

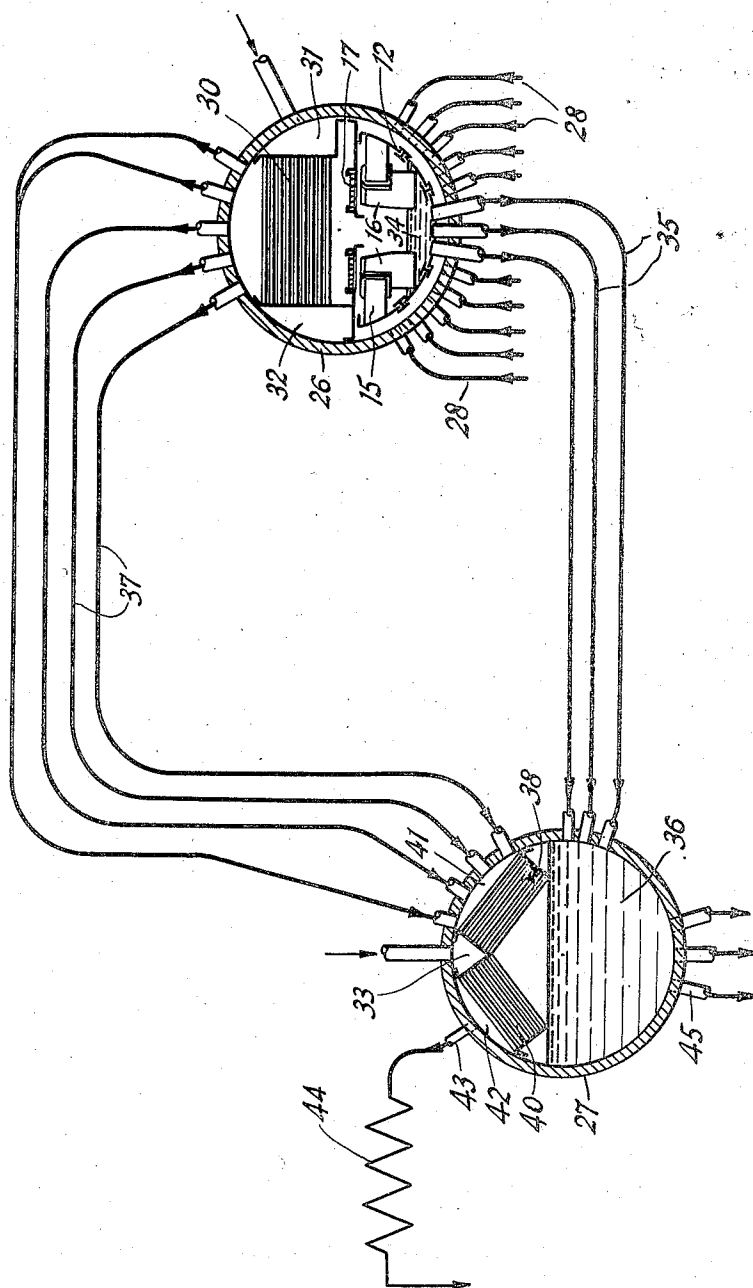
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APPARATUS FOR PURIFYING STEAM

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APPARATUS FOR PURIFYING STEAM

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3 Claims. (Cl. 122—459)

This invention relates to steam purifying apparatus and more particularly to apparatus for removing impurities from generally dry steam by partial condensation of the steam by indirect heat exchange with a cooling liquid.

According to the invention, the steam and water mixture discharging from the generating tube of a steam boiler is passed through steam and water separators with the steam discharging upwardly through a corrugated plate scrubber, and the water discharging downwardly from the separators to the water space of the steam and water drum. Leaving the scrubbers, the substantially dry steam is passed over a surface type heat exchanger which is cooled by a flow of boiler feed water, whereby some of the steam condenses and coats the external surfaces of the heat exchanger with films of condensate. The steam condensate forms about nuclei of the impurities in the steam, with the impurities being collected in the films of condensate liquid formed on the heat exchange surfaces. The condensate flows from the heat exchange surfaces to a discharge position out of contact with the streams of steam leaving the scrubbers.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

The drawing is a transverse section of a steam and water drum and a separate steam condensing drum connected therewith in accordance with the invention.

In the arrangement shown in the drawing, a separate condensing drum 26 is provided at a position above the normal water level in the steam and water drum 27. The riser tubes 28 discharge the mixture of steam and water generated in the heating section of the boiler directly to the condensing drum 26. The curved plates 12, cyclone separators 16, tangential ducts 15 and the corrugated plate scrubbers 17 described in connection with the arrangement of the drawing are also included in the condensing drum 26. As shown, the indirect heat exchange unit 30 consists of transverse horizontally disposed tubes which connect an inlet chamber 31 positioned along one side of the drum with a receiving chamber 32 positioned along the opposite side of the drum for the flow of boiler feed water through the heat exchange tubes. The boiler feed water may be passed directly from the receiving chamber 32 of the drum 26 to a distributor 33 positioned in the steam and water drum 27, as hereinafter described.

