

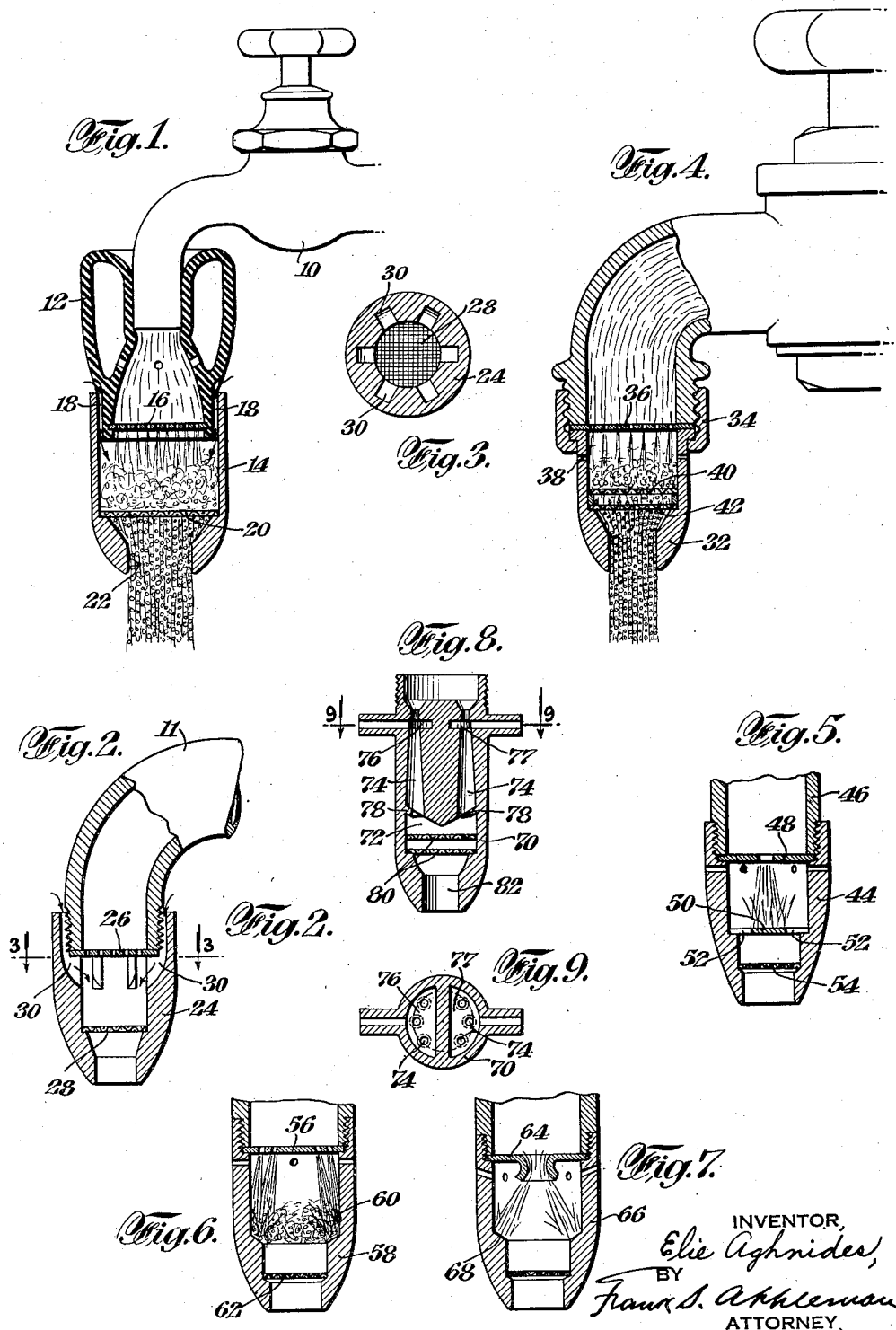
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E. AGHNIDES

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FLUID MIXING DEVICE

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INVENTOR,
Elie Aghnides,
 BY
Frank S. Ackerman,
 ATTORNEY.

