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HEATING SYSTEM

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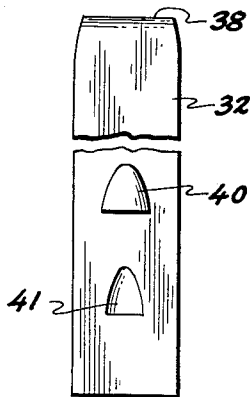
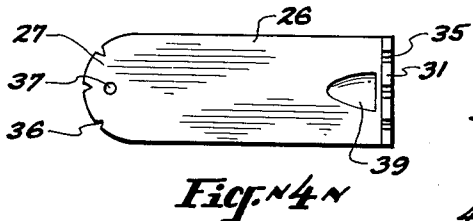
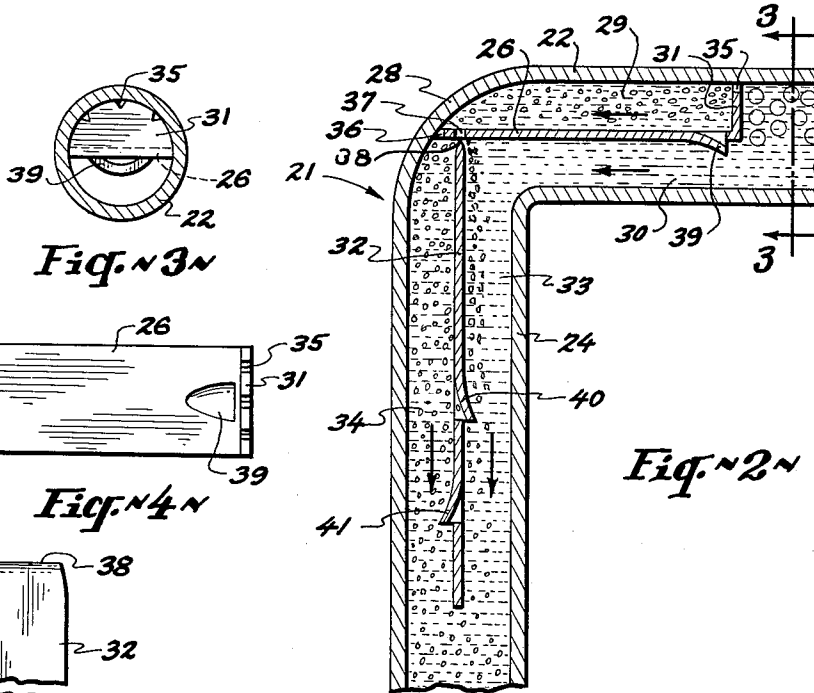
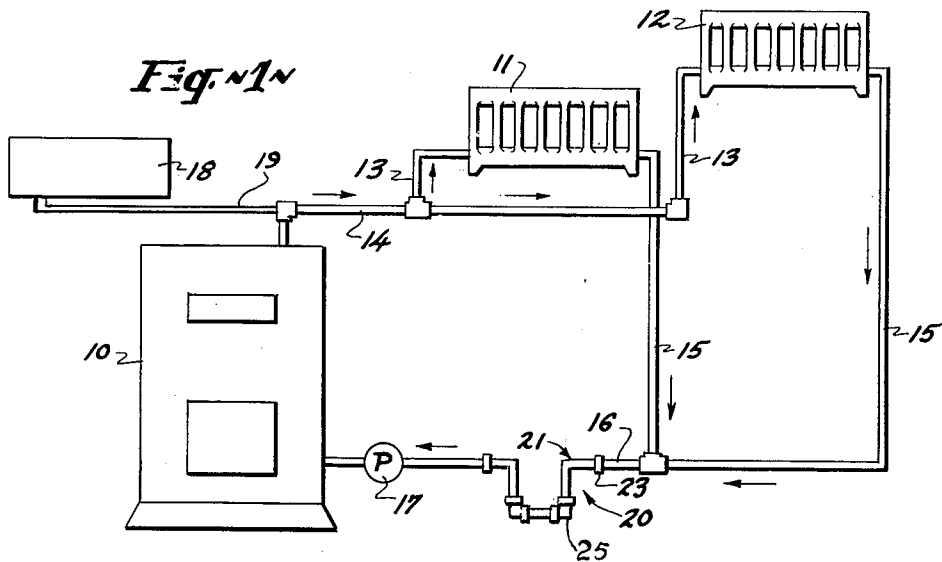


Fig. 5

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HEATING SYSTEM

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The present invention relates generally to closed, hot water heating systems, and is particularly directed to a device for inclusion in such systems to prevent the blocking of the latter by air trapped in the radiators, piping or other parts thereof.

