June 3, 1930. C. A. DUNHAM 1,761,819

EXHAUSTING MECHANISM

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Fig. 1.

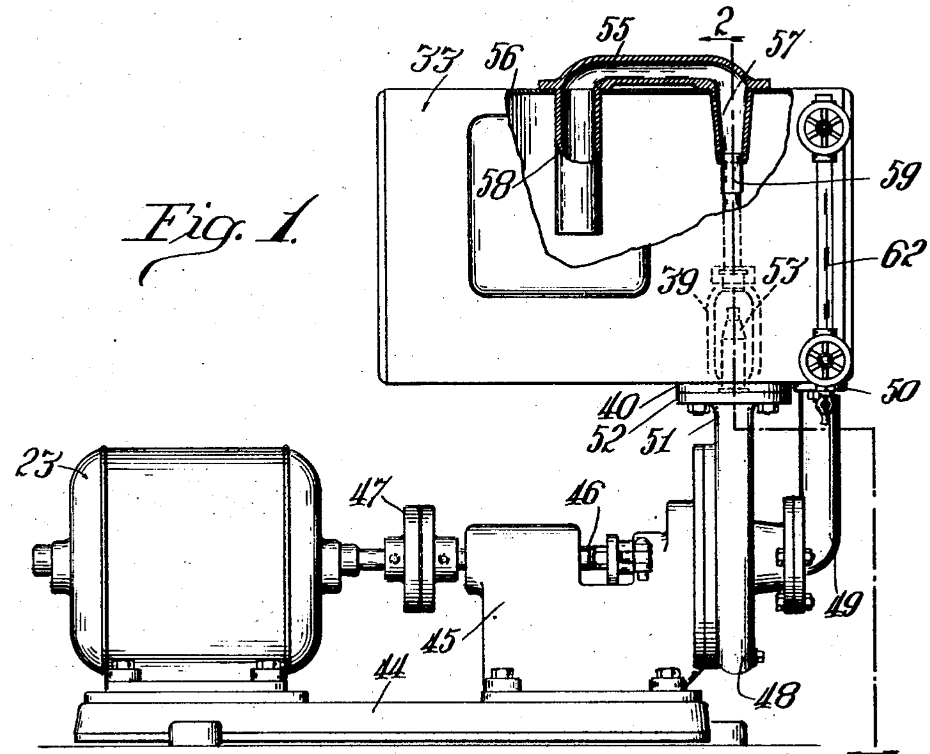

Fig. 2.

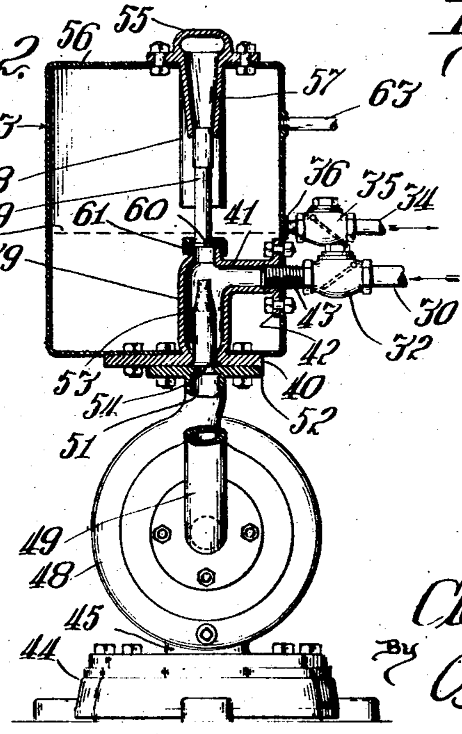

Fig. 4.