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FLUID MIXING DEVICE

Elie Aghnides, New York, N. Y.

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5 Claims. (Cl. 261—76)

This invention relates to a device for intimately mixing a gas with a liquid, and ordinarily is employed for aerating water. This application is a continuation in part of my earlier application Serial No. 52,923, filed December 4, 1935.

5 Broadly speaking, my invention consists of a device intended to be connected to a source of liquid under pressure, such as an ordinary water tap, and includes a chamber provided with one or more apertures through which the water is
10 forced into the chamber with substantial velocity and as a result the liquid stream has very substantial kinetic energy. Proper openings are provided leading into the chamber from the outside air so that the flow of water will draw air into the chamber according to the well-known Venturi
15 principle. In accordance with my invention, means are provided in the path of the stream of water after it leaves the aperture or apertures and before it discharges at the outlet
20 end for finely breaking up the water and offering sufficient resistance for thoroughly mixing it with air. An outlet for the chamber is provided from which the water mixed with air can emerge. It
25 is advisable to have the outlet of smaller cross section than the cross section of the chamber so that the water will flow in a coherent stream; but the outlet should be of sufficient size relative to the aperture or apertures through which the
30 water is introduced into the chamber so that the water mixed with air will emerge at a substantially lower velocity than the water entering the chamber. Of course, when I refer to the outlet
35 forming a coherent stream, I do not mean to imply that the outlet cannot be divided into several such streams, if desired.

The essential feature of my invention is an arrangement of a dividing means in the path of the liquid emerging from the aperture or apertures delivering liquid to the aforesaid chamber,
40 this dividing means being adapted to finely break up the fluids and to imprison in the liquid, air particles forming therein such small bubbles that they remain in suspension in the jet.

In the devices suggested until now, the air
45 drawn in by the liquid separates immediately at the outlet of the apparatus and no known apparatus has for its object, as is the case with my invention, the formation of a coherent "white" jet,
50 this being due to the fine division of the air and to the formation of a true suspension of a multitude of air bubbles in the water.

In the preferred embodiment of my invention, the water is introduced into the mixing chamber
55 through a plurality of apertures. Also I find that

a highly efficient form of dividing means is a fine screen located at the outlet, and I have found that even better results can be obtained if two or more superposed screens are used in the outlet discharge. The size of the mesh employed is not
5 critical but I have obtained good results where the holes in the screen measured about .6 square millimeter.

Such a screen finely breaks up the water and offers sufficient resistance for thoroughly
10 mixing it with air. On the other hand, the resistance of the screen is low enough to permit passage of the air in the form of bubbles disseminated in the water. The streamlets of aerated water are sufficiently close together, so that on
15 issuing, they join each other to form a single jet.

My invention can readily be understood by reference to the accompanying drawing, in which Fig. 1 is a sectional view of a device embodying my invention which is shown as attached to an
20 ordinary water faucet through the medium of a connecting device such as is described in my Patent No. 2,071,780; Fig. 2 is a sectional view of a device adapted to be screwed onto an ordinary water pipe; Fig. 3 is a section on line 3—3 of
25 Fig. 2; Fig. 4 is a sectional view showing a further modified form; Figs. 5, 6, 7 and 8 are additional sectional views showing further modifications; and Fig. 9 is a section on line 9—9 of Fig. 8.

Referring now to Fig. 1, 10 designates an ordinary faucet or tap. 12 is a tap connector, the
30 operation of which is described in detail in my patent above referred to. 14 is the casing of the mixing device enclosing the primary mixing chamber. The perforated screen 16 admits the
35 water into the casing 14 in the form of a plurality of jets. A plurality of air ports 18 are provided for admission of air into the interior of the casing 14. 20 is a screen at the lower part of the casing,
40 and below the screen 20 the casing narrows to form a passage 22.

