June 14, 1955 J. J. BLACKMORE ET AL 2,710,664

WATER DEAERATION

Filed May 15, 1952

FIG. 1.

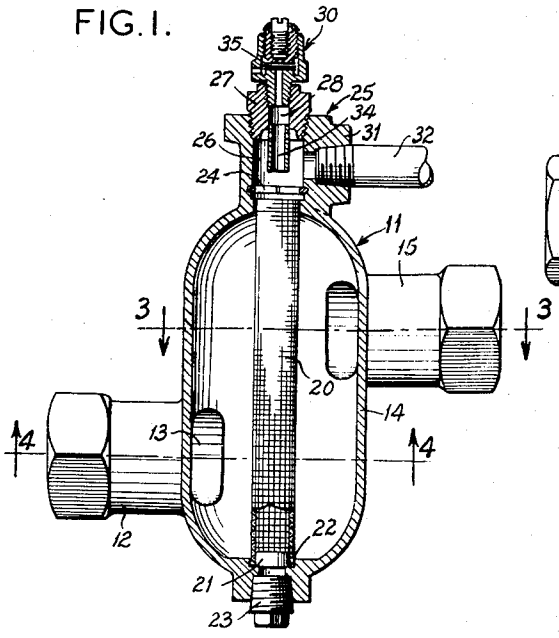


FIG. 2.

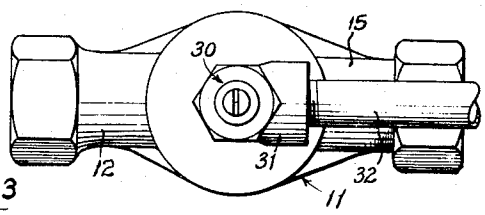


FIG. 3.

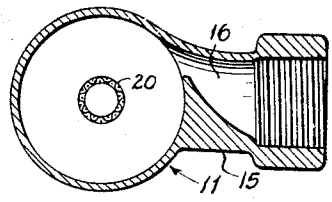


FIG. 4.

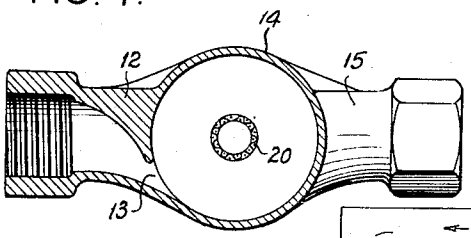
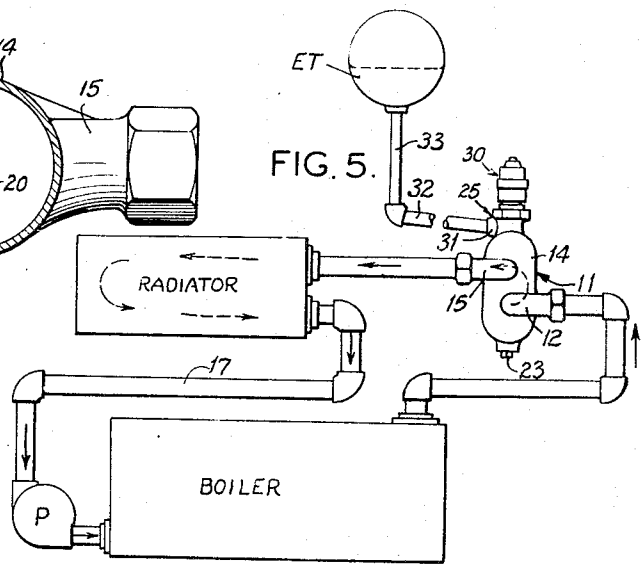


FIG. 5.



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WATER DEAERATION

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7 Claims. (Cl. 183—2.5)

This invention relates to improvements in air-volume controls for expansion tanks, and more particularly to a novel combination of elements for use in hot water heating systems equipped with expansion tanks of pressure type.

