LAMINAR FLOW DEVICE FOR BATHTUB FILL SPOUTS

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ABSTRACT

This invention involves a fluid flow device which is in the form of a spout-end for a plumbing fixture such as a bathtub, and which is devised to establish a substantially silent, smooth clear and laminar flow of water into the plumbing fixture. The spout-end includes two adjacent flat screens of different meshes, followed in the path of flow by a fluid straightener, such as a "rosette," for establishing a plurality of paths which are substantially parallel to each other, and then followed by another pair of screens both of which are concavely shaped at substantially different radii of curvature so that a gap or chamber is centrally formed between the two concave screens for diverting the parallel streams into a tapered or converging stream which is substantially continuous and laminar.

3 Claims, 14 Drawing Figures
Fig. 8.

Fig. 9.

Fig. 10. Fig. 10A.

Fig. 11.

Fig. 12.

Fig. 13.

SCREEN MATERIAL AS FORMED
LAMINAR FLOW DEVICE FOR BATHTUB FILL SPOUTS

This invention relates to fluid flow devices and, more particularly, to fluid flow devices especially adaptable for plumbing fixtures such as, for example, bathtubs and providing a spout-end for producing a substantially silent laminar stream of fluid flowing noiselessly into the plumbing fixture.

It is not uncommon in conventional spouts for bathtubs and in spout-ends for bathtub fittings to emit water into the bathtub in a turbulent stream so that the flow into the bathtub is both noisy and splaschy. Considerable research and development efforts have been directed toward devising a spout structure which would be free of splash and substantially laminar and silent. Efforts to achieve this in the past have not been successful especially with relatively inexpensive spout structures.

In accordance with this invention, a spout-end is devised which substantially overcomes the limitations and adverse features of prior devices. The spout-end of this invention, briefly described, comprises a structure which includes among other things, two substantially flat contiguous screens of different meshes which are aligned so that their meshes are not parallel to each other, one of the screens having a fine mesh and the other a coarser mesh, the screens being followed by a "rosette" element so arranged and formed as to yield a plurality of more or less distinct channels or streams which are substantially parallel to each other in the path of fluid flow, and then followed by another pair of screens which are herein described as concave (or spherical) in shape and having different degrees of curvature so that the two curved screens are spaced from each other so that the maximum spacing will be at the axis of the device, the two curved screens deflecting the parallel streams passing through the rosette so as to taper the streams into a common laminar pattern which yields a clear, substantially splashless and virtually noiseless stream.

The stream emitted by the device of this invention will remain substantially unchanged in its general pattern at different fluid flow rates, except that the diameter of the converging stream will be changed.

This invention will be better understood from the more detailed description hereinafter following when read in connection with the accompanying drawing in which:

FIG. 1 depicts a lateral cross-sectional view of the combination of a spout and a spout-end for a plumbing fixture according to the invention;
FIG. 2 shows a side elevation view of a retainer for holding the screens within the spout-end; FIG. 3 shows a cross-sectional view of the retainer of FIG. 2 taken along the line 3-3; FIG. 4 shows a plan view of the retainer when seen along line 4-4 of FIG. 2; FIG. 5 depicts a front elevation view of the body or housing of the spout-end; FIG. 6 illustrates a cross-sectional view of the body or housing when observed along line 6-6 of FIG. 5; FIG. 7 shows a top plan view of the body or housing as seen along line 7-7 of FIG. 5; FIGS. 8 and 9 show plan views of the upper and lower flat screens, respectively; FIG. 10 shows a ribbon of screen material before formation into a rosette; FIG. 10A shows the same material when shaped as a rosette; FIG. 11 shows a retainer for the curved screens; and FIGS. 12 and 13 depict the upper and lower curved screens, respectively.

Throughout the drawing and the specification the same reference characters will be employed to designate the same or similar parts.

Referring to the drawing, there is shown in FIG. 1 a general arrangement of a spout 10, a wall 20 above the bathtub and a spout-end 30, so arranged and combined that water may normally flow through the aperture of the spout 10 and then through the spout-end 30 to provide a stream of water 15 which is to be substantially laminar as well as substantially noiseless.

