

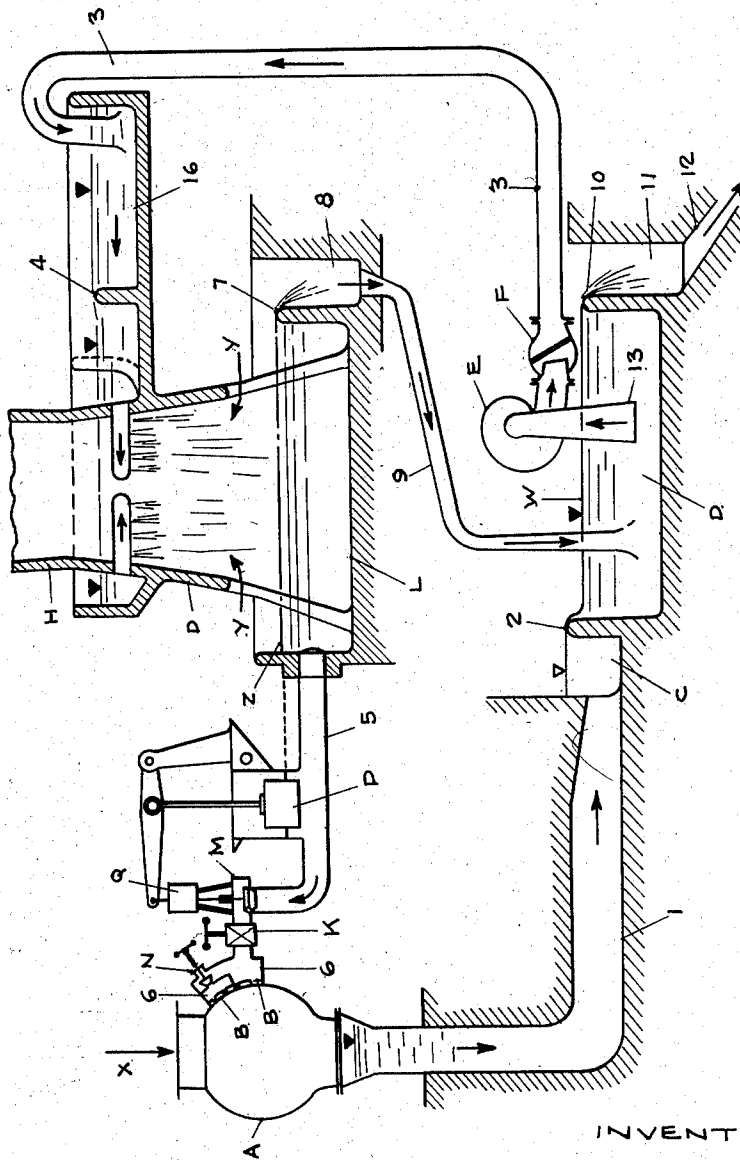
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SELF-REGULATING CIRCULATING AND COOLING SYSTEM

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SELF-REGULATING CIRCULATING AND COOLING SYSTEM

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The present invention relates to a self adjusting installation for the circulation and cooling of the water intended to condense steam in mixture condensers, especially in situations where the supply of circulating water from an outside source is scarce or entirely wanting.

In thermal power plants utilizing natural steam, such as steam derived from natural sources in areas of volcanic activity, mixture condensers located at the discharge end of the steam turbines are frequently used to remarkable advantage. Frequently in such installations practically no river, lake or sea water or only a limited water supply is available for condensing the steam, so that it is necessary to have recourse to water obtained from the condensation of the very steam traversing the turbines. This creates the problem of effecting the circulation of this water and its cooling (usually by common cooling towers or similar apparatus) while avoiding the risk of consequent excessive water losses. Mistakes in operation would lead to great running disturbances, possibly to a reduction of the energy output, or even to the stopping of operation of the plant for a substantial length of time due to the difficulty of replacing wasted water, should the loss exceed a certain quantity.