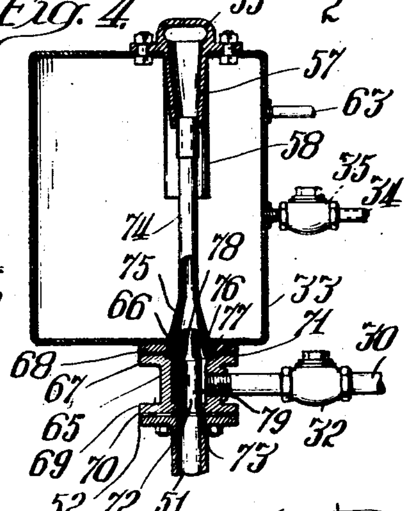

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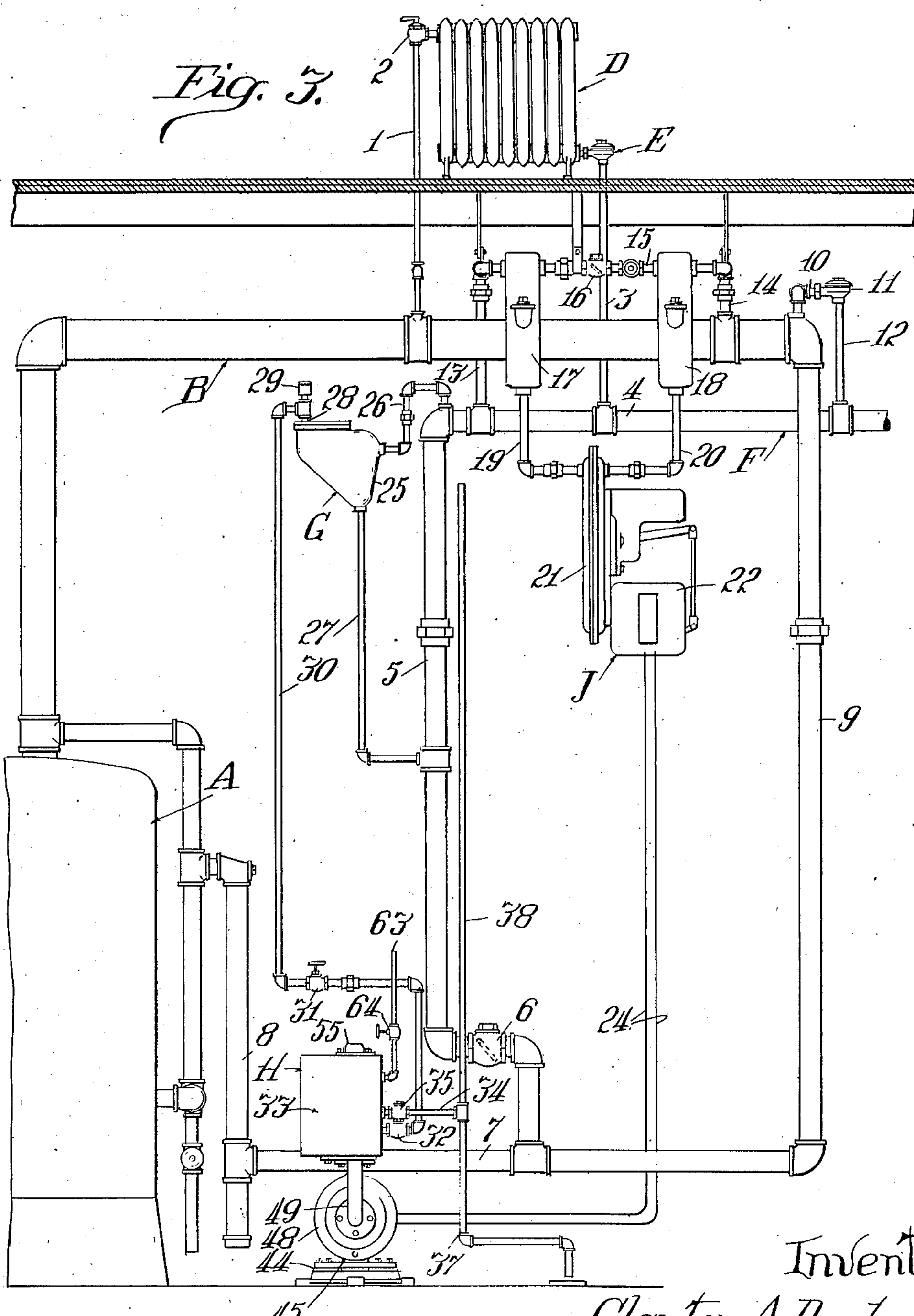
Fig. 3.



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UNITED STATES PATENT OFFICE

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EXHAUSTING MECHANISM

Application filed April 20, 1928. Serial No. 271,635.

This invention relates to an improved exhausting mechanism, particularly adapted for removing air from the return pipe or air line of a steam heating system, in order to lower the pressure within the system.

One object of the invention is to provide a simple and compact exhausting unit, suitable for use with home heating systems.

