Jan. 17, 1967 V. C. SMITH 3,298,929

WATER DISTILLATION APPARATUS WITH VAPOR TRAP

Filed Aug. 7, 1963

FIG. 1

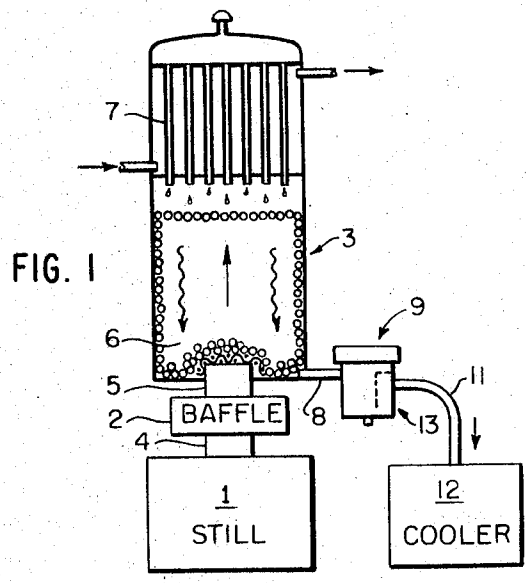
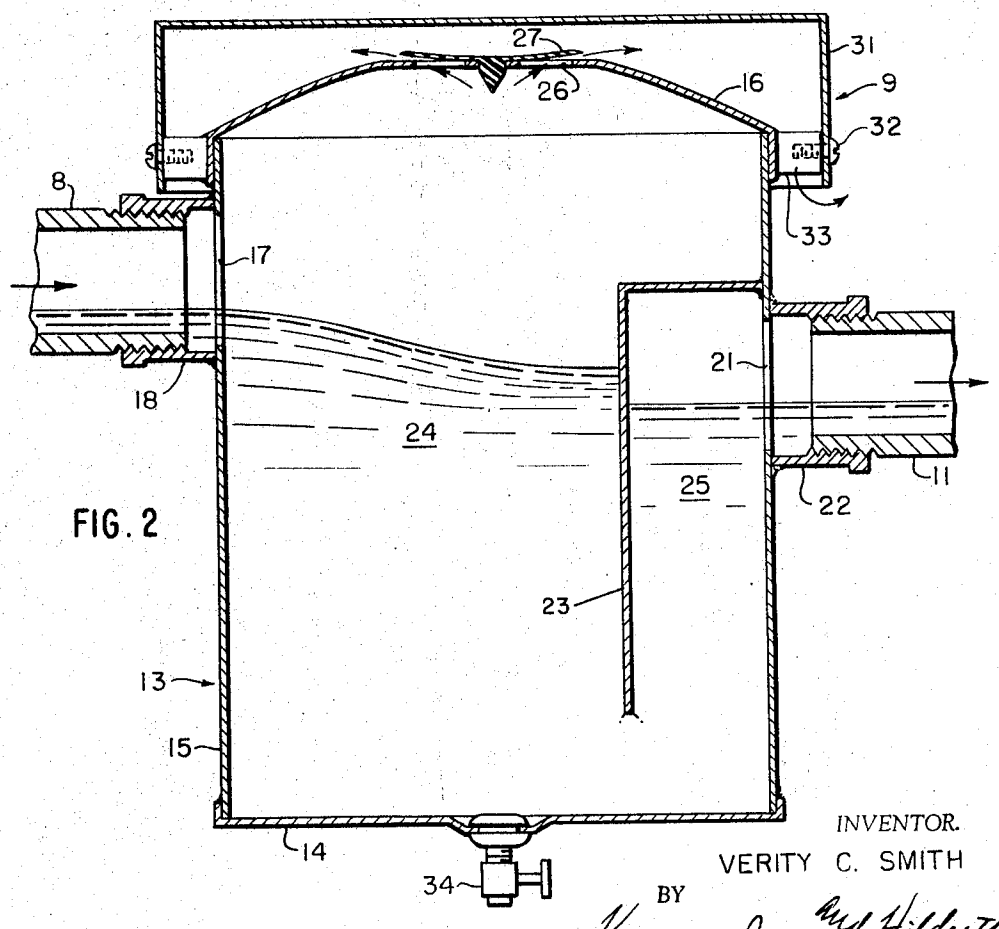


FIG. 2



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United States Patent Office 3,298,929 Patented Jan. 17, 1967

3,298,929 WATER DISTILLATION APPARATUS WITH VAPOR TRAP

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Filed Aug. 7, 1963, Ser. No. 300,474
1 Claim. (Cl. 202—190)

This invention relates to water distillation, and in particular to apparatus for obtaining a distillate of high purity from the base of a countercurrent vapor-distillate unit in a water distillation system.