The installation according to the present invention, relating in general to mixture condensation installations, besides solving the above mentioned problem, exploits to a maximum the input energy of the circulating pumps, by feeding the totality of the water pumped by them through the condenser or condensers, thus obtaining maximum efficiency with respect to power absorbed from the thermo-dynamic viewpoint, in that the thermal drop acting on the steam turbines discharging into the condensers is correspondingly brought up to a maximum.

In a self adjusting installation according to the present invention the water goes under vacuum from the upper cooled water tank located at the base of the cooling tower through a flow adjusting automatic valve responsive to the liquid level in the upper cooled water tank to the injection sprayers in the condensing chamber. Thus, by varying delivery from the circulating pump or pumps, said liquid level remains practically constant as the pumps draw hot water from the lower collecting tank into which it flows from the condensers through a barometric tube and raise it to the cooling tower.

It should be understood that the single figure of the drawing, though showing only one condenser and its accessories (pump, cooling tower, valves, tubes etc.) should be considered as a representation of the machinery of a plant generally composed of more than one steam turbine, so that one must in general have reference to batteries of pumps, batteries of cooling towers, etc.

The invention is illustrated by said figure in schematic form only. In the single figure A is the condensing chamber cooperating with one of the main turbines constituting the plant, which receives, on the one hand, from the direction of arrow X the steam discharged from the turbine, and, on the other hand, the cooling water through the side sprayers B.

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The warm mixture of water and steam is discharged below, and goes through barometric tube 1 to a lower collecting channel C connecting all the discharges from the other condensers installed in the plant; the level in said channel is maintained by overflow 2, so that the outlet of tube 1 is at all times submersed below the level of said overflow in order to prevent air from entering chamber A through tube 1. The water overflows from channel C and collects in the collecting tank D, the only one for the plant, wherefrom it is sucked by the pump or battery of pumps E and delivered through non-return valve F and pipe 3 to the upper collector 16 from which, through suitable overflows 4, the water reaches the tower or towers H, where, by known means, it descends as a spray to cool by contact with the cold air entering from below as indicated by arrows Y. The cooled water drops into tank L located at the base of each tower H, the various tanks L of the tower battery being connected by a channel so that all the tanks attain a common water level.

Cold water is withdrawn from tank L by way of conduit 5 and fed into several compartments 6 of sprayers B, located at various points of the vacuum chamber A of each condenser, as well as into the cooler of undensable gases, which is always attached to each condenser.

Tube 5 carries an automatically adjusting valve M and possibly an intercepting hand valve K. All of the sprayer compartments 6 are controlled by the automatic valve M, although some of said compartments, are also provided with separate hand intercepting valves similar to N, so that each of said compartments may be left open or closed according to operating needs.

The water flows from L to A overcoming the various resistances of the conduits, of the regulating valve M, of the intercepting valve K, and overcoming the head between the water level Z and the sprayers B, if the latter are located higher than the former, entirely by the effect of the difference between the atmospheric pressure and that in the vacuum chamber A.

Float P, located in a pit in communication with tank L, if vertically displaced by variations of level Z, or by direct physical force, or by means of ordinary servomotors working e.g. by hydraulic pressure, acts upon the adjusting valve M to diminish its opening when level Z gets lower and to increase level Z when it gets higher. Within very close limits, said level Z is thus held constant irrespective of the variation of the rate of delivery of the circulating water.

It is to be kept in mind that the amount of steam discharged into A by the turbine mixes in the form of condensed water with the cold water coming from tank L, increasing the total amount; however, such increase is offset by the effect of the partial evaporation of the hot water in tower H, so that the amount of water in the system is on the whole subject to but a small increase caused by the portion of condensed steam coming from the turbine, which does not re-evaporate in the tower.

Of course, such small increase has to be carried from the system. This is achieved in practice by means of a continuous slight overflow at 10, which thus maintains level W of tank D practically constant.

