraying device comprising a body having a liquid inlet, an aerated liquid outlet, and at least one spray outlet therein, said body also having aerating means therein communicating with said liquid inlet and said aerated liquid outlet, said aerating means being operable to mix air with liquid from said liquid inlet to provide a stream of aerated liquid from said
aerated liquid outlet, a liquid diverting and distributing member immovably mounted in said body and communicating with said liquid inlet, said liquid diverting and distributing member receiving liquid from said liquid inlet and providing at least one pair of paths for respectively directing liquid to said aerating means and said spray outlet, and means for selectively diverting liquid from said liquid inlet into one or the other of said pair of paths.

6. The liquid aerating and spraying device of claim 5, further characterized in that said body includes first passage means extending between said liquid inlet and said aerated liquid outlet, and said liquid diverting and distributing member comprises a disk having at least one bore therethrough communicating with said aerating means, said one disk bore comprising a portion of one of said paths and said first passage means.

7. The liquid aerating and spraying device of claim 6, further characterized in that said body includes second passage means extending between said liquid inlet and said spray outlet, and said disk has at least one other bore therethrough spaced from said first mentioned disk bore and communicating with said spray outlet, said one other bore comprising a portion of the other of said paths and second passage means.

8. The liquid aerating and spraying device of claim 7, further characterized in that a plurality of said other bores are provided in said disk, and said spray outlet comprises a plurality of openings in said body.

9. The liquid aerating and spraying device of claim 8, further characterized in that said other disk bores and said spray outlet openings are annularly arranged.

10. The liquid aerating and spraying device of claim 8, further characterized in that liquid diverting and distributing disk has an end face having a cavity therein and a plurality of grooves radiating from said cavity, each of said grooves being connected to one of said other disk bores, said cavity and said grooves comprising another portion of said second passage means.

11. The liquid aerating and spraying device of claim 10, further characterized in that said body has a bearing surface, said first and second passage means include at least one pair of openings in said bearing surface, and indexing means is provided for assuring alignment between said opening of said first passage means and said one disk bore and between said opening of said second passage means and said cavity in said disk when said end face of said disk is engaged with said bearing surface of said body.

12. The liquid aerating and spray generating device of claim 11, further characterized in that said indexing means comprises at least one upstanding post on said end face of said disk and at least opening in said bearing surface of said body for receiving said post.

13. The liquid aerating and spray generating device of claim 12, further characterized in that a pair of said posts are provided on said end face of disk and a pair of said openings are provided in said bearing surface for receiving said posts, one of said posts and its respective opening being of a different size than the other of said posts and its respective opening.