Another object is to provide a relatively noiseless exhausting mechanism.

Another object is to provide an exhausting mechanism adapted to withdraw gases only from the heating system, combined with connecting mechanism whereby the discharge of water from the heating system into the exhauster is avoided.

Another object is to provide an exhauster comprising an ejector, a hurling circuit for forcing water through the ejector, a self-contained water supply, and connections whereby the hurling circuit cannot lose its prime once the exhauster has been supplied with a suitable quantity of water.

Another object is to reduce to a minimum the water-friction in the hurling circuit.

Other objects and advantages of this invention will be apparent from the following detailed description of one approved form of the mechanism.

In the accompanying drawings:

Fig. 1 is a side elevation, partly in section, of the assembled exhausting mechanism.

Fig. 2 is a partial elevation and partial vertical section of the mechanism shown in Fig. 1, the view being taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a diagrammatic elevation of a portion of a vacuum steam heating system, for use in which this exhausting mechanism is especially designed.

Fig. 4 is a partial vertical section, similar to Fig. 2, showing a modification.

The improved exhausting mechansim which forms the particular subject-matter of this invention is designed to withdraw gases only from a heating system of the type disclosed for example in Fig. 3 of the patent to Dunham 1,644,114, granted October 4, 1927. A similar system is disclosed diagrammatically in Fig. 3 of the present drawings, and will now be briefly described. It is to be understood, however, that this improved exhausting mechanism is suitable for use in other heating systems, or for other purposes where the automatic withdrawal of air or other gases from any space to be evacuated is desired.

Referring now to Fig. 3, A indicates the steam generator or boiler which furnishes steam through the supply main B to the radiators, one of which is indicated at D. Condensate and air or other non-condensible gases are drawn out of the radiators through thermostatic traps E into return main F, the liquid condensate gravitating directly back to the boiler A. The vacuum producing mechanism indicated generally at H (which forms the particular subject-matter of this invention) withdraws and vents the air and other non-condensible gases, and maintains the desired vacuum throughout the system. The means indicated generally at J controls the vacuum producing mechanism so as to maintain a fixed difference in pressure between the supply and return sides of the system.

The steam generator A may be of any desired form, and is heated by an automatically controlled mechanism so as to vary the heat applied to the boiler in accordance with temperature conditions and thus regulate the sub-atmospheric pressure of the steam delivered to the radiators. Steam passes from the boiler A through supply main B, riser 1 and inlet valve 2 to the radiator D. It is to be understood that any desired number of radiators may be similarly supplied from the main B. Each inlet valve 2 will normally be open when the radiator is in service to permit free passage of steam from the supply main. The thermostatic trap E normally retains the steam within the radiator but permits the outflow of accumulated liquid condensate and air into the return main F. It is to be understood that all of the radiators D will discharge into the return main F in a similar manner.

The return main F comprises an upper substantially horizontal pipe 4 which inclines slightly so as to drain into the vertical standpipe 5, which discharges at its lower end into a substantially horizontal pipe 7 leading to a pipe 8 connected with the boiler above and below the water level therein, so that liquid condensate in the return main will gravitate directly back into the boiler. A one-way check valve 6 in the lower portion of standpipe 5 prevents water from backing up in standpipe 5 above the normal water level in the boiler. A drip pipe 9 leads down from the discharge end of supply main B and connects with the return pipe 7 below the check-valve 6. The pipe 9 serves to discharge the liquid condensate which accumulates in supply main B. Air in return main B and drip pipe 9 is vented through pipe 10, steam trap 11, and pipe 12 into the upper portion of return main F from which it is withdrawn by the exhausting mechanism H as hereinafter described.

The control mechanism J functions to maintain a substantially constant difference in pressure between the supply main B (and radiators D) and the return main F. An equalizing connection consisting of the vertical pipes 13 and 14 and the horizontal pipe 15 connects the return main F with the supply main B, a one-way check-valve 16 opening toward the supply main B being positioned in the horizontal pipe 15. This check-valve will normally remain closed as long as the pressure in the supply main is higher than the pressure in the return main. A pair of surge chambers 17 and 18 located in pipe 15 at either side of check valve 16, are connected by pipes 19 and 20 with the low and high pressure chambers of a differential controller 21. This differential controller operates in a well known manner (as described more in detail in the Dunham patent above referred to) to close an electric switch 22 when the pressure differential between the supply and return mains falls below a desired minimum, and to open this switch when the desired pressure differential has been attained. Switch 22 controls the driving motor 23 of the exhausting mechanism H, hereinafter described, the switch being connected with the motor through wires 24 or other suitable electric connections.

