[0148] In an embodiment of the invention shown in FIGS. **23**A, **23**B, and **25**, the vessel **1150** includes a drain orifice **1115**. Since the backpressure regulator **1100** may operate within a bounded region **1310** of a large system **1320**, the drain orifice **1115** acts as a pathway to release fluids that are purged from the pressurized conduit **1340** through orifice **1110** into the bounded region **1310**. The drain orifice **1115** may connect the bounded region **1310** to another area of the larger system, or to the external environment **1330**. In addition, the build-up of gases in the bounded region **1310** may result in condensation of such gases. Also, gases purged through the orifice **1110** may be entrained with droplets of liquid that may accumulate in the bounded region **1310**. Thus the drain orifice **1115** may also be used to purge any build up of condensables that accumulate in the bounded region **1310**; the condensables may also be released from the bounded region using a separate orifice **1350**.

[0149] The backpressure regulator may be configured to allow a small leakage rate below the set point in order to purge the build up of volatile gases that act to insulate heat exchange and suppress boiling in a system; the regulator is designed, however, to allow pressure to build in the pressurized conduit despite this small leakage. In an embodiment of the invention, release of volatile components from a pressurized conduit, below the set point of the backpressure regulator, may also be achieved through a specifically-designed leak vent while the arm of the backpressure regulator is in the closed position. The leak vent is configured to allow a certain leakage rate from the port or the orifice while the pressure in the conduit is below the set point. Such leak vent may be designed by a variety of means known to those skilled in the art. Non-limiting examples include specific positioning of the stop and port to allow a small opening while the arm is in the closed position; designing the port such that a small opening, not coverable by the stop, is always exposed; specifying a particular rigid, non-compliant seal configuration between the stop and port when the arm is in the closed position; and configuring the orifice leading to the port to have a small opening to allow leakage of fluids.

[0150] In a particular embodiment of the invention directed toward the leakage of volatiles below the set point of the backpressure regulator, the port **1410** has a small notch **1420** as shown in FIG. **26**A and the close-up of region C of FIG. **26**A depicted in FIG. **26**B. Thus, when a stop is in contact with the port **1410**, when the arm of the backpressure regulator is in the closed position, a leak vent is present that allows a small leakage through notch **1420**. In another particular embodiment of the invention, orifice **1510** has a small opening **1520**, as depicted in FIG. **27**A and blow up of region E of FIG. **27**A depicted in FIG. **27**B. The opening **1520** is configured such that a leak vent is present when the stop covers the port **1510** since fluids may leak through the opening **1520**.

[0151] Various features of a backpressure regulator consistent with embodiments of the invention may be altered or modified. For example, stops to be used with backpressure regulators may have any shape, size, or mass consistent with desired operating conditions, such stops need not be ball-shaped as shown in some embodiments of the invention discussed herein. As well, stops of different weight but similar sizes may be utilized with the retainer to alter the set point of the regulator. Similarly, counter masses of different sizes, shapes and masses may be utilized with embodiments of the invention as long as they are accommodated by the axis and arm configurations (compare **1180** in FIGS. **23**A and **23**B with **1280** in FIGS. **24**A and **24**B); such counter masses may be attached and oriented relative to the arm by any of a variety of techniques apparent to those skilled in the art. The pivot pin placement need not be positioned as shown in FIGS. **23** and **24**, but may be positioned wherever advantageous to provide the mechanical advantage required to achieve a particular pressure set point.

[0152] Embodiments of the invention may optionally utilize the drain orifice feature described earlier. Also, embodiments of the invention may not utilize the counter mass force adjustment feature, relying on the specific properties of a stop to provide the set point for the backpressure regulator.

[0153] Other embodiments of the invention may not utilize a vessel, but rely on orifices that are intrinsically part of the system. In such instances, the backpressure regulator arm may be directly attached to a portion of the system such that the arm, stop, and counter mass are appropriately oriented for the operation of the regulator.

[0154] As described above, various embodiments of this invention may advantageously provide a low-cost, easily maintained, highly efficient, portable, and failsafe liquid purification system that can provide a reliable source of drinking water for use in all environments regardless of initial water quality. The system of the present invention is intended to produce a continuous stream of potable water, for drinking or medical applications, for example, on a personal or limited community scale using a portable power source and moderate power budget. As an example, at the desired efficiency ratio, it is envisioned that the present system may be utilized to produce approximately 10 gallons of water per hour on a power budget of approximately 500 watts. This may be achieved through a very efficient heat transfer process and a number of sub-system design optimizations.

[0155] Knowledge of operating temperatures, TDS, and fluid flows provides information to allow production of potable water under a wide range of ambient temperatures, pressures, and dissolved solid content of the source water. One particular embodiment may utilize a control method whereby such measurements (T, P, TDS, flow rates, etc) are used in conjunction with a simple algorithm and look-up table allowing an operator or computer controller to set operating parameters for optimum performance under existing ambient conditions.

[0156] While the invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modification as will be apparent to those skilled in the art. All such variations and modifications are intended to be within the scope of the present invention as defined in the specification.

What is claimed is:

1. A liquid vapor distillation apparatus comprising:

an evaporative condenser for transforming the liquid to a compressed vapor and for transforming the compressed vapor into a product liquid;

a first heat exchanger;

a second heat exchanger; and

a third heat exchanger, the first heat exchanger comprising:

a first heat source input connected to a first heat source fluid line, the first heat source input connecting the first heat exchanger and the third heat exchanger; and