When the water is turned through this device, if the faucet is opened only slightly, so that very little kinetic energy is developed in the water,
45 as it emerges from the perforations in the screen 16, in proportion to the resistance of the screen 20, then the water will come out of the discharge 22 without air bubbles. On the other hand, as
50 the faucet is opened wider, the velocity of the water emerging from the perforations in the screen 16, increases and acquires the necessary kinetic energy relative to the resistance of the screen 20, to effect entrainment and mixing of the air with the water.

While the total cross sectional area of the per- 55

forations in the screen 16, under the usual conditions of operation, is such as to force the water into the chamber with substantial velocity and the screen 20 has the proper relative resistance thereto, to effect the desired result, it is obvious that any change in the cross sectional area of the perforations in the screen 16 will require a change in the resistance of the screen, to establish the proportion necessary for the maintenance of substantially the same result. This water, again contacting with the screen 20, will pass through the screen with the air and emerge from the outlet 22. As the diameter of outlet 22 is substantially greater than the aggregate diameter of the perforations in screen 16, the water will have relatively low velocity as it comes out from the discharge.

When my device is functioning, the water, due to the thorough admixture of air, has characteristics which are surprisingly different from those of water as ordinarily discharged from a faucet. For example, if one's hand is put in the course of the water, the water will flow evenly and uniformly over the surface and will wet the entire surface without splashing. Also it will be found that if the discharge from such faucet is allowed to flow into a weak soap solution, it will make an extraordinary amount of foam, which will be found very useful for washing; for instance, when washing clothes or dishes. Again it will be found that the introduction of the air into the water will raise its dissolved oxygen content and the aeration tends to remove objectionable odors and gases from the water, rendering it more palatable. These effects are apparently due to the extreme thoroughness with which the aeration takes place in my device and the results are quite different from the results obtained by ordinary injection devices in which the air is not thoroughly broken up so that when the two fluids leave the apparatus, the air quickly separates from the water jet.

In the form of device shown in Fig. 2, a metal casing 24 is screwed directly onto the faucet 11. This casing holds the screen 26 against the mouth of the faucet and the casing is provided with an outlet screen 28. A series of ports 30 are provided in the casing to admit air in a manner similar to that already described in connection with Fig. 1.

In Fig. 4 the casing 32 is provided with a union coupling 34 for connection to an ordinary hose bib. The screen 36 is clamped between the casing 32 and the mouth of the hose bib. Air is admitted to the interior of the casing by a series of horizontal perforations 38. In this case two screens are provided at the outlet as indicated at 40 and 42, which will cause the air bubbles in the water to be somewhat smaller than where only a single screen is employed.

Fig. 5 illustrates a case where a single aperture is employed for admitting fluid to the chamber. In this figure, the casing 44 is screwed to the faucet 46 and clamps in place a plate 48 having a single aperture in the middle. A plate 50 supported by legs 52 is positioned in the lower part of the chamber and below this is positioned a screen 54. The water from the aperture in plate 48 strikes plate 50 and due to its kinetic energy the stream is broken up and thoroughly mixed with the air.

In Fig. 6 the plate 56 has a plurality of holes near the periphery and the casing 58 is formed with inwardly extending projections as indicated at 60. The principal part of the water coming through the openings in the plate 56 will

strike these projections and be broken up as previously described. In this case, a screen 62 is also used in the device.

An effect similar to that shown in Fig. 6 is illustrated in Fig. 7 except that instead of having a plurality of apertures in the plate, the plate 64 has a single central orifice shaped to throw the water outwardly. The casing 66 again has projections as indicated at 68 similar to the projections 60 described above.