In a closed hot water heating system, the formation of relatively large air pockets or bubbles at various locations in the system such as in the radiators or connections causes difficulties. The air enters with the water when the system is filled or replenished or enters through leaks. For example, such relatively large air bubbles may form at the top of a radiator or convactor to prevent the flow of hot water through substantial portions of the radiator so that the heat emitting efficiency of the latter is thereby greatly reduced. Dissolved air also is liberated upon increase of water temperature.

Heretofore, attempts have been made to defeat the difficulty resulting from air trapped in closed, hot water heating systems by providing air eliminating or separating devices, located at the radiators or interposed either in the pipes feeding heated water from the hot water boiler to the radiators or between the boiler and the expansion tank, and intended to remove the air from the heated water passed to the radiators. However, such air eliminating or separating devices are not always effective, so that some air is carried into the system and can collect, after a period of time, in relatively large bubbles within the radiators or convectors or at other locations to form air blocks which impede the operation of the heating system.

It is an object of the present invention to provide a device for inclusion in a closed, hot water heating system which, instead of seeking to eliminate or remove the air entering, or trapped in, the system, as heretofore, acts upon the air-containing-water to reduce or break down the air into small bubbles which are easily carried by the water through the radiators, pipes and other elements of the system so that such air cannot form air blocks interfering with the efficient operation of the heating system.

Another object is to provide a device for inclusion in closed, hot water heating systems to prevent the blocking of the latter by air trapped in the radiators, piping or other parts thereof, and wherein the device may be incorporated in existing heating systems of the described character without requiring extensive or expensive alteration of such systems.

Still another object is to provide a device of the described character which embodies no movable parts, and wherein the conditions under which the mixed air and water flow therethrough are such that the device continues to perform its intended function with little or no maintenance, even when the water circulating through the heating system contains relatively large amounts of scale forming particles or sediment.

In accordance with the invention, the device for preventing the blocking of a closed, hot water heating system by air trapped in the latter is preferably interposed

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in the return piping or mains between the radiators or convectors and the circulating pump, and includes a pipe elbow through which the returning water passes. It also is contemplated that more than one of the devices may be used in a system. For example, devices may be inserted in the return lines from the various individual radiators as well as in the main return line. The pipe elbow is arranged so that the returning water enters it through a horizontal branch of the elbow, whereby the air laden water will tend to pass through the upper portion of the horizontal branch and the air-free water will tend to pass through the lower portion of that branch. Both the horizontal branch and the vertical depending branch of the pipe elbow have partitioning members therein segregating the upper portion of the horizontal branch from the lower portion thereof and separating the vertical branch into two compartments which communicate, at their upper ends, with the upper and lower portions, respectively, of the horizontal branch, and, at their lower ends, with each other. Thus, the air-free water passes substantially unimpeded through the lower portion of the horizontal branch and through the communicating compartment of the vertical branch, while the entry into the upper portion of the horizontal branch and the communication between said upper portion and the related compartment of the vertical branch are restricted to small openings which break up the air bubbles carried by the air-laden water so that, when the air-laden water is again mixed with the air-free water, at the lower ends of the compartments of the vertical branch, the air is then present in the mixture only as very fine bubbles which can easily pass with the water through any of the openings or passages within the system to avoid the development of air blocks in the system.

The above, and other objects, features and advantages of the invention will be apparent in the following detailed description of an illustrative embodiment thereof which is to be read in connection with the accompanying drawing forming a part hereof, and wherein:

Fig. 1 is a schematic representation of a closed hot water heating system having a device embodying this invention included therein;

Fig. 2 is a longitudinal sectional view of a device embodying this invention to prevent the blocking of a system of the type illustrated in Fig. 1 by air trapped in such system;

Fig. 3 is a transverse sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is a top plan view of an element included in the device of Fig. 2; and

Fig. 5 is a front elevational view of another element included in the device of Fig. 2.

