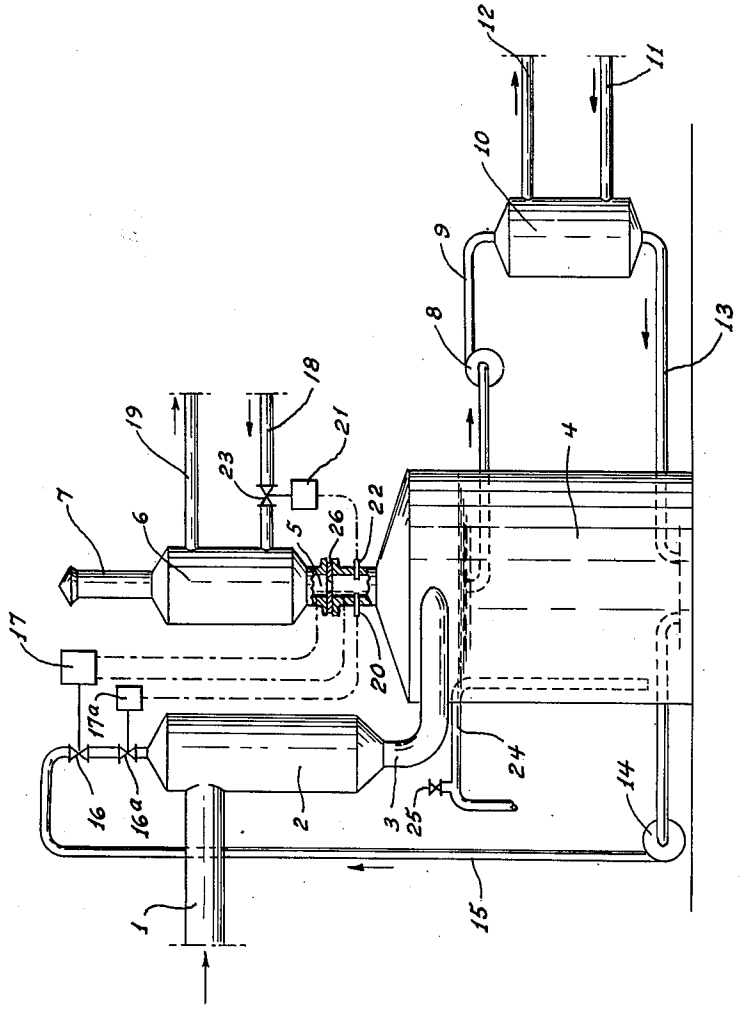
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APPARATUS FOR CONDENSING STEAM

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APPARATUS FOR CONDENSING STEAM

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This invention relates to condensing of steam which is supplied at a highly variating rate, precondensed in a jet condenser and subsequently recondensed in a surface condenser.

In a known method this is effected while recovering heat from the vapors released on discharging a cellulose digester after the completed boiling or digestion process. In this known method the major part of the vapor is condensed in the jet condenser. The condensate and the remaining part of the vapor is passed to the top of an accumulator tank in which the condensate is accumulated and from the top of which the remaining vapor is passed to the surface condenser. Hot surface condensate is pumped continuously from the tank through a heat exchanger, in which the condensate is cooled while heating another liquid for instance fresh water or digestion acid. The cooled condensate is returned to the bottom of the tank, so that at the top part of the tank the condensate accumulated will be hot but at the bottom part of the tank the condensate will be cooled. Cooled condensate is pumped in circulation as cooling medium from the tank through the surface condenser to the jet-condenser and, in heated condition, returned to the top of the tank together with newly formed condensate and remaining vapor. A control valve actuated by temperature impulses in the discharge outlet of the jet condenser regulates the rate of circulation in dependence of the momentaneous requirement of cooling medium for the condensation.

In this way the amount of vapor and cooling medium per time unit will vary in the surface condenser as well as in the jet-condenser, and the surface condenser must therefore be dimensioned so as to be able to take care of short time peak loads of the same relative degree as the jet condenser has to take.

It is generally easy to arrange a jet condenser system to meet such requirements in an economic way, while a surface condenser for the same purpose must be considerably larger and more expensive and thus uneconomical in view of the relatively low average load.

It is the main object of the invention to provide a method of cooperating a precondenser of jet type and a subsequent condenser of surface type so that on varying supply of vapor to the jet condenser the supply of vapor to the surface condenser will be kept substantially constant.

The invention will be more particularly described with reference to the accompanying drawing illustrating diagramatically as an example a heat recovering plant for the aforesaid purpose arranged to operate according to the invention.

Blow vapor in varying amount is passed through an inlet pipe 1 to a jet condenser 2, in which the main part of the vapor is condensed. Remaining vapor and condensate are discharged from the jet condenser through a pipe 3 to a tank 4, in which the condensate is accumulated and from the top of which the remaining vapor, at a temperature corresponding to the pressure in the tank, is passed through a pipe 5 to a surface condenser 6, in which the

remaining vapor is condensed and from which inert gases escape through a discharge outlet 7, while the condensate is withdrawn to the tank 4 through the pipe 5.