In the exceptional case in which for any reason the total delivery of the pump battery E should substantially and suddenly surpass the pre-established delivery of sprayers B, the regulating valve M would rise opening; however, even after valve M has reached its maximum opening, sprayers B would not suffice to carry off all of the water pumped by the pumping battery therefore level Z of the tank consequently would increase to the point of overflowing through weir 7, the excess water would flow into channel 8, from which it would flow, through

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conduit 9 into tank D, thus avoiding any loss of circulating water. Conversely in the exceptional case when, for any cause whatever, the delivery of the pump battery should diminish substantially and suddenly in respect to the delivery formerly passed through by valve M and there should, consequently, follow a lowering of level Z, such lowering would act through float P on valve M, restricting its opening and proportioning it to the reduced pump delivery, so as to automatically adjust level Z to a height slightly lower than the preceding one. In such a case there would be a loss of water, since the whole volume of water corresponding to the lowering of level Z would finally pass through overflow 10 at the end of tank D, dropping into collecting channel 11 and then going to the sewer through conduit 12. This loss would take place once only until the new rate of level E is established, causing no disturbance in the running of the plant. It is to be noted from the above:

(1) That these are not adjusting or throttling means of any kind either on suction pipes 13 of pumps E or on the pressure tubes 3, with the exception of the non-return valve F (which, in any case, may be built and located so as to cause only a negligible loss of charge). All adjusting or throttling means are arranged between the upper tank L and the condenser, so that pump or pumps E constantly work under the head and delivery conditions for which they were constructed, lifting the water with the least loss of energy.

(2) That, since as above illustrated under normal working conditions, the totality of the pumped water is injected into the condensing chamber and is therefore completely exploited as concerns the thermal efficiency of the plant, it is clear that by the present invention for the smallest expense of energy for the operation of the circulating pumps, the other working conditions of the machinery being equal, the maximum thermal loss occurs in the steam turbine (or turbines) of the plant, correspondingly resulting the maximum thermo-dynamical efficiency of the plant.

It is therefore understood that this advantage stands in inverse ratio to the thermal loss in the operation of the turbines. The present invention finds also a particularly advantageous application in power plants operating on natural steam, which is known to have lower pressure and temperature and therefore less of a thermal fall than that of steam produced by fuel boilers.

In practice the particulars of construction of the plant may vary with respect to the described scheme, without for this reason departing in any way from the spirit of the present invention, or from the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A self-regulating circulating and cooling system for use with a direct contact barometric condenser for condensing steam comprising, in combination, a downwardly extending outlet conduit connected to the said condenser to receive hot condensate consisting of a mixture of cooling water and condensed steam and having an outlet opening being located at a lower level than said condenser; a container for cooling water located at a level higher than the level of said outlet opening of said outlet conduit; means for cooling said hot condensate; means for feeding said hot condensate from said outlet opening of said outlet conduit to said cooling means where it is cooled and thereby transformed into cooling water and from there into said container for cooling water; means for establishing and maintaining a constant pressure against which said feeding means operates; conduit means connecting said container for cooling water with said condenser; and means for automatically regulating the cross-sectional area of said conduit means depending upon the water level in said container so as to decrease said cross-sectional area when the water level in said container falls and to increase it when said water level

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risers, thereby proportionately varying the amount of cooling water sucked into said condenser solely by the vacuum prevailing therein.

2. A self-regulating circulating and cooling system for use with a plurality of direct contact barometric condensers for condensing steam comprising, in combination, a plurality of downwardly extending outlet conduits, each connected to one of said condensers to receive hot condensate consisting of a mixture of cooling water and condensed steam, each of said conduits having an outlet opening being located at a lower level than said condensers; a common channel for receiving the condensate discharged from said outlet conduits; means in said common channel for preventing air from entering any of said outlet conduits; a container for cooling water located at a level higher than the level of said common channel; means for cooling said hot condensate; means for feeding said hot condensate from said channel to said cooling means where it is cooled and thereby transformed into cooling water and from there into said container for cooling water; means for establishing and maintaining a constant pressure against which said feeding means operates; conduit means connecting said container for cooling water with each of said condensers; and means for automatically regulating the cross sectional area of each of said conduit means depending upon the water level in said container so as to decrease said cross sectional area when the water level in said container falls and to increase it when said water level rises, thereby proportionally varying the amount of cooling water sucked into said condensers solely by the vacuum prevailing therein.