High purity water distillation systems frequently include a countercurrent vapor-distillate unit, called a scrubbing column, between the still and the condenser. The vapors and distillate flow through the scrubbing column in intimate countercurrent contact with one another, the vapor reheating the distillate substantially to the vaporization temperature and removing from the distillate the last trace of dissolved gases, which are vented from the top of the column. In practice, countercurrent scrubbing of the distillate with the vapor will frequently result in an increase in resistivity of the distillate, the normal method of measuring its purity, from a value of less than 500,000 ohm-centimeters to a value of greater than 3,000,000 ohm-centimeters.

The distillate collects in the bottom of the scrubbing column, and is fed through a cooler to a storage tank, which may be combined with the cooler. It has been found in some instances that the purity of the distillate drawn from the storage tank is quite low. Since tests of the distillate purity showed the distillate supplied to the cooler to be of the normal high purity, but the distillate yield flowing from the cooler to be of a low purity, the cooler was thought to be defective. Replacement of the cooler usually resulted in a return of the distillate yield to a high purity level for a while, after which the purity of the distillate yield would drop back to a low purity level. This exceedingly troublesome fluctuation in the purity of the distillate yield rendered the high purity distillation system unreliable. Because of this, the purity of the distillate could not be assured by the system itself, but could only be assured by periodically testing the distillate yield.

The present invention overcomes these problems, and provides a high purity distillation system which reliably and consistently yields a high purity distillate.

The present invention is predicated on the assumption that impurity vapors also collect in the bottom of the scrubbing column and are fed with the distillate to the cooler and storage unit. When distillate withdrawn from the outlet of the scrubbing column is tested for purity, these vapors are naturally vented from the distillate as it is withdrawn, and the test shows the distillate to be of a high purity. However, when fed to the cooler, these impurity vapors condense as the distillate is cooled, contaminating the distillate yield. The presence of these impurity vapors has not been detected by analytical procedures. Yet, their presence is indicated by the discovery that when a vapor trap is included between the scrubbing column and the cooler, the cooler reliably and consistently yields a high purity distillate. For example, by installing a vapor trap at the outlet of the scrubbing column of a high purity distillation system yielding a low purity distillate, the purity of the distillate flowing from the cooler will increase from a level of 300,000 ohm-centimeters to a level of 3,000,000 ohm-centimeters within an hour after installation of the vapor trap, and the purity will remain at this high level.

The vapor trap of the present invention receives the reheated distillate output from the scrubbing column and permits only the liquid distillate to flow therethrough. Preferably, the vapor trap includes a housing divided into two compartments only in liquid communication with one another so that only the high purity distillate can flow into the downstream compartment, the impurity vapors collecting in the upstream compartment being vented to the atmosphere.

The invention is further described in detail below with reference to the accompanying drawings, in which:

FIG. 1 schematically illustrates the distillation system of the present invention with the condenser and scrubbing column shown in vertical cross-section, a vapor trap being included between the distillate outlet of the scrubbing column and the cooler; and

FIG. 2 is a vertical cross-sectional view of the vapor trap in operation.

A typical water distillation system incorporating the vapor trap is shown in FIG. 1 and includes a still **1**, a baffle **2** and a chamber **3** housing the condenser and scrubbing column, connected in serial fluid communication with one another by conduits **4** and **5**. Each of these components of the distillation system may be of conventional design, and form of themselves no part of this invention.

The still **1** receives the water to be distilled and includes heating means for converting the water to vapor. The vapor passes upwardly through conduit **4**, baffle **2**, conduit **5**, the scrubbing column **6** within chamber **3** to the coils of condenser **7**. The vapors are condensed to a liquid distillate by condenser **7**, and the distillate drops from the condensing coils back through the packing material of the scrubbing column in intimate contact with the upwardly flowing vapors. During this countercurrent flow of the vapors and distillate, the distillate is heated by the vapors and the last trace of dissolved gases are scrubbed from the distillate to purify it. The gases rising to the top of the chamber are vented by a vent cap in the top wall of the chamber.

The hot liquid distillate collects in the bottom of the scrubbing column, and flows through conduit **8** to a vapor trap **9**. The vapor trap blocks the flow past the trap of any vapors flowing with the distillate from the scrubbing column, and vents these vapors to the atmosphere. The purified distillate flows from the vapor trap through an outlet conduit **11** to a cooler **12**, which also may store the purified distillate for use. While the vapor trap is shown as a separate unit, it may be formed within and as a portion of chamber **3**, or even as a portion of the cooler.