Referring to the drawing in detail, and initially to Fig. 1 thereof, which illustrates the invention in connection with a closed, hot water heating system, such a heating system is there seen to include a conventional hot water boiler 10 and heating elements 11 and 12, such as, radiators, convectors, unit heaters and the like. The heating elements 11 and 12 are connected to the boiler 10 by risers 13 extending from a hot water supply pipe 14, and also by return pipes 15 which open into a return main 16 extending back to the boiler and having a conventional circulating pump 17 interposed therein. Since the illustrated heating system is of the closed type, an expansion tank 18 is included and is connected to the boiler 10 by suitable piping 19. Since the construction and operation of the above described parts of a hot water heating system are common and well known, no further description thereof appears necessary for a full understanding of the present invention.

In order to prevent the development of air blocks

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within the closed, hot water heating system of Fig. 1, a device embodying the present invention and generally identified by the reference numeral 20 is incorporated in the system at a location past which all of the air and water in the system must flow following the transfer of heat from the water in the radiators, convectors or other heating elements, for example, at a location in a horizontal portion of the return main 16 between the return pipes 15 and the pump 17.

The device 20 includes a pipe elbow 21 made up of a horizontal branch 22 which, at its open end, is joined to the upstream part of the return main 16, as by a conventional coupling 23 (Fig. 1), and a vertical branch 24 depending from the horizontal branch 22 and joined by suitable piping 25 (Fig. 1) and conventional piping to the downstream part of the return main leading to the circulating pump. Thus, all of the water and air in the hot water heating system is made to flow through the pipe elbow 21, in the direction of the arrows on Fig. 2, prior to returning to the circulating pump.

During the flow of the water and air through the horizontal portion of the return main 16 at the upstream side of the pipe elbow 21, the air tends to rise within the return main so that the air-laden water occupies the upper portion of the return main and substantially air-free water flows along the lower portion of the return main.

Within the horizontal branch 22 of the pipe elbow there is provided an elongated, horizontal plate member 26 (Figs. 2, 3 and 4) passing substantially through the central axis of branch 22 and engaging, at its opposite longitudinal edges, with the inner surface of the related branch of elbow 21. One end of the plate member 26 is rounded, as at 27 (Fig. 4), to closely engage the inner surface of the pipe elbow at the bend 28 (Fig. 2) between the branches 22 and 24 so that the plate member 26 acts as a partition dividing the interior of the horizontal branch 22 into an upper chamber 29 and a lower chamber 30. At its forward, or upstream end, the plate member 26 is provided with an upwardly projecting, semi-circular member 31 which, at its arcuate periphery, contacts the inner surface of the branch 22 to restrict the entry into the upper chamber 29 of the latter, in a manner hereinafter described in detail.

Within the vertical branch 24 there is provided an elongated plate member 32 (Figs. 2 and 5) which extends vertically and is laterally disposed with its opposite longitudinal edges engaging the inside surface of branch 24 and its upper end edge engaging the underside of plate member 26 to divide the interior of the vertical branch of the elbow 21 into a front chamber 33, communicating at its upper end with the chamber 30, and a rear chamber 34 having restricted communication at its upper end with the chamber 29, in a manner hereinafter described in detail. At the lower end of the plate member 32, the chambers 33 and 34 merge so that the fluids respectively flowing through said chambers are there caused to co-mingle or mix.

As seen in Figs. 2, 3 and 4, the semi-circular member 31 has notches 35 in its arcuate periphery which, in cooperation with the inner surface of branch 22 of the pipe elbow, define restricted or small openings into the upper chamber 29 at the upstream end of the latter.

In order to establish restricted communication between the downstream end of the chamber 29 and the upper end of the chamber 34, the rounded end 27 of plate member 26 also has notches 36 in the peripheral edge thereof which, together with the inner surface of the bend 28, define small openings, and the rounded end 27 is further provided with an opening 37 (Figs. 2 and 4) which is positioned so that the upper edge of the plate member 32, in the form of a knife edge, as at 38, extends across the opening 37 at the underside of the plate member 26.

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Further, as seen in Figs. 2, 3 and 4, the plate member 26 has a louvre or scoop 39 struck therefrom and opening adjacent the member 31 in the upstream direction at the side of the plate member facing downwardly, while the plate member 32 has louvres 40 and 41 struck from the lower portion thereof and opening in the downstream direction at the opposite sides of the plate member 32 for purposes described in detail below.