3. A self-regulating circulating and cooling system for use with a direct contact barometric condenser for condensing steam comprising, in combination, a downwardly extending outlet conduit connected to the said condenser to receive hot condensate consisting of a mixture of cooling water and condensed steam and having an outlet opening being located at a lower level than said condenser; a collecting tank for receiving the condensate discharged from said outlet conduit, said collecting tank including means for removing from the system any water above a predetermined level in said collecting tank; a container for cooling water located at a level higher than the level of said collecting tank; means for cooling said hot condensate; means for feeding said hot condensate from said collecting tank to said cooling means where it is cooled and thereby transformed into cooling water and from there into said container for cooling water; means for establishing and maintaining a constant pressure between said collecting tank and said cooling means, said feeding means thereby continuously operating against said constant pressure; conduit means connecting said container for cooling water with said condenser; and means for automatically regulating the cross-sectional area of said conduit means depending upon the water level in said container so as to decrease said cross-sectional area when the water level in said container falls and to increase it when said water level rises, thereby proportionately varying the amount of cooling water sucked into said condenser solely by the vacuum prevailing therein.

4. A self-regulating circulating and cooling system for use with a direct contact barometric condenser for condensing steam comprising, in combination, a downwardly extending outlet conduit connected to the said condenser to receive hot condensate consisting of a mixture of cooling water and condensed steam and having an outlet opening being located at a lower level than said condenser; a collecting tank for receiving the condensate discharged from said outlet conduit, said collecting tank including means for removing from the system any water above a predetermined level in said collecting tank; a container for cooling water located at a level higher than the level of said collecting tank, said container in-

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cluding means for transferring any water above a predetermined level into said collecting tank; means for cooling said hot condensate; means for feeding said hot condensate from said collecting tank to said cooling means where it is cooled and thereby transformed into cooling water and from there into said container for cooling water; means for establishing and maintaining a constant pressure between said collecting tank and said cooling means, said feeding means thereby continuously operating against said constant pressure; conduit means connecting said container for cooling water with said condenser; and means for automatically regulating the cross-sectional area of said conduit means depending upon the water level in said container so as to decrease said cross-sectional area when the water level in said container falls and to increase it when said water level rises, thereby proportionately varying the amount of cooling water sucked into said condenser solely by the vacuum prevailing therein.

5. Apparatus of claim 4 wherein said cooling means is disposed directly above said cooling water container and cools said condensate by exposing same to the air before transferring it to said container.

6. A self-regulating circulating and cooling system for use with a direct contact barometric condenser for condensing steam comprising, in combination, a downwardly extending outlet conduit connected to the said condenser to receive hot condensate consisting of a mixture of cooling water and condensed steam and having an outlet opening being located at a lower level than said condenser; a container for cooling water located at a level higher than the level of said outlet opening of said outlet conduit; means for cooling said hot condensate; means for feeding said hot condensate from said outlet opening of said outlet conduit to said cooling means where it is cooled and thereby transformed into cooling water and from there into said container for cooling water; means

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for establishing and maintaining a constant pressure against which said feeding means operates; conduit means connecting said container for cooling water with said condenser; a float member freely riding on the surface of said cooling water; and a regulating valve in said conduit means between said cooling water container and said condenser, said valve being actuated by said float member to automatically regulate the cross sectional area of said conduit means depending upon the water level in said container so as to decrease said cross sectional area when the water level in said container and said float member fall and to increase said cross sectional area when said water level and said float member rise, thereby proportionately varying the amount of cooling water sucked into said condenser by the vacuum prevailing therein.

7. Apparatus as claimed in claim 6 wherein manually operated valve members are connected to said conduit means between said regulating valve and said condenser to initially establish the amount of water to be sucked into said condenser.

8. Apparatus as claimed in claim 6 including a plurality of spraying members mounted on said condenser at the input of said cooling water, each of said spraying members having its own manually operable valve to connect or disconnect same into said system whenever desired.

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