It has been long known and commonly practiced to provide, in connection with and as a part of a hot water heating system consisting of a boiler and radiator units, an expansion tank of such nature as to permit expansion of the liquid content of the system as its temperature is increased. Quite prevalently, such provision for expansion consists of a closed, usually elongate metal tank located in the basement of the residence or other building, which tank normally contains a volume of water and a volume of air, providing a cushioning agency against which liquid expansion takes place. However, a serious operational difficulty is prevalently experienced in the tendency of the pressure-type expansion tank to become water logged, or otherwise expressed, to become filled with water due to the gradual absorption of its air content, the air being carried into the system, again released, and eventually lost incident to the venting of radiators and the like.

It is accordingly a major and principal objective of the present improvements to provide an effective agency for supplying to a pressure-type expansion tank a small volume of air from time to time, and thereby serving to maintain a controlled volume of air in the tank for the purposes noted.

Stated in reference to structure utilized, the present invention has as an object, the combination with an air separator and an expansion tank in a hot water circulating system, of means serving as an air chamber and collector, and means for keeping at least a small volume of air in such chamber, the air volume being predetermined within reasonable and practical limits.

Yet another and highly important object of the invention is realized in the provision as a part of the combination referred to in the preceding object, of an automatic air vent acting to control the volume of air collected for transfer to the expansion tank.

Stated more particularly in reference to preferred embodiments of the improvements, the design and experimental work culminating in the present subject has resulted in a compact, readily installed merchantable device including a highly efficient air separator, built into which is an air collector, together with automatic means for limiting the amount of air thus collected, and yet assuring a plenary air supply at all times for maintenance of the desired air-water level in a pressure expansion tank.

The foregoing and numerous other objectives and advantages will more clearly appear from the following detailed description of a preferred embodiment and installation in a closed water heating system, particularly when considered in connection with the accompanying drawing, in which:

Fig. 1 is a vertical sectional view with certain parts

shown in elevation, of an air separating, entrapping and venting unit;

Fig. 2 is a top or plan view of the unit of Fig. 1;

Fig. 3 is a horizontal sectional view taken through the water discharge region of the separator as indicated by line 3—3 of Fig. 1;

Fig. 4 is a view similar to Fig. 3, but taken along line 4—4 of Fig. 1 through the inlet region of the separator, and

Fig. 5 is a partly diagrammatic and partly structural representation, that portion of Fig. 5 representing a heating system being primarily diagrammatic, and that portion representing the air separator and air volume control features being structural in nature, but on a scale somewhat reduced in comparison with Fig. 1.

Referring now by characters of reference to the drawing and first to Fig. 5, a boiler is diagrammatically indicated by legend and is connected into a takeoff line or pipe from which the flow is directed into the air separator forming a portion of the flow circuit and generally indicated at 11. The separator 11 is provided with an inlet fitting 12, the fitting being formed internally to provide a tangentially directed nozzle 13 opening into the body or casing element 14 constituting the tank of the separator.

Located at a higher level than the fitting 12, is a similar discharge fitting 15, internally of which is a tangential outlet passage or nozzle 16. After the liquid is impelled through the separator identified with the casing 11 it will proceed through the one or several radiation units indicated by legend in Fig. 5, thence returned through the line of piping 17 via a rotary or other type of pump P to the boiler. The flow circuit is included herein solely for completeness, since conventional except for the air separator and the branch circuit associated therewith for connection of the separator to the expansion tank, as will appear.

The separator 11 is of the general type disclosed in U. S. Patent No. 2,578,568 issued to the present applicants December 11, 1951, the separator 11 being modified in minor respects over the unit shown by the patent aforesaid.

Particularly in case a pump P be employed, but to a lesser degree if the flow in the system occurs solely by thermosiphon or gravimetric action, the tangential inlet nozzle and the takeoff at an opposite and higher zone through the discharge fitting, will result in a rapid whirling of the normally aerated water within the tank 14 of the separator 11.