The above described device 20 operates as follows:

As previously mentioned, during the flow of the air and water through the horizontal part of the return main 16 opening into the branch 22 of the pipe elbow, the air tends to rise, so that substantially air-free water enters the lower portion of branch 22 and the air-laden water, which may include relatively large air bubbles, enters the upper portion of branch 22. Thus, the air-free water flows unimpeded through the lower chamber 30 of branch 22 and then through the communicating chamber 33 of the vertical branch 24 to maintain a continuous flow of water through the device 20 to the part of the main 16 returning to the circulating pump 17. On the other hand, the air-laden water can enter the upper chamber 29 of branch 22 only through the relatively small openings defined by the notches 35 of member 31. If the air-laden water contains large air bubbles which resist passage through the notches 35 a relatively high pressure develops at the upstream side of the member 31, in part due to the jet action of air-free water admitted to chamber 29 through the louvre or scoop 39, until the pressure differential at the opposite sides of member 31 becomes great enough to enforce the large air bubbles to break apart and thereby pass, as relatively small bubbles, through the notches 35. Then the air-laden water, containing the air as relatively small bubbles, flows along the chamber 29 to the downstream end of the latter where it is forced to pass through the small openings defined by the notches 36 and the opening 37 bisected by the knife edge 38 into the chamber 34 so that the air bubbles are further broken down into small bubbles. Finally, the air-laden water, containing the air in the form of very small or minute bubbles, flows downwardly through the chamber 34 and, after passing the lower end of plate member 32, co-mingles or mixes with the air-free water flowing from the chamber 33.

The louvres 40 and 41 of the plate member 32 serve to promote the mixing together of the air-free water and of the air-laden water, after the air in the latter has been broken down to minute bubbles of air substantially uniformly distributed throughout. As is apparent, relatively low pressures are produced at the downstream sides of the louvres 40 and 41 so that air-laden water tends to flow through the louvre 40 into the chamber 33 to mix in the latter with air-free water, while air-free water tends to flow through the louvre 41 into the chamber 34 to mix in the latter with air-laden water.

From the foregoing, it is apparent that the device 20 embodying the present invention serves to break up the air circulated with the water into minute air bubbles which are uniformly distributed throughout the water, and it has been found that such minute air bubbles cannot cause air blocks in the radiators, convectors or other heating elements, or otherwise interfere with the efficient operation of the closed, hot water heating system in which the device 20 is incorporated. Since the device 20 includes no moving parts, the plate member 26 and the plate member 32 being suitably held in fixed positions within the related branches of the pipe elbow 21, it can be easily and relatively inexpensively produced, and there is nothing to go out of order or to require frequent maintenance, while the continuous flow of water through the device discourages the deposit of sediment or scale forming particles therein.

Further, the described device embodying the invention can obviously be installed in existing hot water heating systems merely by removing a section of the

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return main and substituting the device 20 therefor, whereby the advantages of the invention may be obtained with only a slight altering or reworking of the existing system. Finally, although the device embodying this invention, when incorporated in a closed, hot water heating system, does away with the necessity of the usual air eliminators or separators for removing the air from the circulated water, it is apparent that a heating system having a device embodying the invention therein may also incorporate such air eliminators.

While the invention has been described and illustrated with reference to a particular embodiment thereof, it is to be understood that the invention is not limited to that particular embodiment, and that various changes and modifications may be effected therein without departing from the scope or spirit of the invention, except as indicated in the appended claims.

What is claimed is:

1. A device for interpositioning in the piping of a closed, hot water heating system to prevent the blocking of the system by air contained therein; said device comprising a body defining two substantially parallel passages extending therethrough and having horizontal entry portions arranged one above the other to respectively receive a flow of air-laden water and a flow of air-free water, the passage receiving the flow of air-free water being substantially unobstructed throughout its length, the passage receiving the flow of air-laden water having obstructions therein at least at the entry portion thereof and at a location intermediate its ends to define relatively small openings through which the air-laden water must pass thereby to break up the air contained in the water into minute bubbles, and said two passages communicating with each other at the ends thereof remote from said entry portions to co-mingle the air-free water and the water containing air in the form of minute bubbles.

2. A device for interpositioning in the return piping of a closed, hot water heating system to prevent the blocking of the system by air contained therein; said device comprising a body defining first and second substantially parallel passages extending therethrough and having horizontal entry portions arranged with the horizontal entry portion of said first passage disposed above the horizontal entry portion of said second passage to respectively receive a flow of air-laden water and a flow of air-free water, said first and second passages further having vertical discharge portions with said second passage being substantially unobstructed throughout its length and said first passage having obstructions therein at least at the entry portion thereof and at the junction between the horizontal entry and vertical discharge portions thereof to define relatively small openings through which the air-laden water must pass thereby to break up the air into minute bubbles, said vertical discharge portions of the first and second passages communicating with each other at least at the ends thereof remote from the related horizontal entry portions to co-mingle the air-free water with the water containing minute air bubbles.

