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[54] **COMBINATION HOT CONDENSATE COOLING
 AND WATER HEATING AND STORAGE AND
 DELIVERY SYSTEM**
 7 Claims, 1 Drawing Fig.

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165/107
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[56] **References Cited**

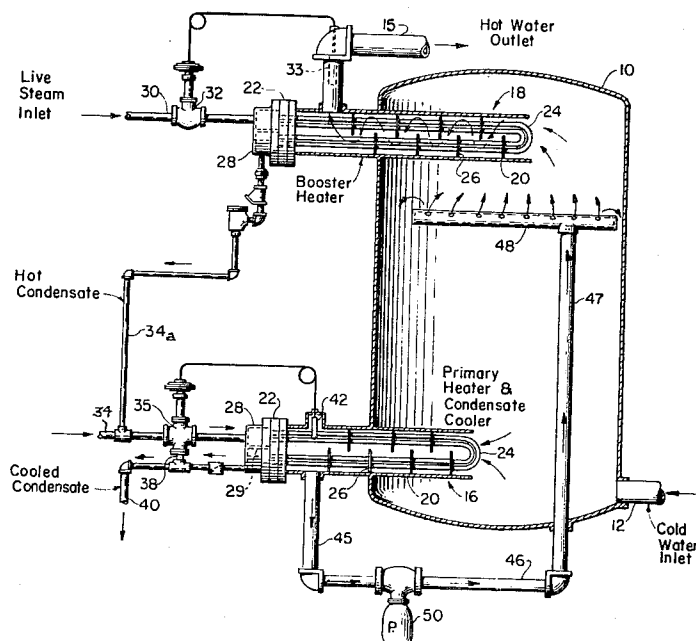
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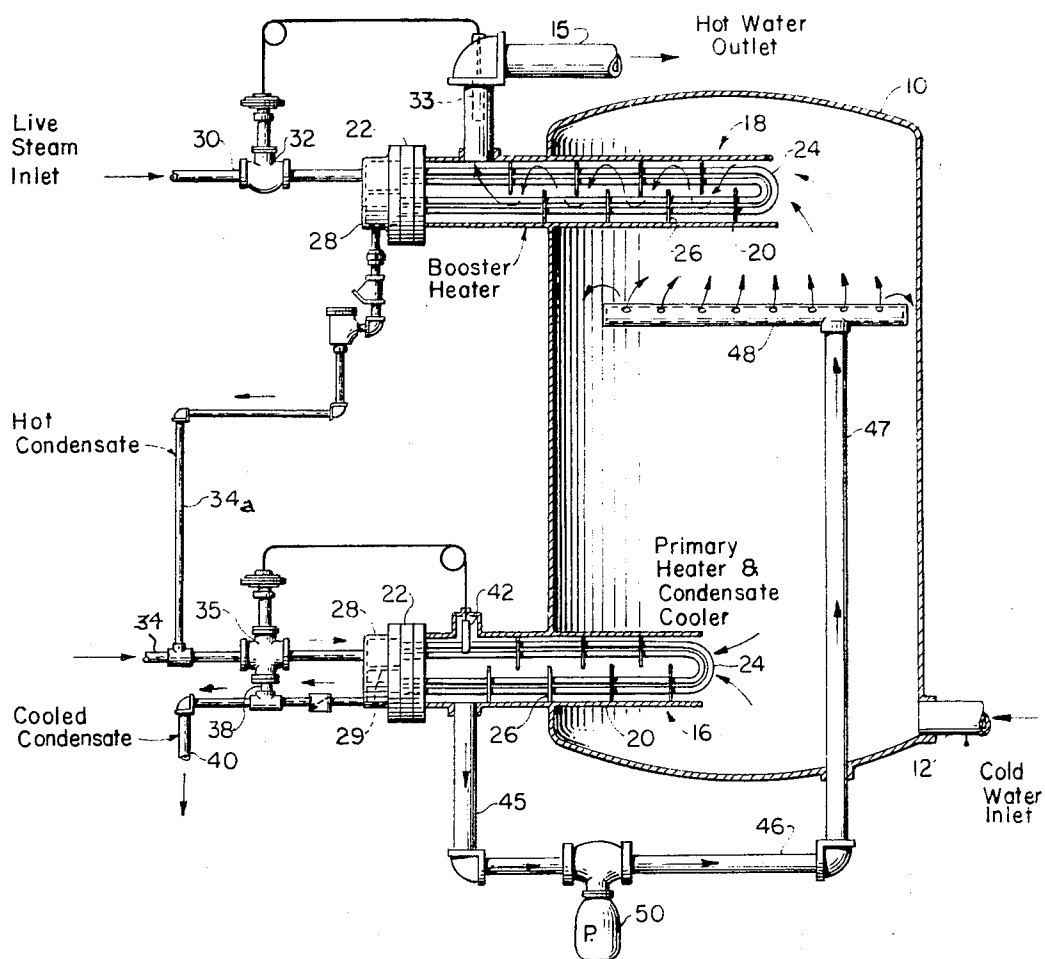
ABSTRACT: A combination hot condensate cooling and water heating and storage and delivery system is disclosed. The system relates particularly to use in an office or residential or industrial building facility employing steam as a