Located centrally and axially of the tank 14 is an air screen of tubular form indicated at 20, the lower end of the screen 20 being plugged as by a circular element 21 set into a conforming countersunk recess 22 within the casing 14. A threaded plug 23 facilitiates assembly and serves to complete the closure at this end of the casing. The opposite or upper end of the vertical screen 20 is held in place by an expanding snap ring 24 engaging a circular groove in the upper portion of the casing.

Surmounting the casing 14 is a fitting shown as integral with the casing, although such relation, while making for compactness and enabling production of the separator and air collector as a package unit or article of manufacture, the top fitting may nevertheless be separately formed and connected to the casing. This upper fitting as shown, is generally indicated at 25, and is of the general nature of a T element or fitting. It includes a vertical bore providing an air-collecting cell 26 in the fitting, the top of the cell being closed by a threaded plug 27 provided with a bore 28 therethrough and threaded at its upper end to receive an automatic vent unit generally designated at 30 and later more particularly described as to its nature and function.

In the example shown, the fitting portion 25 is pro-

vided with a lateral connection consisting of a boss **31** internally threaded to receive an expansion tank connecting pipe **32**. Such pipe is by preference given a slight rise as indicated by Fig. 5, into a vertical riser portion **33** the latter connecting into the bottom of the expansion tank ET.

Dependingly carried by the plug **27**, and shown as extending vertically downwardly but only over a portion of the depth of the air cell, is a drop tube **34**. The drop tube is fully open at its ends, forms an extension of the bore **28**, and leads directly into a bore or passage located axially of the automatic vent unit **30**.

Although the automatic vent device may consist of any of a number of such units currently available to the trade, the device shown, since per se not a part of the present invention except as one element of the combination, is shown as of a type in which there are utilized a series of stacked liquid absorptive elements indicated for completeness of understanding at **35**, and acting, when wet, to seal a delivery passage through the vent device. However, as the moisture content of the unit **35** is reduced, the relative shrinkage of the elements will permit any air directed into the vent device, gradually to bleed to atmosphere. Among the devices of this general nature and suitable for use in the present combination is the Dole automatic air vent unit illustrated.

It is a matter of preference that the drop tube, and particularly the lower end thereof, be located proximate the inlet to the expansion tank pipe **32**. This is for the reason that the downward extent of the drop tube **34** will determine the liquid level usually existing at a given time in the air cell space **26**. Thus, with the air cell and drop tube related somewhat as shown by Fig. 1, the air cell is open directly into the pipe **32**, and also in normal operation a water level is maintained partly over the height of the opening into the line **32**.

The function of the device described is believed best understood by considering the flow circuit of the heating system proper as that of the usual closed system comprising, in order, the boiler, circulation lines **12**, **11** and **15** into the radiation units, thence through return piping **17**, and the pump for return to the boiler. The present improvements are by preference installed as a branch, opening into the main hot water flow circuit. This branch comprises, as shown, the fitting constituting an air collector and being the assembly **25**, together with the automatic air vent, the remainder of this branch leg or line including the pipe elements **31**, **32**, **33** and the tank ET.

When the system is first put into operation, or restored to service after drainage for any purpose, water will be admitted to the flow circuit from the usual source, and since the control element **35** of the air vent unit is initially dry, air will be slowly bled out of the automatic air vent **30** until the element **35** becomes sufficiently moistened to preclude further air flow. It is, however, preferred to vent the air quickly from unit **30** upon starting the system, as may readily be done by loosening the top closure screw on the unit until a flow of water appears, then tightening the screw. Upon either a first fill or refill of the system, a normal volume of air will be entrapped in the expansion tank ET. When the boiler is fired, heating of the water from city mains or other source, will give off a portion of its air, and at the same time will expand. The water in the closed flow circuit will now be circulated by pump P or by gravity differentials, whereupon a relatively rapid whirling action will take place within the casing **14** of the separator, resulting in a collection of separated air particles in the vortex within and possibly to some extent exteriorly of the screen **20**, so that air rises along and through this tubular element, gradually building up an air volume within the air cell space **26**. As the volume of air is thus accumlated and augmented, the level of water in the chamber **26** will gradually recede, at least until such time as same is brought below the highest point of the inlet port into the line **32**. As soon as the water level thus recedes and the air volume in the cell is correspondingly increased, the separated air delivered from the casing **14** will find its way along and within the line **32** into the riser **33**, thus causing the air particles to bubble upwardly through the liquid in the tank ET, augmenting or at least maintaining the air volume in the upper part of the tank. Thus, instead of the usual gradual depletion of the air in the expansion tank, same is maintained at a safe and serviceable value, for long periods of time.