Alternately, the boiler feed water may be divided for parallel flow to the inlet chamber 31 and the distributor 33, with the boiler feed water discharging from the chamber 32 into the lower portion of the drum 26 above the curved plates 12. The condensate forming on the surfaces of the heat exchanger 30 flows along the tubes to gravitationally accumulate in the lower portion 34

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of the drum 26, and discharges through the tubes 35 to the water space 36 of the steam and water drum 27. In the construction described, the overflow outlet (not shown) from the receiving chamber 32 is preferably such as to assure flow of cooling fluid (i. e. boiler feed water) through all of the tubes of the heat exchanger 30.

The saturated steam leaving the condensing drum 26 passes through the tubes 37 to the drum 27, and through an indirect heat exchanger positioned therein. The heat exchanger in the drum 27 is formed by two tube bundles 38 and 40 arranged as an inverted V in the upper portion thereof. As shown, the distributor 33 is defined by the tube sheets at the upper ends of the tube bundles 38 and 40 where the tube sheets are secured to the drum along their upper edges and are joined at their lower edges to form the fluid tight chamber. The lower ends of the tube bundles are likewise fitted into tube sheets which are attached along one edge of the drum. In the construction described, the tube sheets not only define the walls of the distributor 33, but also define the walls of a steam inlet chamber 41 and outlet chamber 42 on opposite sides of the distributor 33.

The inlet chamber 41 receives steam from the drum 26 through the tubes 37, with the steam passing in series across the tube bundles 38 and 40 to the chamber 42. Thereafter the steam flows through the tubes 43 to, and through, a superheater 4. Steam condensate collecting on the surfaces of the tube bundles 38 and 40 flows along the surfaces to discharge into the water space 36 of the drum, where it is joined by feed water passed through the tubes of the tube bundles 38 and 40. The water in the drum 27 thereafter enters the circulatory system of the boiler through the downcomers 45.

Under some conditions it is desirable to provide a supplementary condensation of the steam by interposing a surface cooler in the connecting tubes 37. The tubes 37 may be provided with a common heat exchange unit or each of the tubes 37 may be provided with an individual surface heat exchanger. In either event, the condensate will flow along the walls of the tubes 37 into the boiler drum 27 with the steam condensate eventually mixing with the water in the water space 36 of the drum.

The steam purifying provisions described are not only applicable to a steam generator of the natural circulation type, but can also be advantageously applied to a steam generator of the forced circulation type. With forced circulation the arrangement of equipment may be substantially similar to that hereinbefore described, or the heat exchange surfaces can be installed in the steam flow stream prior to the passage of the steam through purifying devices of the mechanical type.

While in accordance with the provisions of the statutes I have illustrated and described herein a preferred embodiment of the invention, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a steam boiler the combination comprising a closed pressure vessel, means for delivering a mixture of steam and water to said vessel, separating means within said vessel for separating water from said steam and water mixture, means for condensing some of the steam discharging from said separating means by indirect heat exchange with boiler feed water, a steam and water drum positioned at a level below said vessel and having a steam outlet in the upper portion and a water space in the lower portion thereof, means connecting said vessel and drum for series flow of steam from said vessel to the

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steam outlet of said drum, means connecting said vessel and said drum for series flow of boiler feed water from said vessel to said drum, means for partially condensing said steam within said drum by indirect heat exchange with boiler feed water with the feed water thereafter discharging to the water space of said drum, and means for flow of the water separated from said steam and the steam condensate from said vessel to the water space of said drum.

2. In a steam generator, the combination comprising a closed pressure vessel, means for delivering a mixture of steam and water to said vessel, means within said vessel for separating water from said steam and water mixture, means for partially condensing said steam by indirect heat exchange with a cooling fluid, a steam and water drum positioned at a level below said vessel, a pair of oppositely inclined tube bundles in the upper portion of said drum, said tube bundles opening to a common closed cooling fluid inlet chamber in the upper portion of said drum and discharging at a position intermediate the height of said drum, a steam outlet in the upper portion of said steam and water drum adjacent one of said bundles, means connecting said vessel and said drum for series flow of said cooling fluid through said elements and tube bundles, means connecting said vessel and drum for series flow of steam from said vessel to the steam outlet of said drum, and means for flow of separated water and steam condensate from said vessel to said drum.

3. In a steam generator, the combination comprising a closed pressure vessel, means for delivering a mixture of steam and water to said vessel, means within said ves-

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sel for separating water from said steam and water mixture, walls within said vessel defining an upward flow path for steam from said separating means, a plurality of horizontally disposed substantially straight tubular elements extending across said steam flow path and opening at opposite ends into closed inlet and outlet chambers within said vessel, a steam and water drum positioned at a level below said vessel, a pair of oppositely inclined tube bundles in the upper portion of said drum, said tube bundles opening into a common closed inlet chamber in the upper portion of said steam and water drum adjacent one of said bundles, means connecting said vessel and said drum for series flow of feed water through said elements and tube bundles, means connecting said vessel and drum for series flow of steam from said vessel to the steam outlet of said drum, and means for flow of separated water and steam condensate from said vessel to said drum.

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