medium for heating the building or operating the industrial appliances. It is of prime importance from the standpoint of environmental preservation to avoid the dumping of hot condensates into the local sewer system; and for reasons of economy it is desired that the heat given up by the condensates when being cooled, be usefully employed. The system consists of a single tank having a cold water inlet into the lower level thereof. A combination condensate cooling and "primary" heater unit is disposed within a first shroud having fluid flow communication at one end with the lower level of the interior of the tank, and is provided with a water outlet connection at the other end thereof. A water-circulating conduit system including a pump is arranged to have its intake end connected into said outlet connection, and terminates at its delivery end in a distributing conduit traversing the upper level of the interior of the tank. A "booster" heater unit of the steam heated tube type is disposed within a shroud arranged in open fluid communication at one of its ends with the upper level of the interior of the tank, and has a heated water delivery conduit leading from the other end of the heater shroud. The "booster" heater unit is arranged to be supplied whenever necessary from a "live steam" source, while the "primary" heater unit utilizes the heat available from hot condensate discharges which require to be cooled before disposal, such as from the building-heating system and from the "booster" heater unit. A temperature sensor in the heated water delivery conduit controls the supply of live steam to the "booster" heater. A second temperature sensor located adjacent the outlet from the "primary" heater shroud selectively controls the input of hot condensate to the "primary" heater unit and/or diversion thereof away from said unit; such as may be required to furnish primary heating of the storage tank contents to the prescribed temperature; the "booster" heating unit being employed only on occasion and such as may be requisite to augment the primary heating operation.



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COMBINATION HOT CONDENSATE COOLING AND WATER HEATING AND STORAGE AND DELIVERY SYSTEM

SUMMARY AND OBJECTS OF THE INVENTION

The invention relates both to "hot" condensate cooling for environmental beneficiation, and storage water heater systems; and more particularly to such systems as may reliably provide constantly available supplies of water deliverable at prescribed temperatures.

A heating facility employing steam, such as for heating a building, generating power, or other industrial steam using purposes, necessarily produces a substantial quantity of hot condensate liquid. It is desirable for various reasons to cool this condensate such as for example before delivery to a sewer or returning it to the boiler plant. To economize the overall operation it is desirable that the heat of the condensate be usefully employed; and it is a primary object of the present invention to provide an improved "hot" condensate cooling system which utilizes the abstracted heat in novel manner so as to pre-heat the feed water supply to the hot water heating system of the facility.

Another object of the invention is to provide for the above purposes a single storage water tank system incorporating an improved condensate cooling and multistage heating and water transport arrangement from which requisite quantities of water at a prescribed temperature may be drawn off at will; and whereby substantial installation investment and operational and maintenance economies may be realized compared to conventional systems for similar purposes.

