

[54] **WATER SEPARATOR-SUPERHEATER**

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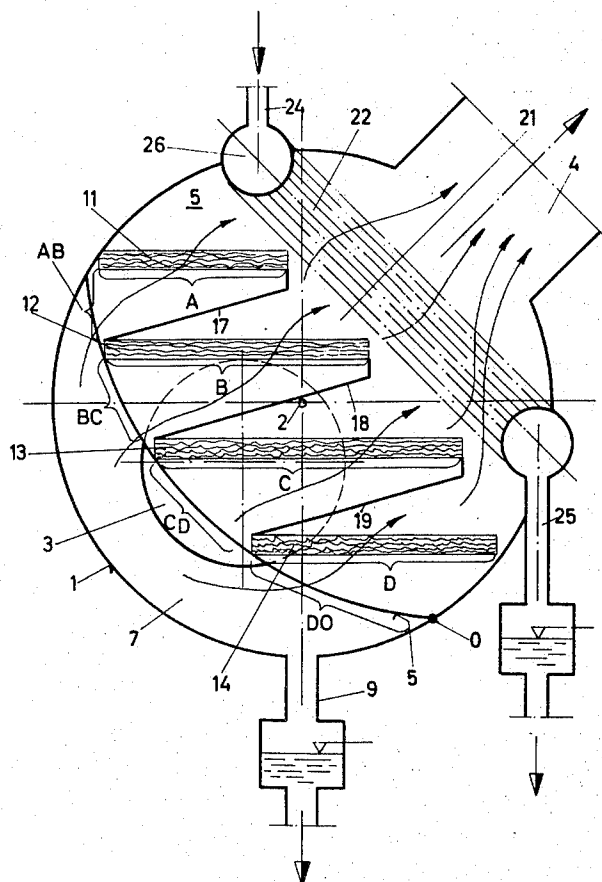
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[57] **ABSTRACT**

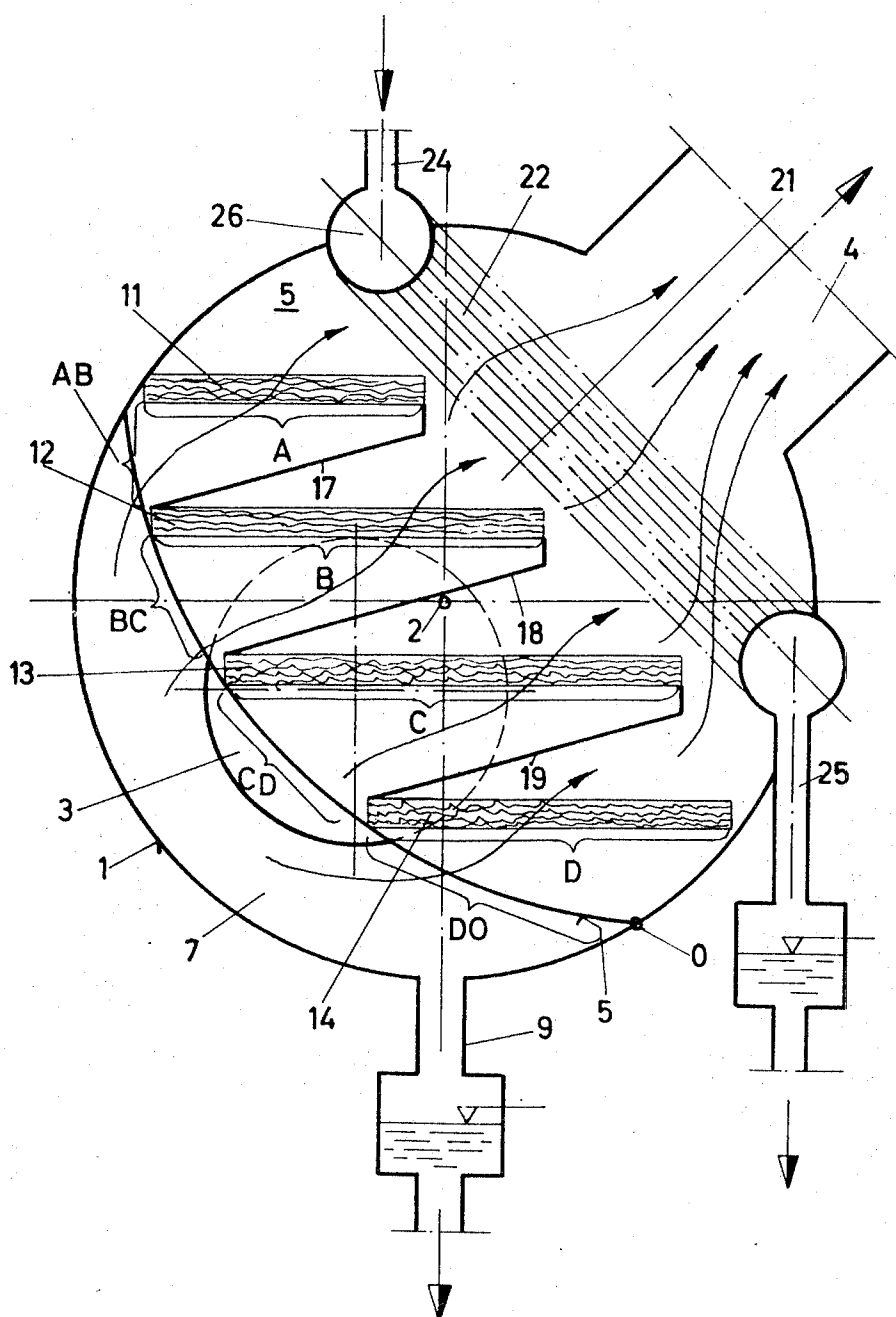
A water-separator-superheater structure includes a horizontally disposed casing having a drum-shaped configuration into which wet steam is admitted at the bottom portion of the drum. The wet steam is caused to flow upwardly at an angle through a plurality of horizontally disposed wire netting mattresses arranged in superposed stepped relation which serve to separate out the moisture which drains off through the bottom of the casing, and the dried steam then passes through a tube type superheater to a discharge outlet. The tubes of the superheater between which the dried steam passes are disposed at a steeply inclined angle in order to promote self-draining.