3. A device for interpositioning in the return piping of a closed, hot water heating system to prevent the blocking of the system by air contained therein; said device comprising a body defining first and second substantially parallel passages extending therethrough and having horizontal entry portions arranged with the horizontal entry portion of said first passage disposed above the horizontal entry portion of said second passage to respectively receive a flow of air-laden water and a flow of air-free water, said first and second passages further having vertical discharge portions with said second passage being substantially unobstructed throughout its length and said first passage having obstructions therein at least at the entry portion thereof and at the junction

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between the horizontal entry and vertical discharge portions thereof to define relatively small openings through which the air-laden water must pass thereby to break up the air into minute bubbles, said body further defining a common exhaust passage into which said vertical discharge portions of said first and second passages both open, and communicating openings between said vertical discharge portions adjacent the ends of the latter opening into said common exhaust passage to effect mixing of the flow of air-free water with the flow of water containing minute air bubbles during the movement of the flows through said discharge portions and upon discharge into said common exhaust passage.

4. A device for interpositioning in the return piping of a closed, hot water heating system to prevent the blocking of the system by air contained therein; said device comprising a body defining first and second substantially parallel passages extending therethrough and having horizontal entry portions arranged with the horizontal entry portion of said first passage disposed above the horizontal entry portion of said second passage to respectively receive a flow of air-laden water and a flow of air-free water, said first and second passages further having vertical discharge portions with said second passage being substantially unobstructed throughout its length and said first passage having obstructions therein at least at the entry portion thereof and at the junction between the horizontal entry and vertical discharge portions thereof to define relatively small openings, means between said horizontal entry portions of the first and second passages to cause air-free water from said horizontal portion of the second passage to flow into said horizontal portion of the first passage for inducing a relatively low pressure at the downstream side of said obstruction in the entry portion of said first passage so that the air-laden water is forced through the related small openings to break up the air into minute bubbles, said vertical discharge portions of the first and second passages communicating with each other at least at the ends thereof remote from the related horizontal entry portions to co-mingle the air-free water with the water containing minute air bubbles.

5. A device for interpositioning in the return piping of a closed, hot water heating system to prevent the blocking of the system by air contained therein; said device comprising a body defining first and second substantially parallel passages extending therethrough and having horizontal entry portions arranged with the horizontal entry portion of said first passage disposed above the horizontal entry portion of said second passage to respectively receive a flow of air-laden water and a flow of air-free water, said first and second passages further having vertical discharge portions with said second passage being substantially unobstructed throughout its length and said first passage having obstructions therein at least at the entry portion thereof and at the junction between the horizontal entry and vertical discharge portions thereof to define relatively small openings, means between said horizontal entry portions of the first and second passages to cause air-free water from said horizontal portion of the second passage to flow into said horizontal portion of the first passage for inducing a relatively low pressure at the downstream side of said obstruction in the entry portion of said first passage so that the air-laden water is forced through the related small openings to break up the air into minute bubbles, said body further defining a common exhaust passage into which said vertical discharge passages both open at their lower ends, and communicating openings between the lower parts of said vertical discharge passages to effect mixing of the air-free water with the water containing minute air bubbles during the flow thereof through said lower parts of the respective vertical discharge portions and upon discharge into said common exhaust passage.

6. A device for interpositioning in the return piping of a closed, hot water heating system to prevent blocking of the system by air contained therein; said device compris-

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ing a pipe elbow adapted to be interposed in the return piping so that the water and air in the system flow through said elbow and including a horizontal entry branch and a vertical discharge branch depending from the latter, a first partition extending horizontally through said horizontal entry branch and dividing the latter into upper and lower chambers to respectively receive air-laden water and air-free water, a second partition extending vertically through said vertical discharge branch and dividing the latter into front and rear chambers respectively communicating, at their upper ends, with said lower and upper chambers, the communication between said front chamber of the discharge branch and said lower chamber of the entry branch being substantially unobstructed, and means obstructing the entry into said upper chamber of the horizontal entry branch and the communication between said upper chamber and the rear chamber of said discharge branch to define small openings through which the air-laden water must pass to break up the air into minute bubbles, said front and rear chambers of the discharge branch communicating with each other at least at the lower end of said second partition to co-mingle the air-free water with the water containing minute air bubbles.