Another object of the invention is to provide an improved water storage and heating device as aforesaid which automatically supplies water at the desired temperatures while drawing upon a "live steam" heat supply source only as needed to efficiently comply with the heated water demands.

Another object is to provide an improved heating system as aforesaid which will economically and automatically and constantly furnish water uniformly heated to the prescribed temperatures, in the quantities required, regardless of sudden or erratic demands therefor.

Specifically, the invention contemplates an improved means and method for cooling hot condensate from any facility employing "live" steam (or other hot liquid or gas), including means for utilizing the heat derived therefrom in the heating and storing of "hot" water in a single, minimum sized accumulator tank; whereby water at a prescribed temperature is available to service withdrawal outlets to accommodate constant and/or intermittent and/or small or large quantity demands. The system may be readily constructed in unit form; fully self-contained and requiring minimum floor space; and is therefore suitable for installation in out-of-way locations. It may be readily connected to existing piping systems, and normally draws upon the associated steam generating boiler in such limited manner as to avoid interference with constant steam pressures at the other associated steam operated equipment. Hence, the boiler load is leveled off, thereby improving the boiler efficiency and life span. The above stated and other advantages of the apparatus of the invention will be apparent from the following description of an exemplary embodiment of the invention is a storage water heater unit as illustrated in the accompanying drawing.

THE DRAWING

FIG. 1 is a vertical sectional view through a combination condensate cooling and water heating and storage apparatus of the invention.

DETAILED DESCRIPTION

As shown therein, the system may comprise a single tank as illustrated at 10 which is of cylindrical form and supported to stand vertically; but it is to be understood that the tank 10 may in lieu thereof be provided of any other preferred shape or form and may stand in any other attitude and be supported in

any manner, as preferred. In any case, the tank will include provision for connection to a cold water supply conduit such as shown at 12; the heated water outlet connection being indicated at 15. As shown herein by way of example, the system is constructed to include a pair of "immersion"-type heater units designated generally at 16, 18, respectively, which are provided to extend substantially into the tank 10 at different levels therein. Each comprises an elongated casing or shroud 20, which is welded or otherwise affixed to the wall of the tank 10, where it extends into the tank. In each case a tube sheet as indicated at 22 carrying the terminal ends of a bank of reverse bent tubes 24 is attached to the flanged outer end opening of the shroud 20. Baffle plates 26 are disposed vertically, and alternately occupy upper and lower portions of the casing 20, and function simultaneously as vertical supports for the tubes 24 and as liquid passageway guide devices so as to cause the water circulating through the casing 20 to pursue a zigzag path around the heat exchange tubes 24. The baffles 26 also control the velocity of water flow through the heater.

A manifold cover or bonnet as indicated at 28 is fixed to the outer face of each tube sheet 22, and is provided with an internal partition rib 29; the rib being dimensioned to bear firmly against the tube sheet when the unit is in assembly so as to thereby divide the bonnet into two sections, as shown in the drawing. Thus, it will be appreciated that the tubes 24 may be initially assembled upon the tube sheet 22 and that this subassembly may then be slip-fitted into the shroud 20, and the tube sheet and bonnet assembly may then be firmly fixed in place by suitable bolts or the like to complete the mounting of the heat exchange unit in the tank.

A live steam (or other hot fluid) supply conduit 30 is arranged to supply the booster heating unit 18, under control of a valve 32 which in turn is controlled by a temperature sensor 33 located in the heated water delivery conduit 15. The "hot" condensate discharges from the building-heating system or the like are received through a conduit as indicated at 34 and from the booster heater tube system through a conduit 34, to a three-way valve 35 which selectively operates either to pass the hot condensate through the primary heater or to divert it through a conduit 38 to a bypass system 40. The valve 35 is under control of a temperature sensor 42 which is responsive to the temperature of water in the outer end of the primary heater shroud 20. A constant circulation conduit system having its intake in fluid flow communication with the interior of the outer end of the primary heater shroud is illustrated to comprise conduits 45, 46, 47, and terminates in a distributor conduit 48 disposed transversely of the interior of the tank 10 in the upper one-half portion thereof. A pump as illustrated at 50 is disposed in the line of the conduit system and is arranged to operate continuously so as to circulate the water in the tank as illustrated by the directional arrows.