The spout-end 30 includes a housing or body 32 which is externally threaded at 34 so as to be readily connectable to the corresponding external threads 35 of the spout 10 of the plumbing fixture illustrated as attached to the wall 20. The housing 32 is arranged to receive two flat screens 38 and 40 which have meshes of different diameters. The upper screen 38 preferably has a finer mesh than the adjacent flat screen 40. The screen 38 which is of finer mesh will serve primarily to filter the incoming fluid so that substantially no dirt or other foreign material will be trapped within the spout-end. The outer screen 40 will function primarily to distribute the incoming fluid across the entire cross-sectional area of the housing 32. Both screens 38 and 40 are held in physical contact within the housing 32 by retaining ring 46 which may be externally threaded, as shown at 47, so as to mesh with the internal threads 48 at the upper end of the housing 32. If desired, the retaining ring 46 need not be threaded but may be slightly tapered so as to fit tightly, like a tapered cork, into the upper end of the housing 32 and held in that position continuously.

The two screens 38 and 40 are in close physical contact with each other and so oriented that the respective component wires of the two screens are not parallel to each other but are preferably offset or biased at a considerable angle with respect to each other, such as 45°.

Adjacent to the lower flat screen 40 there is positioned a rosette 50 which provides a plurality of substantially parallel channels to straighten the stream. The rosette 50 is preferably made of a continuous length of screen material 52 as shown in FIG. 10A, having a width which is uniform throughout and about equal to the vertical dimension of the rosette 50 shown, for example, in FIG. 1. The screen material 52, when formed into the rosette 50, provides a plurality of radially disposed passageways 54 having a wall member 56 circumscribing the passageways 54. As observed from FIGS. 10 and 10A, the screen strip 52 is folded into a sinusoidal cavity. When the strip 52 is assembled and appropriately bent into the form shown in FIG. 10, it will define a rosette pattern having a plurality of uniform substantially parallel passageways 54 when viewed in the direction of the flow path, the passageways extending radially of the spout-end. A substantially similar rosette and its method of construction are shown and described in U.S. Pat. No. 3,321,140, issued May 23, 1967, and assigned to the same assignee.

The rosette 50 is then followed by a pair of screens 62 and 64 which are of different concave (or spherical) shapes and dimensions as shown in FIGS. 1, 12 and 13 so that the two screens 62 and 64 have their respective radii located along the axis of the spout-end but at different positions along that axis. The curved screens are crimped together or otherwise held by an annular retaining ring 66, shown in FIG. 11, the assembly being seen more clearly in FIG. 1. The two curved screens 62 and 64, like the flat screens 38 and 40, have square or rectangular meshes which are crossed or biased at an angle such as 45°.

The housing 32 has a substantially flat annular section or ledge 70 upon which the retaining ring 66 is supported as shown, for example, in FIG. 1. The rosette 50 is seated on the peripheral retaining ring 66. The parallel flat screens 38 and 40 are in turn positioned on and above the rosette 50 and are maintained in contact with each other in their respective positions by the upper retaining ring 46 after it is inserted or threaded into the upper end of the housing or body 32. It will be observed that the inner wall of the housing 32 has its greatest dimension, i.e., its diameter, at the upper end 72 of the housing 32. Hence, the flat screens 38 and 40 are held in close contact with each other within the segment 72 of the housing 32 (the greatest internal dimension of the segment of the flat body 32). The dimension of segment 72 is a bit wider than the cylindrical wall 73 of the housing 32 where the retaining ring 66 is positioned. Immediately following the ledge or peripheral rim 70 and the cylindrical wall 73, the inner contour of the housing 32 is linearly tapered at 74 in the downstream direction to further reduce the dimension, name-
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ly, the internal diameter, of the housing 32. The linearly tapered rim 74 is then followed by a cylindrical wall 76 which provides the minimum dimension or diameter of the housing 32. It will be observed that the dimensions of the housing 32 become reduced in the downstream direction of fluid flow and the smallest dimension is reached at the exit port 76.