In order to assure the withdrawal of gases only into the exhausting mechanism H, and permit this exhausting mechanism to be located at any level or location desired, the exhausting connection between mechanism H and return pipe F leads through an air eliminator G. This air eliminator G is of well known form and comprises a tank 25, the upper portion of which is connected with an upper portion of return main F through the pipe loop 26 so that normally only air or other gases will pass into the tank 25. Any liquids that may accumulate in tank 25 flow out through pipe 27 leading to a lower portion of the standpipe 5. An air outlet 28 leading from the top of tank 25 is provided with a normally open float controlled valve which will automatically close in case the accumulation of liquid within tank 25 reaches a certain maximum height. This prevents the passage of any liquid through outlet 28. An outwardly opening check-valve indicated at 29 permits the escape of air in case the pressure in the return side of the system rises above atmospheric pressure, but this check-valve will normally remain closed when a vacuum is maintained in the system. The air exhaust pipe 30 leads from the air outlet 28 of the air-eliminator G to the exhausting mechanism H. It will be apparent from the above description that only air or other gases may be withdrawn from the system through the pipe 30. Air exhaust pipe 30 is provided with a normally open cut-off valve 31, and leads through a one-way check-valve 32 into the exhausting mechanism H. The check-valve 32 opens toward the exhausting mechanism but will automatically close to prevent the return of fluids into pipe 30.

Referring now also to Figs. 1 and 2, the exhausting mechanism H which forms the particular subject-matter of this invention will be described in detail. The metal tank 33 is completely closed, except for the inlet and outlet openings hereinafter specified. A fluid outlet pipe 34 provided with the outwardly opening check-valve 35, connects at 36 with an opening in one side wall of tank 33, thus determining the normal water level within the tank. Any excess of liquid accumulating within the tank will drain out through pipe 34 and the downward extension 37 leading to a sewer connection. An air discharge pipe 38, open at its upper end, leads up from pipe 34 to a sufficient height to preclude the remote possibility of liquid accumulating therein and spilling therefrom.

The ejector casing 39 is positioned within tank 33 below the normal water level (indicated by the dotted line *x*). A base plate 40 at the lower end of casing 39, provided with the water inlet opening, is secured to the outside of casing 33 around an opening of sufficient size to permit the insertion of the casing 39. The air inlet extension 41 leads from one side of casing 39 and is outwardly flanged at 42 and secured to the inner side wall of tank 33 about a suitable inlet opening. The base plate 40 and flange 42 are secured to the walls of the tank 33 by bolts or other suitable fastenings, the joints being such as to prevent the leakage of water from tank 33, or the direct inflow of water from the tank to the interior of casing 39. The end of air exhaust pipe 30 leading from the return main of the heating system is screwed into the air inlet 41 of the casing 39.

On a suitable supporting base 44 is mounted the motor 23 and a standard 45 in which is pivoted the pump shaft 46, which is connected through coupling 47 with the motor shaft. The casing 48 of a suitable water pump, preferably of the centrifugal type, is supported on standard 45. The inlet water manifold 49 leading to said pump is connected directly at its upper end 50 to an outlet opening in the bottom of tank 33. The pump is fed directly by water which gravitates from the bottom of the tank 33. The discharge outlet 51 of pump 48 is flanged at its upper end 52 and connected to the base plate 40 of the ejector casing 39. It will thus be seen that the tank 33 is supported directly from the pump, by means of the pipe inlet and outlet connections 49 and 51. Other supports for tank 33 may be provided if desired, but will ordinarily be unnecessary.

An upwardly projecting ejector nozzle 53 fits at its lower end within the bottom inlet of casing 39 and is provided with an outwardly extending flange 54 which is clamped between the plates 40 and 52 to hold the nozzle firmly in position. An exhauster manifold 55 is mounted on the top 56 of the tank 33, and is of substantially U-shape comprising a downwardly extending inlet pipe 57 and discharge pipe 58 extending through suitable openings in the top of the tank. A delivery tube 59 leads from the fluid outlet opening at the top of casing 39 and discharges into the inlet pipe 57 of manifold 55. Delivery tube 59 is provided with an outwardly extending flange 60 near its lower end, which is clamped against the upper face of casing 39 by means of the collar 61, so as to hold the delivery tube 59 in place and to seal the outlet opening in casing 39.