6 Claims, 1 Drawing Figure



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WATER SEPARATOR-SUPERHEATER

This invention relates to an improvement in the structure of a water separator-superheater for use in turbine plants.

In modern day nuclear power plants, the steam leaves the HP-turbine mostly wet. In a water separator-superheater the water is separated from the steam and the water-free steam is subsequently superheated by means of live steam in a heat exchanger before it is conducted into the LP-cylinder of the turbine. The efficiency is thus increased, and one thus avoids erosion of the LP blades. The separation of water from wet steam by means of wire netting mattress and subsequent superheating by means of tubular heat exchangers is known, for example, in the following arrangements:

- a. Axial introduction of steam into the lower half of the horizontal cylindrical tank, which is divided by a wire netting mattress in the horizontal plane through its longitudinal axis. In the upper half is arranged a heat exchanger with U-tubes. The steam issues vertically upward. Disadvantages: poor utilization of the tank-cross section, thus large dimensions; the condensate formed in the horizontal nest of tubes requires scavenging steam for its elimination (efficiency loss of the plant).
- b. Introduction of steam from the bottom or axially into the horizontal cylindrical tank. In the lower half of the tank are arranged two exactly superposed wire-netting mattresses, in the upper half of the tank are located heat exchangers with horizontal tubes, the steam being conducted along the tubes. The steam issues upward. Disadvantages: high axial velocity of flow of the steam to the wire netting mattresses; numerous steam deflections and thus increased pressure loss; effect of the horizontal position of the tubes as under (a).

The object of the present invention is to eliminate the disadvantages and to find an economically more favorable solution. It is characterized by shielding means between the wet steam inlet and the inflow chamber in front of the wire netting mattresses and by a stepped nested arrangement of the wire netting mattresses whose entrance range is connected with the respective exit range of the superposed mattress by a drop cover plate, as well as characterized by the tubular heat exchanger arranged in the outflow chamber directly adjoining the mattress exits, with greatly inclined tubes for self-drainage.

An embodiment of the subject of the invention will be described on the basis of the accompanying drawing, the single view of which shows in a purely schematic representation a cross section through a water separator-superheater.