Water or other fluid entering the spout-end at the upper end of housing 32 traverses the screen 38 so that dirt and other foreign materials will be filtered and detained by screen 38. The coarser screen 40 will then spread or distribute the filtered influent liquid substantially over the entire cross-sectional dimension 72 of the housing 32. As the liquid passes screen 40 of larger mesh, it travels through the parallel paths of rosette 50, the rosette serving to straighten the influent liquid into a plurality of longitudinal fluid channels or streams. The channelled streams are in communication with each other through the screened walls of the rosette 50 which allows pressure equalization between the walls and hence an equalization of velocity of fluid flow. All of these channels or streams therefore transmit fluid at about the same velocity and in the same direction, that is, in parallel paths. The several channels or streams then impinge upon the concaval screens 62 and 64 which, much like conventional light lenses, deflect the respective channels or streams, about the way conventional light lenses do, so as to direct the several channels or streams toward the common center or axis of the housing 32. These separate channels or streams will thence be merged or coordinated into a substantially uniform or composite stream, as shown at 15, which will be tapered to a predetermined degree as it emerges from the lowermost substantially cylindrical opening or exit port 76 of the housing 32. The tapered wall 74 of the housing 32 is designed to assist in directing, i.e., pointing, the several streams into their coalescing, coordinated and laminated pattern.

The curvilinear screens 62 and 64, as shown in FIG. 1, have their rims contiguous to each other, but the spacing between these screens beyond their rims increases and is at its maximum dimension at about the axis of the housing 32. A chamber resembling a light lens is formed by the screens 62 and 64. The screens so shaped and arranged have been found to taper the several streams into a compacted pattern.

The water emitted from the exit port of the spout-end housing 32 of this invention will form a substantially smooth, clear and unobstructed stream which is not turbulent and remains nonturbulent even after it impinges upon the base of the bathtub or other fixture. The impact upon the base of the fixture will be substantially free of splash and it will be noiseless to a very large extent. This pattern of flow, with its improved characteristics, will be maintained notwithstanding fairly wide changes in the rates of fluid flow through the spout-end.

The spout-end of this invention is relatively simple and easily constructed because it is composed of a plurality of readily available components which can be assembled even by unskilled personnel. The device is therefore easy to manufacture in quantity and at low cost.

In one model of a spout-end constructed according to this invention, the flat screens 38 and 40 and the curved screens 62 and 64 were made of monel wire of 0.008 in. diameter and all of the screens, except screen 38, were sewn into a square weave at about 30 units per linear inch. The wire of screen 38 was woven into a square weave with some 40 units per linear inch. The screen material for the rosette 50 was monel wire of a diameter of 0.0095 in. having 40x36 meshes per square inch and a width of about 0.69 in. before it was sinuously shaped and a width of 0.39 in. after it was so formed. Obviously, the body 32 and the retainer 46 may be made of any materials, such as metals or plastic.

It is quite important that the device embody at least one flat screen such as 38, although good operation can be achieved with two or more flat screens. It is also important to have at least one of the concaval or spherical screens in the structure, but good operation can be achieved with two or more concaval or spherical screens. Moreover, if two or more curved screens are employed, they may have the same or different concavity or sphericity.

It is important to have the area of the exit port 76 somewhere between six-tenths to nine-tenths of the area at the inlet to the device. Moreover, the dimensions downstream of the tapered section 74 should be at least one-sixteenth of an inch in length. The meshes of the screens should be any of the sizes Nos. 16 to 40. The device should be designed and constructed for velocities not exceeding a predetermined value, such as 4 feet per second.

While this invention has been shown and described in certain particular arrangements merely for the purpose of illustration and explanation, it will be clearly understood that the invention and its components may be arranged in other and widely varied organizations without materially departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A substantially laminar nonaerated spout-end comprising a housing having a linear axis, a plurality of contiguous flat screens adjacent the entrance of the housing, the contiguous flat screens being of different sized meshes which are displaced from each other by a predetermined angle, a device made of screened material and positioned downstream of said flat screens and forming a plurality of substantially parallel paths which parallel the axis of the housing, a pair of curved screens of different curvatures, the rims of said curved screens being contiguous so that the curved screens provide therebetween a chamber, a retainer crimped to the rims of said curved screens for holding the curved screens in a predetermined spaced relation to each other, a holder positioned at the entrance of the housing for holding the flat screens, the screened device and the curved screens in position on a ledge of said housing, the fluid traversing said housing emerging as a substantially smooth, laminar and noiseless coordinated stream.

2. A spout-end according to claim 1 in which the housing is made of plastic and the wall of which is provided with steps directed toward the axis of the housing for pointing the emergent stream toward the axis of the housing.

3. A spout-end according to claim 2 in which the meshes of the curved screens are displaced from each other by a predetermined angle.

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