A sight gauge 62, connected in the usual manner at one side of tank 33, indicates the water level therein, and water may be supplied to the tank when necessary through pipe 63 provided with valve 64 and leading from the city water supply.

The exhauster will be initially primed with water by opening the valve 64 and permitting water to run into tank 33 until it commences to drain out through pipe 34 and discharge pipe 37. The water supply is then shut off and normally no more water will be needed. When the motor-driven pump 48 is started in operation, water will be withdrawn from tank 33 through manifold 49 and forced upwardly by the pump through ejector 53 and discharged through the exhausting chamber in casing 39 upwardly into and through the delivery tube 59. The ejector operates in a well known manner to create a partial vacuum in casing 39, thus drawing in air or other gases from pipe 30 past the check valve 32, these gases being entrained with the water discharged from nozzle 53 and carried upwardly through the delivery tube 59. These fluids pass through the exhauster manifold 55 and are discharged back into tank 33. As the air pressure rises in tank 33, the excess air will flow out through pipe 34 and air discharge pipe 38. Any moisture that may be carried in from the heating system through pipe 30 and discharged into tank 33 will gradually raise the liquid level in the tank, but this excess liquid (which will normally be quite small) will drain out through pipe 34 and drain pipe 37.

A modified form of the apparatus is shown in Fig. 4. Here, the casting 65 forming the lower portion of the ejector casing is mounted beneath the opening 66 in the bottom of the tank, a flange 67 at the top of casing 65 being secured to a flange or plate 68 welded to the bottom of the tank about opening 66. The lower flanged end 69 of casing 65 is mounted on the flanged upper end 52 of pump outlet 51. Suitable gaskets 70 and 71 are mounted between the flanges 52, 69 and 67, 68, respectively. The ejector nozzle 72 has an outwardly extending flange 73 at its lower end which is clamped within a correspondingly shaped recess in the lower end of casing 65 to hold the nozzle properly centered within the casing. The delivery tube 74 (which replaces the tube 59 of Figs. 1 and 2) tapers outwardly and downwardly at 75 to an enlarged lower portion 76 fitting within the opening 66 in the bottom of tank 33, and is formed with an outwardly extending flange 77 clamped within a corresponding annular recess in the upper end of casing 65. The nozzle 72 has a converging upper discharge port portion 78 of similar inclination to the tapered lower end 75 of the delivery tube 74, so that the liquid stream from the nozzle will be discharged toward and guided directly into the delivery tube, and the gases from the heating system will also be drawn into this nozzle stream with a maximum velocity component and with a minimum of frictional retardation. The end of the air exhaust pipe 30 from the heating system is screwed into an inlet opening in one side of casing 65, as indicated at 79.

The operation of this modified form of the apparatus is substantially the same as that of the first described form, but the ejector apparatus is somewhat more accessible and easier to install and replace.

It will now be apparent that the exhausting mechanism has its own self-contained water supply, which is substantially constant, and that the water level in the tank 33 has no relation whatever to the water level in the boiler or return piping. Therefore the exhausting mechanism may be located at any convenient level.

Since the ejector is positioned below the normal water level, either within or directly below the tank, and the tank is supported upon the pump, the pump and ejector cannot lose their prime so long as there is any appreciable water supply in the tank 33. Since there is only one way in which these parts can be operatively assembled, it is impossible for an inexperienced workman to set up these parts so that the pump ejector will be at an improper elevation. At the same time, the exhausting unit is compact and sightly, and occupies only a small space.

Instead of having the delivery tube 59 discharge against the top of tank 33, the discharged fluids are carried through the manifold passages 57, 55, 58, at comparatively low velocity from which passage the liquid flows directly into the water supply in the tank. This eliminates the noise that would be caused by the impact of the stream against the wall of the tank.

I claim:

1. An apparatus of the character described comprising a tank, a fluid outlet in one side of the tank determining the water level therein, an exhauster mounted in the bottom of the tank below the water level but sealed to prevent the direct inflow of water from the tank, the outlet of the exhauster discharging into the tank above the water level, a water pump having its inlet connected with the lower portion of the tank and its outlet connected with the water inlet of the exhauster, and means for driving the pump.

