Description

Recooling system

The invention relates to a recooling system for cooling water from the condenser of a steam power plant.

A steam power plant is normally used to generate electric energy or even to drive a machine. Here, a working medium, normally a water/steam mixture, carried in an evaporator circuit of the steam power plant is evaporated in an evaporator. The steam generated in the process expands to perform work in the steam turbine of the steam power plant and is then fed to the condenser thereof. The working medium condensed in the condenser is then fed to the evaporator again via a feedwater pump.

The working medium in the condenser is normally condensed by heat exchange with cooling water which is fed to the condenser and heats up in the process. The heated cooling water is in turn normally cooled in a recooling system by heat exchange with the ambient air. The cooled cooling water is then available again for cooling the condensate.

The recooling system normally comprises a number of cooling towers. Allocated to each cooling tower is a catch basin which is connected to a collecting passage and in which cooled cooling water is collected. The recooled cooling water is fed back from there into the condenser via a condenser pump. Such a recooling system is as a rule adapted to the conditions of the power station site and therefore requires considerable outlay in terms of construction and design. In addition,

a complicated individual level control for the water level of each catch basin is required for such a recooling system.

The object of the invention is therefore to specify a recooling system for cooling water from the condenser of a steam power plant, which recooling system can be installed and operated in an especially simple manner.

This object is achieved according to the invention by a recooling system of the abovementioned type having a number of cooling modules, of which each can be fed via a water-feed shaft allocated to it, the water-feed shafts being connected like communicating tubes to one another and via a common main cooling-water line to the condenser.

The invention starts out from the idea that the installation cost for the recooling system is reduced by standardized components. When standardized components or modules are used for the recooling system, it can be adapted like a unit construction system to the respective power station plant.

In addition, the recooling system can be especially simple to operate if an individual level control for each water-collecting basin allocated in each case to a cooling module is replaced by a level control common to all water-collecting basins. A level control common to all water-collecting basins can be achieved by a central water supply being designed for all cooling modules in such a way that a variation in the cooling-water inflow to a cooling module leaves the cooling-water inflow to the other cooling modules more or less unchanged. Such a design can be achieved by the water-feed shafts being connected to one another

according to the principle of communicating tubes. The term "communicating tubes" is defined, for example, in "Duden: Das große Wörterbuch der Deutschen Sprache", volume 5 (1980), Bibliographisches Institut Mannheim.

Thus, according to the principle of communicating tubes, the level of a liquid in tubes connected to one another and open at the top is the same in each tube. The water-feed shafts of all cooling modules therefore have the same water level so that the inflow of cooling water to all cooling modules can be centrally controlled. An especially simple and reliable water-level control, namely with the aid of the operating conditions prevailing in the condenser and also by means of the delivery capacity of the cooling-water pump, can be achieved here by the water-feed shafts connected to one another being connected to the condenser via a common main cooling-water line.

In order to uncouple the cooling-water inflow to a cooling module from the cooling-water inflow to the other cooling modules in an especially simple manner, a water overflow is expediently connected to the water supply, which water overflow is connected on the outlet side to a water return. Therefore a constant water level is maintained in each water-feed shaft in an especially simple manner even when the pressure conditions in the water supply vary. The operating conditions for each cooling module are therefore at least more or less independent of the cooling-water conditions in the condenser and of the operating state of the condenser pump.

In a further advantageous development, each water-feed shaft can be shut off by means of an intake fitting allocated to it. The water intake to each cooling module can therefore be controlled with especially simple means. During maintenance or repair

work on a cooling module, its water intake can be interrupted in a simple manner, the water overflow serving as bypass for the cooling-water flow now in excess. Thus the water intake into the other cooling modules is unchanged even when a cooling module is shut off. Therefore a complicated level control in the collecting basins of the cooling modules is not necessary even when one or more cooling modules are shut off.

The advantages achieved by the invention consist in particular in the fact that, on the one hand, the recooling system, due to its modular structure, can be adapted like a unit construction system to a predetermined power station concept in an especially flexible manner, in which case standard components may be used. On the other hand, the recooling system is also especially flexible during operation due to the design of the water-feed shafts, which are connected to the condenser of the steam power plant like communicating tubes via a common main cooling-water line.

During varying operating conditions, for example when switching over from summer to winter operation, during which varying demands are made on the recooling system, the total flow of the cooling water to be cooled can be split up into a first partial flow which is cooled in cooling modules and into a second partial flow which is fed back directly into the water return via the water overflow, like a bypass, without cooling. In the process, the operation of each cooling module and of the entire recooling system can be maintained even during the use of unregulated cooling-water pumps within the tolerances predetermined for this recooling system without complicated level control.