From the surface layer of condensate in the tank 4 hot condensate is pumped continuously by means of a pump 8 through a pipe 9 to an indirect heat exchanger 10, in which the condensate is cooled in heat exchange with for instance pure water or digestion acid, which is supplied to the heat exchanger through a pipe 11 and is withdrawn therefrom in heated condition through a pipe 12. The cooled condensate is returned through a pipe 13 to the bottom part of the tank 4. An overflow discharge outlet 24 with a vacuum valve 25 is arranged to allow cooled condensate to escape from the bottom part of the tank in a quantity corresponding to the amount of hot condensate supplied to the top part of the tank from the condensers so that the condensate level in the tank will be kept constant.

Cooled condensate accumulated in the bottom part of the tank is pumped by means of a pump 14 and supplied as cooling medium through a pipe 15 to the jet condenser 2. Provided that the valve 16*a* is open the supply of this cooling medium is controlled by a valve 16 under the action of a regulator 17 operated by impulses derived from the difference between the pressures on each side of a diaphragm 26 in the pipe 5 so as to cause said valve 16 to increase its section of passage, when the pressure difference tends to exceed a predetermined value and to decrease its section of passage when the pressure difference tends to fall beneath the same value. In this way the supply of cooling medium to the jet condenser will be adjusted so that, independently of variations in the rate of supply of vapor to the jet condenser, a sufficient quantity of the vapor will be condensed momentaneously in said condenser to maintain the momentaneous quantity of remaining vapor to the surface condenser constant. Thus, it is an advantage of the invention that there is no need of over-dimensioning the surface condenser for peak loads and it may be operated with a constant flow of cooling medium, which is supplied through a pipe 18 and discharged through a pipe 19. As an additional advantage of the invention in the exemplified combination, the surface condenser may be utilized for preparing of hot water in the same manner as the heat exchanger 10, since a cooling medium other than condensate may be used and since also in this case a continuous condensation process takes place.

However, in the case now referred to, during certain periods the vapor will vary not only in amount but also in respect of the temperature. As the blow starts all air in the apparatus must first be expelled. Subsequently, a mixture of vapor and air will enter and only thereafter substantially pure vapor will be supplied. If a flow of air or a relatively cool flow of air-vapor mixture through the pipe 5 should be allowed to cause full supply of cooled condensate to the jet condenser, large quantities of such condensate would be supplied to the hot top layer of condensate in the tank 4 and thus disrupt the continuous process of preparing hot water in the heat exchanger 10. Further, if in the same circumstances the constant flow of cooling medium to the surface condenser 6, that is to say the medium to be heated in this condenser should continue, the desired heating effect would fall short and also this heating process would be disrupted.

Therefore, according to the invention, a check valve 16*a* actuated by a regulator 17*a* via a thermo-impulse member 20 in the pipe 5, is arranged to open to full extent only when the temperature of the vapor in said pipe has a predetermined minimum value, preferably somewhat lower than the vapor temperature corresponding to the vapor pressure in the tank 4. In addition a regulator

21 influenced by another thermo-impulse member 22 in the same pipe 5, is arranged to actuate a valve 23 in the pipe 18 so that the valve 23 will be kept closed at temperatures lower than a predetermined limit temperature in the pipe 5 and is fully opened when said limit temperature is reached. This temperature should at least not be higher than the vapor temperature corresponding to the vapor pressure in the tank, that is to say the saturation temperature of the vapor and may suitably be somewhat lower than that of the aforesaid minimum temperature so that full supply of cooling medium will be ensured within the time necessary for having the temperature of the flow of vapor increased from the limit temperature to maximum temperature.

It is of course possible by a person skilled in the art to make further modifications within the scope of the invention. Thus, the two regulators 17 and 17*a* could be arranged to form one single regulator unit which influenced by differential pressure as well as temperature, is adapted to cause one single valve to fill the functions of both the valve 16 and the valve 16*a*.

The invention may of course also be applied to other processes than that now exemplified, in which the problem of co-operation between a jet condenser system and a surface condenser system is actual.

What I claim is:

1. In apparatus for condensing a flow of steam supplied at a highly varying rate, comprising in combination, a jet condenser, a surface condenser and controls interrelating the operations of said jet surface condensers, said jet condenser having an inlet for the flow of steam, an inlet for cooling medium and an outlet for steam and condensate, said surface condenser having an inlet for steam and passage means for passing a cooling medium in indirect heat exchange relation with respect to steam let into said surface condenser, an accumulator for collecting condensate from said jet condenser, a communication for steam from said outlet from said jet condenser to said inlet for said surface condenser, said controls including flow responsive means and temperature responsive means in said communication responsive to the steam passing therethrough, a pair of valve means in series in said cooling medium inlet for said jet condenser and for controlling the flow therethrough, means for controlling the action of one of said pair of valve means in response to the action of said flow responsive means and means for controlling the action of the other of said pair of valve means in response to the action of said temperature responsive means, whereby instantaneous control of cooling medium for said jet condenser can be effected in response to the flow of steam to said surface condenser.

2. Apparatus according to claim 1 and including valve means for controlling the flow of cooling medium for said surface condenser and means to control said valve means in response to the temperature of steam passing through said communication.

3. Apparatus as in claim 1, in which said accumulator is a tank of substantial capacity and said inlet for cooling medium for said jet condenser is in communication with the lower part of said accumulator.

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