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CONDENSING METHOD
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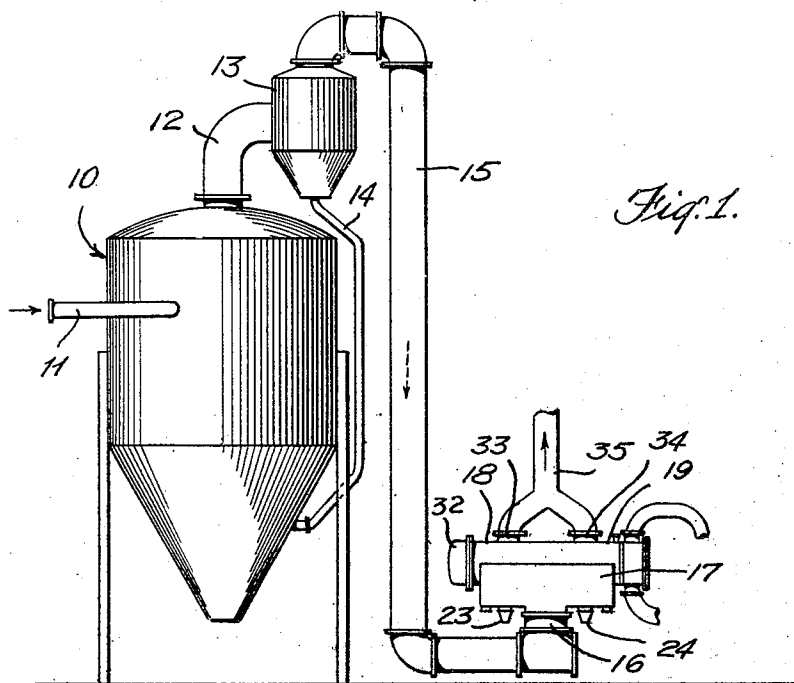


Fig. 1.

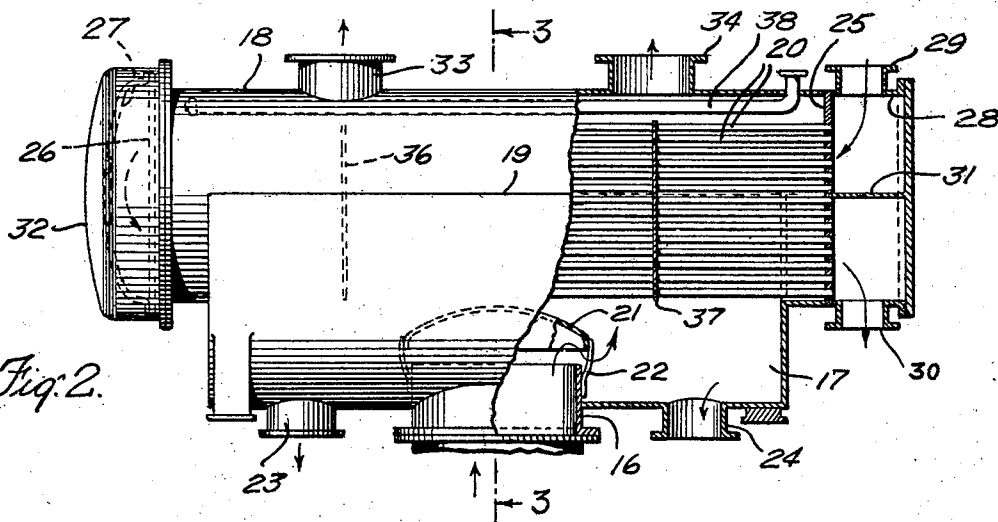


Fig. 2.

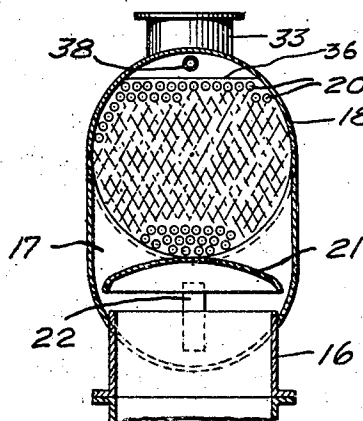


Fig. 3.

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CONDENSING METHOD

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1 Claim. (Cl. 257—51)

My invention relates to surface condensing systems which are particularly useful in connection with paper mill pulp digester systems, although the invention is capable of more general application. More particularly, the invention pertains to a novel method for the recovery of heat by the condensation of condensable vapors having solid particles entrained therein.

In paper mill digesters, it is customary to heat the sulphate or soda pulp, which consists largely of water, to temperatures of 300° F. or higher, with the result that the pressure within the digester will approximately correspond to the pressure of water vapor at a saturation temperature corresponding to the temperature of the liquid in the digester. It is common practice in many mills, at the end of the cooking period, to discharge the pulp, while at the maximum cooking pressure directly into a blow-down tank which is ordinarily under atmospheric pressure. As a result of this sudden reduction in pressure, a large amount of evaporation or "flashing" takes place and the heat of the enormous quantities of vapor formed at such times is lost unless provisions are made for its recovery. For example, if during the cooking period the usual pressure of 100 to 110 lbs. gage is held on the digester, and if the digester is then blown down under such pressure, the heat in the steam flashed off will amount to over 2,000,000 B. t. u. per ton of pulp. By condensing the steam, this amount of heat may be recovered and made use of in heating water or for other purposes.

Obviously, in order to obtain relatively pure and uncontaminated heated water from such a process, it is desirable to use surface type condensers in which the cooling water is entirely out of contact with the steam and other vapors containing numerous impurities derived from the cooking process. However, in the past, when surface condensers of the conventional type have been so employed, they have proved generally ineffective, due to accumulations of pulp that have been entrained by the steam and driven into the tube bundle and onto the condensing surfaces during condensation, thus materially decreasing the efficiency of the apparatus.