7. A device according to claim 6 wherein said means obstructing the entry into said upper chamber and the communication between the latter and said rear chamber includes an upwardly bent member at the upstream end of said first partition having a notched periphery engaging the inner surface of said horizontal entry branch so that said notched periphery cooperates with said inner surface in defining the small openings at the entry to said upper chamber, and an end portion at the downstream end of said first partition extending horizontally across the upper end of said rear chamber and having a notched periphery engaging the inner surface of the pipe elbow to define at least certain of said small openings between the upper chamber and the rear chamber.

8. A device according to claim 7 wherein said end portion at the downstream end of the first partition has an opening therethrough which is bisected by the upper edge of said second partition, and said upper edge of the second partition is in the form of a knife edge to break up the air bubbles passing through the related opening.

9. A device according to claim 6 wherein said first partition has a louvre projecting into said lower chamber adjacent the upstream end of said first partition to provide for a flow of air-free water from the lower chamber into said upper chamber which induces a relatively low pressure in the latter so that the air-laden water is thereby urged into said upper chamber through said small openings at the entry into the latter.

10. A device according to claim 6 wherein said second partition has louvres in its lower part projecting into said front and rear chambers of the vertical discharge branch to establish communication between said front and rear chambers, whereby air-free water flows from the front chamber into the rear chamber and water containing minute air bubbles flows from the rear chamber into the front chamber to promote the mixing together of the air-free water and the water containing minute air bubbles.

11. A hot water heating system comprising a hot water boiler, at least one heating element, hot water supply piping extending from said boiler to each heating element, return piping extending from each heating element back to said boiler and having a circulating pump interposed therein, and means interposed in said return piping separating the flow through the latter into air-free water and air-laden water and acting on the latter to break up the air therein into minute bubbles, and thereafter to comingle the air-free water with the water containing minute air bubbles.

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12. A hot water heating system comprising a hot water boiler, at least one heating element, hot water supply piping extending from said boiler to each heating element, return piping extending from each heating element back to said boiler and having a circulating pump interposed therein, and a device for preventing blocking of the system by air contained therein including a body interposed in said return piping and having substantially parallel first and second passages extending therethrough and arranged to respectively receive a flow of air-free water and a flow of air-laden water, said first passage being substantially unobstructed throughout its length to maintain a continuous flow of water through said return piping, said second passage having obstructions therein at its upstream end and at a location intermediate its ends defining small openings through which the air-laden water must pass thereby breaking up the air into minute bubbles, and said first and second passages communicating with each other at their downstream ends to comingle the air-free water with the water containing minute air bubbles.

13. A device for interpositioning in the piping of a closed hot-water heating system to prevent the blocking of the system by air contained therein, said device comprising a body defining two substantially parallel passages extending therethrough, and having horizontal entry portions arranged one above the other to respectively receive a flow of air-laden water and a flow of air-free water, the passage receiving the flow of air-free water being substantially unobstructed throughout its length, the other passage having at least one obstruction therein located in the path of flow of the air-laden water to break up the air contained in the water into minute bubbles, and said two passages communicating with each other at their discharge ends to co-mingle the air-free water and the air-laden water having the air in the form of minute bubbles therein.

14. A device according to claim 13 wherein said obstruction comprises means defining at least one small opening through which the air-laden water must pass.

15. A device for interpositioning in the return piping of a closed, hot water heating system to prevent the blocking of the system by air contained therein; said device comprising a body defining first and second substantially parallel passages extending therethrough and having horizontal entry portions arranged with the horizontal entry portion of said first passage disposed above the horizontal entry portion of said second passage to respectively receive a flow of air-laden water and a flow of air-free water, said first and second passages further having vertical discharge portions with said second passage being substantially unobstructed throughout its length and said first passage having an obstruction therein at the junction between the horizontal entry and vertical discharge portions thereof to define at least one relatively small opening through which the air-laden water must pass thereby to break up the air into minute bubbles, said body further defining a common exhaust passage into which said vertical discharge portions of said first and second passages both open, and at least one communicating opening between said vertical discharge portions adjacent the ends of the latter opening into said common exhaust passage to effect mixing of the flow of air-free water with the flow of water containing minute air bubbles during the movement of the flows through said discharge portions and upon discharge into said common exhaust passage.

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