Some form of automatic air vent is regarded as highly desirable, and is circuitwise arranged substantially as is the presently disclosed unit **30**. If no automatic air venting provision were utilized, it would of course be quite possible under certain conditions, that the volume of air gradually accumulating above the separator casing **14** might become excessive and with later addition of air with added water, might drop to a level such as to be recirculated through the fitting **15**, hence through the radiation units, with obvious impairment of heating efficiency.

It will however have appeared that by reason of the length and location of the drop tube **34** in reference to the air cell space **26**, as and when the volume of air in the cell is such as to bring the water level therein below the entrance to the drop tube **34**, the elements **35** will immediately release sufficient air to permit a slight rise in the water level above the entrance to the drop tube. Thus the arrangement serves to hold the water level in the branch leg, as well as the volume of air in the cell, hence in the expansion tank, within the desired limits.

Experience has shown that drainage and refilling to a normal extent will in virtually all cases suffice to supply added air to the system, so that the air volume control device forming a part of and acting with the expansion tank branch leg, will serve under virtually all normal conditions to maintain a sufficient volume of air in the pressure tank.

Reference is herein made, both in specification and claims, to an expansion tank of pressure type, it being intended thereby to include all closed types of expansion tank in distinction from those classes of overhead expansion tanks of solely gravity type which are prevalently open to atmosphere and thus incapable of retention of air added from the circulatory system.

It should further be expressly understood that no restriction is intended to any specific type of automatic air venting device, the unit indicated at **30** for this purpose having been selected merely by way of example because of its compactness, light weight, moderate space requirement and low cost.

Although the invention has been described by particularized reference to a selected exemplary embodiment, the detail of description should be understood solely in an instructive, rather than in any limiting sense, many variants being possible within the fair intended scope of the claims hereunto appended.

We claim as our invention:

1. As an article of manufacture, an air separation and recovery device for use in a hot water boiler and radiator system, the device comprising a vertical casing element of a generally cylindrical shape provided with a tangential discharging inlet fitting and a tangentially located discharge fitting adapted for connection into a closed hot water flow circuit, a fitting at the top of the casing and constituting an air entrapment cell, an automatic air vent device carried by said top fitting, and a drop tube within said fitting and extended downwardly into the air cell, the air cell being provided with an outlet port, the drop tube being open at each end, one end of said tube being located proximate to the outlet port, the outlet port extending above and below the end of said tube, and the other end of said tube being disposed in communication with said air vent device through an opening provided in said air cell.

2. In an air separation and recovery device for use in a hot water heating system, an air separator of centrifugal

type, and comprising a casing of elongate character, an inlet fitting terminating in a nozzle opening tangentially into the casing, a fitting providing above the inlet fitting a discharge opening, through which water is discharged from the casing, a screen located axially of the casing, a fitting comprising an air cell above said casing and open to the interior thereof, a plug element in said air cell fitting and having an opening therethrough, an automatic air vent device carried by the plug element and communicating with the opening therethrough, and a vertical drop tube extended depthwise below the plug and incompletely through the space within the air cell fitting, the air cell fitting being provided with a lateral outlet port, the drop tube having its lower end located in a zone directly opposite said port, the upper end of said tube being disposed in communication with the opening in said plug element, and thence in communication with the automatic air vent device, whereby to provide for escape of the air through said tube and through said air vent device.