2. An apparatus of the character described comprising a tank, a fluid outlet in one side of the tank determining the water level therein, an exhauster mounted in the bottom of the tank below the water level but sealed to prevent the direct inflow of water from the tank, a U-shaped manifold mounted in the top of the tank, a delivery tube within the tank connecting the outlet of the exhauster with the manifold, the other end of the manifold discharging the fluids from the exhauster back into the tank, a water pump having its outlet connected with the water inlet of the exhauster, and its inlet connected with the lower portion of the tank, and means for driving the pump.

3. An apparatus of the character described comprising a tank, a fluid outlet in one side of the tank determining the water level therein, an exhauster mounted within the tank below the water level but sealed to prevent the direct inflow of water from the tank, the water inlet and gas inlet of the exhauster projecting separately through the walls of the tank, a U-shaped manifold mounted in the top of the tank, a delivery tube connecting the outlet of the exhauster with the manifold, the other end of the manifold discharging the fluids from the exhauster back into the tank, and means for withdrawing water from the tank and returning it to the tank through the exhauster.

4. An apparatus of the character described comprising a tank, a fluid outlet in one side of the tank determining the water level therein, an exhauster mounted within the tank below the water level but sealed to prevent the direct inflow of water from the tank, the water inlet and gas inlet of the exhauster projecting separately through the walls of the tank, the outlet of the exhauster discharging into the tank above the water level, and means for withdrawing water from the tank and returning it to the tank through the exhauster.

5. An apparatus of the character described comprising a tank, a fluid outlet connected in one side of the tank and determining the water level therein, an outwardly opening check-valve in said outlet, an exhauster casing having a water inlet in its lower end, a gas inlet in its side, and a fluid outlet in its upper end, said casing being mounted within the tank below the water level so that its water inlet opens through the bottom of the tank and its gas inlet opens through one side of the tank, a pipe for delivering return gases from a heating system communicating with the gas inlet, a check-valve in said pipe opening toward the tank, a supporting base, a motor mounted on the base, a water pump having upwardly opening inlet and outlet connections, the pump being mounted on the base, driving connections between the motor and pump, the tank being mounted on the pump connections with the pump inlet communicating directly with the tank through a water outlet in the bottom of the tank, an upwardly projecting ejector nozzle mounted in the exhauster casing with its lower inlet end communicating with the water outlet of the pump, a delivery tube projecting upwardly from the outlet of the exhauster, and a U-shaped manifold with downwardly projecting inlet and discharge openings mounted in the top of the tank, the delivery tube being connected to the inlet of the manifold.

6. An apparatus of the character described comprising a tank, a fluid outlet connected in one side of the tank and determining the water level therein, an outwardly opening check-valve in said outlet, an exhauster casing having a water inlet in its lower end, a gas inlet in its side, and a fluid outlet in its upper end, said casing being mounted within the tank below the water level so that its water inlet opens through the bottom of the tank and its gas inlet opens through one side of the tank, a pipe for delivering re-

turn gases from a heating system communicating with the gas inlet, a check-valve in said pipe opening toward the tank, an upwardly projecting ejector nozzle mounted in the lower portion of the exhauster casing to receive the water through the water inlet, a water outlet in the bottom of the tank, means positioned outside of the tank for withdrawing water from this outlet and returning it through the nozzle of the exhauster, and a delivery tube projecting upwardly from the outlet of the exhauster and discharging into the tank above the water level therein.

7. An apparatus of the character described comprising a tank, a fluid outlet connected in one side of the tank and determining the water level therein, an outwardly opening check-valve in said outlet, an exhauster casing having a water inlet in its lower end, a gas inlet in its side, and a fluid outlet in its upper end, said casing being mounted within the tank below the water level so that its water inlet opens through the bottom of the tank and its gas inlet opens through one side of the tank, a pipe for delivering return gases from a heating system communicating with the gas inlet, a check-valve in said pipe opening toward the tank, an upwardly projecting ejector nozzle mounted in the lower portion of the exhauster casing to receive the water through the water inlet, a water outlet in the bottom of the tank, means positioned outside of the tank for withdrawing water from this outlet and returning it through the nozzle of the exhauster, a delivery tube projecting upwardly from the outlet of the exhauster, and a U-shaped manifold with downwardly projecting inlet and discharge openings mounted in the top of the tank, the delivery tube being connected to the inlet of the manifold.

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