Another form of my device is shown in Figs. 8 and 9. In this arrangement it is possible to mix three fluids, one of which is under pressure. Leading into a mixing chamber 72 are a plurality of passages 74 to permit entrance of a fluid under pressure into the mixing chamber 72 enclosed by casing 70. The inlet port 76 intersects and leads into one group of passages 74 near the upper end of the passages; and another inlet port 77 likewise intersects and leads into another group of passages 74. The inlet ports 76 and 77 do not connect with one another; in consequence the channels 74 are grouped into two sections, each section being connected to an inlet port. In this form of my device each inlet port may admit a different fluid into the mixing chamber. The cross-sectional area of passages 74 is greater after intersection by inlet ports 76 and 77 and the cross-sectional area of the passages continues to increase as the passages approach the mixing chamber. As in preceding examples, the fluid under pressure courses through passages 74 and draws fluids from inlet ports 76 and 77 into the enlarged portion of passages 74. Baffles 78 project into the passages at the point where the passages discharge into the mixing chamber. The baffles in part interrupt the course of the fluids in each passage and thereby serve to effect a preliminary mixing of the fluids. Within the mixing chamber two screens 80 in spaced relation are placed across the path of the fluids emerging from the passages 74 to interrupt abruptly the course of all such fluids and thereby cause the fluids to mix and sub-divide into minute particles. The fluids are discharged through the outlet 82.

While I have referred to perforated upstream plates and downstream screens, it is possible to use perforated plates or (except in certain forms) screens in either position. In the various forms of device shown, the screens and the plates forming the apertures are made readily removable so that the devices can easily be claimed.

What I claim is:

1. A device for producing a coherent jet of water containing air bubbles, comprising a chamber, the inlet end of which is adapted for connection with the discharge end of a tube containing water under pressure and the outlet end of which is adapted to discharge the said coherent jet, a diaphragm at the upstream end of the chamber having at least one orifice through which the stream of water is adapted to be forced into the chamber with substantial velocity, an air port opening into the chamber through which air is induced by the stream of water, and means, in the path of the stream of water after it leaves the orifice and before it discharges at the outlet end, for finely breaking up the water and for offering sufficient resistance for thoroughly mixing it with air and for thereafter uniting the aerated water to form a coherent jet having small bubbles disseminated throughout the jet.

2. A device for producing a coherent jet of water containing air bubbles, comprising a cham-

ber, the inlet end of which is adapted for connection with the discharge end of a tube containing water under pressure and the outlet end of which is adapted to discharge the said coherent jet, a diaphragm at the upstream end of the chamber having at least one orifice through which the stream of water is adapted to be forced into the chamber with substantial velocity, an air port opening into the chamber through which air is induced by the stream of water, and means, in the path of the stream of water after it leaves the orifice and before it discharges at the outlet end, for finely breaking up the water and for offering sufficient resistance for thoroughly mixing it with air and means for thereafter uniting the aerated water to form a coherent jet having small bubbles disseminated throughout the jet.

3. A device for producing a coherent jet of water containing air bubbles, comprising a chamber, the inlet end of which is adapted for connection with the discharge end of a tube containing water under pressure and the outlet end of which is adapted to discharge the said coherent jet, a diaphragm at the upstream end of the chamber having at least one orifice through which the stream of water is adapted to be forced into the chamber with substantial velocity, an air port

opening into the chamber through which air is induced by the stream of water, and means, in the path of the stream of water after it leaves the orifice and before it discharges at the outlet end, for finely breaking up the water and for offering sufficient resistance for thoroughly mixing it with air and for thereafter uniting the aerated water to form a coherent jet having small bubbles disseminated throughout the jet, the resistance offered by the said means and the cross sectional area of the orifice being proportioned to effect the entrainment and mixing of the air with water before their discharge from the said outlet end.

4. The device of claim 1 in which the said means comprises a screen at the discharge end of the chamber, the openings in which are sufficiently close together so that the streams of aerated water issuing therefrom immediately join each other to form a single jet.

5. The device of claim 1 in which the said means comprises superposed screens, the screen at the discharge end of the chamber having apertures which are sufficiently close together so that the streams of aerated water issuing therefrom immediately join each other to form a single jet.

ELIE AGNIDES.