3. In an air separation and recovery device adapted for use in a hot water heating system, an air separator of centrifugal type, and comprising a casing of a vertically elongate character, an inlet fitting terminating in a nozzle opening tangentially into the casing, a fitting above the inlet fitting and providing a discharge opening, and including a nozzle through which water is discharged from the casing, a vertical screen located axially of the casing, a fitting comprising an air cell above said casing and open axially to the interior thereof, and to the interior of said tubular screen, a plug element in the top of said air cell fitting and having an opening therethrough, an automatic air vent device carried by the plug element and communicating with the opening therethrough, and a vertical drop tube extended depthwise below the plug and incompletely through the space within the air cell fitting, the air cell fitting being provided with an outlet port in its lateral wall, said port being vertically spaced from said plug and located in a zone above and below the lower end of said drop tube, the upper end of said tube being in communication with said plug opening, and hence with said air vent device, whereby to provide for escape of the air through the tube and through the air vent device.

4. In an air separation and recovery device for use in a hot water system, the device comprising a casing element, the casing element being provided with an inlet and an outlet port, means located in said casing element for separating air from the water, an air-collecting chamber communicating with the casing element, the chamber being provided with a laterally disposed water and air outlet port, a drop tube extending into a portion of said air-collecting chamber, and an automatic air vent device disposed above the chamber, one end of said drop tube being connected to the air vent device, the other end being located in a zone directly opposite the water and air outlet port in said chamber, whereby to maintain a volume of air and a level of water in the collecting chamber.

5. In an air separation and recovery device for use in a hot water system, the device comprising a casing element, the lower portion of which defines a water chamber, said water chamber being provided with an inlet and an outlet port, means located in said water chamber for separating air from the water, the upper portion of said casing element defining an air cell, a drop tube extending downward into said cell, the cell being provided with a laterally disposed water and air outlet port, and an automatic air vent device located above said cell, the drop tube having one end connected to the air vent device and the other end located in a zone opposite the water and air outlet port in said cell, whereby to maintain a volume of air and a level of water in said cell, said water and air outlet port extending above and below the end of said drop tube.

6. In an air separation and recovery device for use in a hot water system, the device comprising a vertical casing of a generally cylindrical shape, said casing being provided with a tangential inlet and a tangential outlet port, means located centrally in said casing for entrapping the air in the water, an air-collecting chamber located above and disposed in communication with said casing, said chamber being provided with an outlet port, the latter said port being located in the side wall portion of said chamber, and spaced from its upper wall portion, a drop tube extending vertically downward into said chamber, and an automatic air vent device arranged above said tube, the tube having its upper end connected to the air vent device, and its lower end located in a zone proximate and opposite to the outlet port in said chamber, whereby to determine the lowest level of the space normally occupied by a volume of air in said air-collecting chamber, the outlet port in said chamber extending above and below the lower end of said drop tube.

7. In an air separation and recovery device adapted for use in a hot water system, the device comprising a vertically elongate casing, said casing having a lower portion that defines a water-chamber, said water chamber being provided with an outlet and an inlet port, means located centrally of said water chamber for entrapping the air in the water, the casing having an upper portion that defines an air-collecting cell, a plug located at the top of the casing, said plug constituting the top wall of said cell, the plug being provided with a vertical bore, a drop tube dependingly carried by said plug, the drop tube being open at both ends, the upper end of said drop tube being in communication with said plug bore, the lower end of said tube being located in said cell, and an automatic air vent device carried by said plug in said bore, the air collecting cell being provided with an outlet port in its lateral portion, the latter said port being spaced from the top wall of said cell, and being located in a zone that extends both below and above the lower end of said drop tube, whereby to determine the lowest level of the space normally occupied by a volume of air in said cell.

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