An exemplary embodiment of the invention is explained in more detail with reference to a drawing, in which:

Figure 1 shows a recooling system for cooling water from the condenser of a steam power plant, having a number of cooling modules, and

Figure 2 shows a water supply for the recooling system according to Figure 1.

The same parts are provided with the same reference numerals in both figures.

The recooling system 1 for cooling water from the condenser 2 of a steam power plant (not shown in more detail) according to Figure 1 comprises a number of cooling modules 4. In this arrangement, a fan 6 is allocated to each cooling module 4. The cooling modules 4 are connected to the condenser 2 via a main cooling-water line 8 on the cooling-water inlet side and via a cooling-tower return passage 10 and a cooling-water pump unit 12 on the cooling-water outlet side. The condenser 2 is connected on the primary side in the water/steam cycle 14 (only indicated) of the steam power plant.

The cooling modules 4 are standardized with regard to their dimensions and rain area. An adaptation to the specific requirements of the steam power plant is possible in an especially simple manner by a suitable selection and combination of the cooling modules 4. Thus Figure 1 shows a series arrangement of the cooling modules 4. Alternatively, however, other arrangements are also possible, for example in pairs or in block form.

A water-feed shaft 20 according to Figure 2 is allocated to each cooling module 4. The water-feed shafts 20 are connected to the main cooling-water line 8 common to them. In this arrangement, the water-feed shafts 20 are connected both to one another via a water-feed passage 22 and to the condenser

2 of the steam power plant via the main cooling-water line 8 like communicating tubes. A water-distribution line 26 which can be shut off by an intake fitting 24 branches off from each water-feed shaft 20. Via the main cooling-water line 8 and the feed passage 22 as well as via the water-distribution line 26, cooling water K can be fed from the condenser 2 of the steam power plant to the cooling module 4 allocated to the respective water-feed shaft 20.

Via a collecting basin (not shown) allocated to it and via a basin drain shaft 28, each cooling module 4 is connected on the cooling-water outlet side to a cooling-tower return passage 10 common to all cooling modules 4. The cooling-tower return passage 10 is in turn connected to the condenser 2 via the cooling-water pump unit 12.

Connected to the main water line 8 is a water overflow 32 which is connected on the outlet side to the cooling-tower return passage 10. By means of a weir wall 34 arranged in the water overflow 32, a constant water level 36 is maintained in the water overflow 32 and thus a constant water level 36' is also maintained at the same height in each water-feed shaft 20 connected to the water overflow 32 like communicating tubes. In the event of overfeeding through the main cooling-water line 8, a partial cooling-water quantity K' which cannot be directed to the cooling modules 4 flows over the weir wall 34 of the water overflow 32 and is therefore directly admixed to the cooled cooling water K'' flowing in the cooling-tower return passage 10. Therefore the water overflow 32 prevents, like a bypass, overfeeding of the water-feed shafts 20 and the water-distribution lines 26 of the cooling modules 4.

For maintenance or repair work on a cooling module 4 for example, this cooling module 4 can be shut off by means of the intake fitting 24 allocated to it,

so that the inflow of cooling water K to be cooled is prevented. In this case, the partial cooling-water quantity K' of the uncooled cooling water admixed to the cooled cooling water K'' via the water overflow 32 increases accordingly. However, the inflow of cooling water K to be cooled to the cooling modules 4 which have not been shut off remains unchanged on account of the unchanged water level 36' in the water-feed shafts 20 allocated to these cooling modules 4 in each case, so that no complicated level control or inflow control in the other cooling modules 4 is necessary even when a cooling module 4 is shut off.

The recooling system 1 can therefore be adapted to different requirements in an especially simple manner. By means of the intake fittings 24, the ratio of recooled cooling water K to the partial cooling-water quantity K' which has not been recooled can be varied in an especially simple manner and can therefore be adapted to different operating conditions of the steam power plant. In particular when switching over from summer to winter operation, the recooling system 1 of the steam power plant can therefore be used in an especially flexible and simple manner.

With regard to the structural design of the recooling system 1, various types of construction are possible for the cooling modules 4. In particular, the latter may be designed in a timber type of construction, a steel-frame type of construction or even a reinforced-concrete type of construction.

Patent Claims

1. Recooling system for cooling water (K) from the condenser (2) of a steam power plant, having a number of cooling modules (4), of which each can be fed via a water-feed shaft (20) allocated to it, the water-feed shafts (20) being connected like communicating tubes to one another and via a common main cooling-water line (8) to the condenser (2).

2. Recooling system according to Claim 1, characterized by a water overflow (32) which is connected to the main cooling-water line (8) and is connected on the outlet side via a cooling-tower return passage (10).

3. Recooling system according to Claim 1 or 2, characterized in that each water-feed shaft (20) can be shut off by means of an intake fitting (24) allocated to it.