The drum-shaped water separator-superheater jacket 1 represented in the drawing is circular-cylindrical with a longitudinal axis 2. The entrance of the wet steam takes place through an inlet port 3 in a drum bottom of the water separator-superheater, while the superheated steam issues through an outlet nipple 4 which can be arranged at any point along the drum. A shielding wall 5 is arranged between the inlet port 3 and an inflow chamber 7. At the lowest point of the water separator-superheater is arranged a drain pipe 9. Wire netting mattresses 11, 12, 13 and 14, arranged in staggered and superposed position, serve to drain the wet steam. Between these wire netting mattresses 11-14 are provided drop cover plates 17-19, which connect the inflow region of one mattress with the outflow region of the superposed mattress in such a way that two following mattresses with the respective drop cover plates appear Z-shaped in their cross section. The widths A, B, C and D of the mattresses 11-14 are proportional to the steam inflow cross sections AB, BC, CD and DO. This has the result that the steam entrance velocities into the chambers between the wire netting mattresses are equal. Behind the wire netting mattresses 11-14 is arranged a steam outflow chamber 21 in which steeply inclined superheater tubes are provided. These extend in normal planes to the longitudinal axis 2. Hot steam is admitted into the superheater tubes 22 through an inlet nipple 24 and a distributor. At the bottom of the superheater is provided an outlet nipple 25 for the discharge of the condensate formed.

In the operation of the plant, the wet steam flows out of the high-pressure part of the steam turbine through the inlet port 3 into the water separator-superheater, in which it is deflected to a great extent by the shielding wall 5, to arrive in the inflow chamber 7. The free flow area between the shielding wall 5 and the water separator-superheater jacket 1 is about equal to the cross section of the inlet port 3. The installation of the shielding wall 5 prevents the wet steam from flowing at high velocity directly into the chamber under the wire netting mattresses 11-14. It also permits a more uniform admission of these chambers with wet steam, as well as a direction of flow of the steam which allows it to pass through the water separator-superheater practically without any additional substantial deflection. In the chamber 7 can be provided additional devices for the rectification and uniform distribution of the steam along the tank, such as baffle plates, perforated plates etc. By means of the wire netting mattresses, the water contained in the wet steam is separated to a great extent. It flows into the drain pipe 9 and is fed from there again into the steam cycle. The practically water-free steam flows then around the superheater tubes 22 in which the superheated steam entering through the nipple 24 gives off its heat to the water-free steam and condenses, the condensate flowing off through the inclined superheater tubes 22 into a collector manifold from which it is likewise fed to the steam cycle through the nipple 25. In this manner the water-free steam flowing around the superheater tubes 22 is superheated and arrives through the outlet 4 in the low-pressure-part of the steam turbine.

As can be seen from the drawing, the wet steam is conducted in the above described water separator-superheater through the wire netting mattresses 11-14 and subsequently directly through the tubular heat exchangers for superheating. Both the wire netting mattresses and the superheater extend over the entire length of the water separator-superheater.

This embodiment has the following advantages over the presently known models:

The supply of the wet steam can be effected over a short distance and without preceding water removal.

The pressure loss in the above described water separator-superheater is minimal since the wet steam is only slightly deflected and the steam velocity is kept substantially constant during its passage through the water separator-superheater.

The removal of the superheated steam can be effected at one or several points along the apparatus, suitable for the turbine.

The circular cross section of the tank is fully utilized.

The condensate of the condensing superheated steam flows off by itself so that no scavenging steam is required for its discharge.

The above described embodiment of a water separator-superheater requires only two-thirds of the presently occupied space with the same output, and it weighs only two-thirds as much. It is, in addition, simple in its design and flow arrangement, so that favorable conditions also exist for its cleaning.

We claim:

1. In a water-separator-superheater structure the combination comprising a cylindrical drum, said drum including therein an inlet for wet steam at the bottom of the drum, an inflow chamber for the wet steam, a plurality of wire netting mattresses arranged in superposed stepped relation, shielding means between said wet steam inlet and said inflow chamber in front of said wire netting mattresses, a drop cover plate connecting the entrance region of each wire netting mattress with the exit region of the mattress located next above, a dry steam outflow chamber, and a tubular heat exchanger located in said dry steam outflow chamber directly adjacent the exit regions of said wire netting mattresses, the tubes of said heat exchanger being steeply inclined to provide self-draining.

2. A water separator-superheater structure as defined in claim 1 wherein said tubes of said heat exchanger extend substantially at a right angle to the longitudinal axis of said drum.

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3. A water separator-superheater structure as defined in claim 1 wherein said inflow chamber includes a free flow area approximately equal to the cross section of said wet steam inlet.

4. A water separator-superheater as defined in claim 1 and which further includes means arranged in said wet steam inflow chamber for obtaining uniform distribution of the steam and for rectifying its flow.

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5. A water-separator-superheater as defined in claim 1 and which further includes an outlet for superheated dry steam at the discharge side of said superheater and which extends obliquely upwardly.

6. A water separator-superheater as defined in claim 1 wherein the entrance cross sections to said wire netting mattresses are proportional to the width of said mattresses.

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