A presently preferred construction of the vapor trap **9** is illustrated in FIG. 2. The vapor trap includes a cylindrical housing or casing **13** comprising a base pan **14**, a cylindrical side wall **15**, and a top wall **16** receiving the outer marginal portions of one another and soldered, brazed, or otherwise sealed and attached to one another at the overlapping marginal portions. An inlet opening **17** is provided in the side wall **15** adjacent the top wall **16**, and an interiorly threaded inlet nipple **18** which receives the threaded end of conduit **8** is secured and sealed about the outer peripherial portion of the side wall **15** defining the inlet opening. An outlet opening **21** is provided in the side wall **15** opposite and lower than the inlet opening **17**, and an interiorly threaded outlet nipple **22** which receives the threaded end of conduit **11** is secured and sealed about the outer peripheral portion of side wall **15** defining the outlet opening.

A baffle **23** is secured and sealed within the cylindrical canister **13** to the side wall **15** about outlet opening **21**. The baffle includes a top wall shaped as a segment on a chord of the cylindrical canister and a rectangular side

wall, which walls are sealed to one another and to the side wall of the canister. The lower side wall end of the baffle is spaced from the base pan **14** to permit fluid to flow from the inlet under the baffle to the outlet. The baffle isolates the cylindrical canister into an inlet compartment **24** and an outlet compartment **25**.

During operation, the hot liquid distillate collects in the bottom of the scrubbing column **6** with any vapor impurities and flows through conduit **8** to the inlet compartment **24** of the vapor trap **9**. The liquid distillate collects in the lower portion of the inlet compartment, and any vapor impurities flowing with the distillate collect in the top portion of the inlet compartment. The liquid distillate flows from the inlet compartment under the side wall of the baffle **23** to the outlet compartment **25**, filling it to the level of outlet opening **21**. The baffle wall extends well into the distillate pool in the vapor trap, and positively separates and isolates the vapor impurities collecting in the top portion of the inlet compartment from the outlet compartment. Thus, only the pure distillate flows from the outlet compartment **25** through conduit **11** to the cooler **12**.

The top wall **16** of the vapor trap includes vapor vent opening **26** through which the vapor collecting in the top portion of the first compartment may be vented to the atmosphere. A flapper valve **27** is attached to the top wall over the vapor vents. Under a slight vapor pressure, such as normally exists in the scrubbing column, the outer rim portion of the head of the flapper valve will lift from the top wall, as shown in FIG. 2, to vent vapors collecting within the top portion of the inlet compartment to the atmosphere. Preferably top wall **16** is convex, and slopes away from vents **26** to positively cause water condensing on the exterior surface of the top wall to flow outwardly, rather than back through the vents and into the vapor trap.

A dust cover **31** is secured over the cylindrical casing spaced from the top wall in any convenient manner, as by machine screws **32** passed through openings adjacent the rim of the cover and threadably received in studs **33** welded or otherwise attached to the top wall. The dust cover and the top wall form a tortuous path for vapors flowing from the vents outwardly under the rim of the cover to the atmosphere, and this tortuous path impedes any countercurrent flow of impurities from the atmosphere back into the vapor trap. While a more elaborate venting arrangement may be provided if desired, such as a filter valved to permit vapors to flow only from the vapor trap, the illustrated venting arrangement has proven entirely adequate. The center portion of base pan **14** preferably is depressed, and receives the inlet of a drain cock **34** through which the distillate may be drained from the interior of the vapor vent when desired.

Preferably the members forming the distillation system, including the vapor trap and the cooler, are completely tinned on the inside surfaces exposed to the vapors and distillate, as is common. The vapor trap may be formed as a part of the scrubbing column, or as a part of the cooler if so desired. The vapor trap need not necessarily vent the vapors to the atmospheric, but may only block the flow of the vapors to the cooler.

While the preferred construction of the vapor trap has been described, it will be apparent that any conventional vapor trap may be employed to permit only the distillate to flow to the cooler. Also, while a scrubbing column generally similar to that disclosed in my U.S. Patent 2,816,064 issued December 10, 1957 for "Water Distillation" is shown, the vapor trap may be employed with various other countercurrent vapor-distillate units, such as the unit disclosed in my U.S. patent application, Serial No. 269,503 filed April 1, 1963, for "Water Distillation Condenser," or even in other distillation systems in which the distillate is reheated to drive off dissolved gases. In short, various modifications of the disclosed system will be apparent to those skilled in the art and familiar with the principles herein disclosed, and such modifications may be made without departing from the spirit and scope of the invention.

I claim:

In a water distillation system which includes in vertical alignment a still, a vented condenser, and a scrubbing column between the still and condenser having a distillate outlet at the bottom of said scrubbing column, the improvement comprising a vapor trap housing, a baffle wall within the housing dividing the housing into an inlet compartment and an outlet compartment in fluid communication with one another only adjacent the base of the housing, means for supplying the distillate collected at the outlet of the scrubbing column to the inlet compartment, the distillate collecting in the lower portion of the inlet compartment and flowing to the outlet compartment, means for venting the upper portion of the inlet compartment, a dust cover overlying said venting means, and means at the outlet compartment for supplying the distillate collecting in the outlet compartment to a cooler and storage unit.

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