By this it will be seen that the cooler layers of water in the tank will be drawn through the lower shroud 20 in heat exchange relation with the condensate heated tube system therein, and then delivered into the upper level of the tank 10. This provides a constantly operating combination condensate cooling and storage water heating and temperature leveling system the booster heater unit being operative only occasionally and whenever it is required to boost the temperature of the water being withdrawn through the conduit 15 to the service outlets. Each such operation of the booster heater creates a fresh supply of hot condensate for use by the primary heater; thereby effecting substantial economies in live steam usage compared to prior systems. A primary benefit however is that the primary heater unit operates as a condensate cooler, whereby the effluent discharge from the system will be at reduced temperature with consequent benefit to the environment.

We claim:

1. A combination hot condensate cooling and water heating and storage and delivery system particularly adapted to an office or residential or industrial building facility employing steam as a medium for heating the building or operating the

industrial appliances thereof, or the like, said system comprising in combination:

- a water tank having a cold water inlet into the lower level thereof;
 - a combination condensate cooling and primary water heater unit disposed in fluid flow communication at one end with the lower level of the interior of said tank, and having a heated water outlet connection at the other end thereof;
 - a water-circulating conduit system including a pump having its intake end connected into said outlet connection and delivering to an outlet distributing conduit traversing the upper level of the interior of said tank;
 - a booster heater unit of the hot fluid heated tube type arranged in open fluid communication at one of its ends with the upper level of the interior of the tank, and having a heated water delivery conduit leading from the other end thereof;
 - a live hot fluid source operatively connected with said booster heater unit to energize the latter whenever necessary to deliver heated water therefrom at a desired temperature;
 - said booster heater unit having a hot condensate discharge conveying conduit delivering condensate discharges which require to be cooled before disposal;
 - a temperature sensor in the heated water delivery conduit controlling the supply of live hot fluid to said booster heater;
 - a second temperature sensor located adjacent the outlet from the primary heater selectively controlling the input of hot condensate to the primary heater unit and/or diversion thereof away from said unit, such as may be required to furnish primary heating of the storage tank contents to the prescribed temperature without overheating;
- whereby said hot condensates are cooled and at the same time furnish heat supplies to said primary heating unit, and whereby said booster heating unit draws upon the live hot fluid supply only on occasion and such as may be

requisite to adequately augment the primary heating operation.

- 2. A combination hot condensate cooling and water heating and storage and delivery system as set forth in claim 1 wherein;
- said primary heating unit comprises a bundle of return bent hot condensate conveying tubes enclosed within a shroud extending part-way into the interior of said tank from exteriorly thereof.
- 3. A combination hot condensate cooling and water heating and storage and delivery system as set forth in claim 1 wherein;
- said booster heating unit comprises a bundle of return bent hot condensate conveying tubes enclosed within a shroud extending part-way into the interior of said tank from exteriorly thereof.
- 4. A combination hot condensate cooling and water heating and storage and delivery system as set forth in claim 1 wherein;
- said hot condensate conveying conduit includes a branch inlet receiving hot condensate discharges from sources other than said booster heater unit.
- 5. A combination hot condensate cooling and water heating and storage and delivery system as set forth in claim 1 wherein;
- said outlet distributing conduit comprises a horizontally disposed closed end pipe having water outlet apertures at intervals therealong.
- 6. A combination hot condensate cooling and water heating and storage and delivery system as set forth in claim 1 wherein;
- said pump is continuously operating.
- 7. A combination hot condensate cooling and water heating and storage and delivery system as set forth in claim 1 wherein said hot fluid comprises steam.

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