Accordingly, it is the object of this invention to provide a method of heat recovery which is arranged to overcome the above mentioned disadvantages and to prevent solid particles from adhering to the tubes of the surface condenser, or otherwise affecting its efficient operation.

The particular features and advantages that characterize my invention will be clearly under-

stood from the following description considered in connection with the accompanying drawing forming a part thereof, and in which:

Fig. 1 is a generally diagrammatic elevational view illustrating a digester blow-down tank and a preferred form of condenser for operation in accordance with my invention;

Fig. 2 is an enlarged longitudinal view partly in elevation and partly in section, of the condenser shown in Fig. 1, and

Fig. 3 is a transverse sectional view of the condenser taken on line 3—3 of Fig. 2.

Like reference characters refer to the same parts throughout the several views.

Referring to the drawing, reference character 10 designates a blow-down tank which receives the pulp contents from a digester, not shown, through a tangential connection 11. From the upper portion of the blow-down tank 10 a conduit 12 leads to a cyclone-type separator 13, a conduit 14 returns separated pulp or other solid material from the separator to the lower portion of the blow-down tank, and a vapor line 15 leads from the upper portion of the separator to a steam inlet connection 16, which enters the lower wall of a large vapor distributing or expansion chamber 17, formed as shown, by continuing the walls of shell 18 of a condenser 19 operated in accordance with the invention, for the greater part of the length of the shell, downwardly to a point materially below the condensing tubes 20. A hood or impingement baffle 21 extends over the discharge end of the inlet connection 16 and is spaced therefrom and supported by strips 22. On either side of the inlet connection and adjacent the ends of the expansion chamber 17, are condensate drain connections 23 and 24. The condensing tubes 20 are supported within the shell 18 by a fixed tube sheet 25 at one end, and by a floating tube sheet 26 at the other end to which a cover plate 27 is suitably secured. A water box 28, provided with cooling water inlet and outlet nozzles 29 and 30 respectively, is suitably secured to the stationary tube sheet end of the shell, and by means of a diaphragm 31 the cooling water flows through the condensing tubes in two passes. At the floating head end of the tube bundle the shell is closed by a shell cover plate 32. Non-condensable gases are released from the top of the condenser by outlets 33 and 34 which are large enough to also adequately release the entire volume of steam in case the water supply should fail. Such vapors are either vented to atmosphere, or to a disposal system, not shown, by conduit 35. The condensing tubes are supported intermediate their ends by

spaced support plates 36 and 37. A perforated pipe 38, which connects with a water supply, not shown, extends for substantially the full length of the tube bundle within the space between the upper wall of the shell and the top row of tubes.

In operation, steam which is periodically released from the digester system and flashed off in the blow-down tank, flows from the separator 13 together with non-condensable vapors and particles of entrained pulp that were not removed from the vapor stream in the separator, through the conduit 15 to the condenser inlet in the large vapor distributing chamber 17 wherein a further expansion takes place, resulting in a substantial reduction in the velocity of the vapors before they enter the condensing surface of the tube bundle. The relatively low vapor velocity thus produced, tends to eliminate a portion of the entrained pulp particles, and any particles not so eliminated from the vapor stream will ordinarily be knocked down by the continuous rain of condensate descending from the tube surfaces. Direct impingement of the entering vapor and solids on the condensing surface is prevented by means of the baffle 21, which also prevents the rain of condensate from entering the steam inlet connection 16. Furthermore, in this connection, it will be noted that since the walls of the inlet connection extend a substantial distance above the bottom of the chamber 17, normally all the condensate and any pulp carried thereby must pass through the drain connections 23 and 24 and cannot enter the inlet connection 16. Since the water box 28 is so arranged that the cooling water flows in two passes, first through the tubes of the upper portion of the condensing surface, and then through the tubes of the lower portion thereof, the cooling water flows counter-current to the flow of the steam.

As already referred to, the velocity of the steam is so reduced on entering the condenser, that very little, if any, pulp will be carried by the steam from the distributing chamber upwardly into the tube bundle. However, the steady downward flow of condensate during condensa-

tion serves as a continuous wash for the tube surfaces and effectively prevents the possible accumulation of any pulp thereon. Obviously the effectiveness of the condensing surface and the washing effect of the condensate is augmented by the counter-current flow of cooling water and steam.

At times when the system is shut down, the entire tube bundle and the lanes between the condenser shell and the tube bundle may, if desired, be thoroughly scoured and washed down by water which may be discharged from the perforated water pipe 38.

It will be apparent, that by utilizing the invention, steam containing solid material and other impurities resulting from a sulphate or soda pulp cooking process, or other similar processes, may be readily and economically condensed in a surface type condenser, thereby recovering the heat of the vapors, which is imparted to the condenser cooling water, and thus provides a useful source of uncontaminated heated water.

Quite apparently, the principles of the invention may be employed to recover heat from condensable vapors other than steam, in which solid material is entrained.

Since certain changes may be made in the specific form and arrangement of the apparatus disclosed without departing from the principles of the invention, it is to be understood that no intention is entertained to limit the invention except by the scope of the appended claim.

What I claim is:

In the method of recovering heat from the vapor of pulp digester blowdown, the steps of introducing the vapor and entrained pulp into the lower portion of a condensing zone, flowing the vapor and entrained pulp upwardly over a condensing surface, and withdrawing condensate from said zone, the operation being such that condensate of the vapor flows downwardly over said condensing surface and prevents the accumulation thereon of the pulp entrained in the vapor flowing over said surface.

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