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E. C. HUGÉ

2,297,704

FLUID SYSTEM

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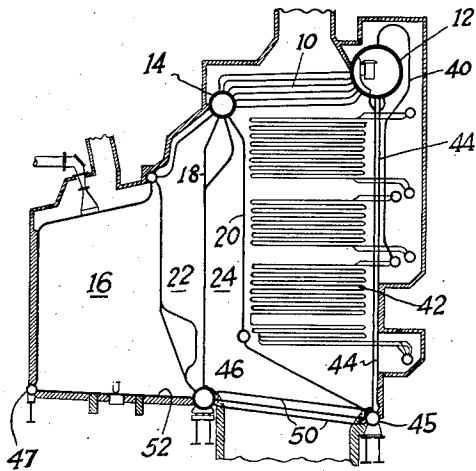


Fig. 1

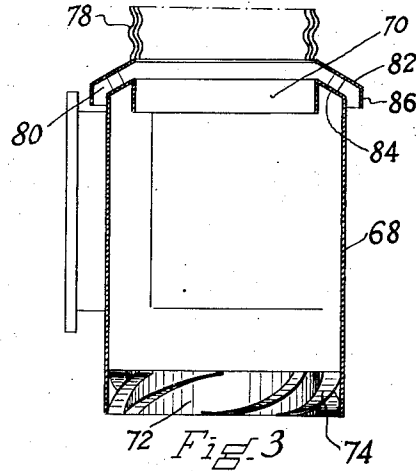


Fig. 3

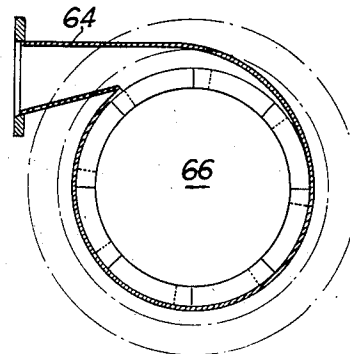


Fig. 4

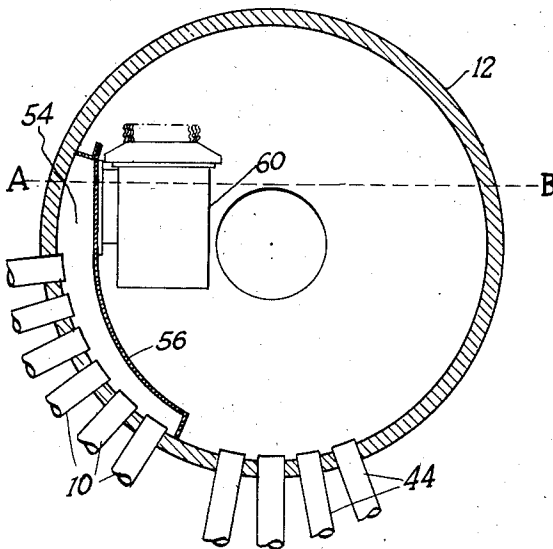


Fig. 2

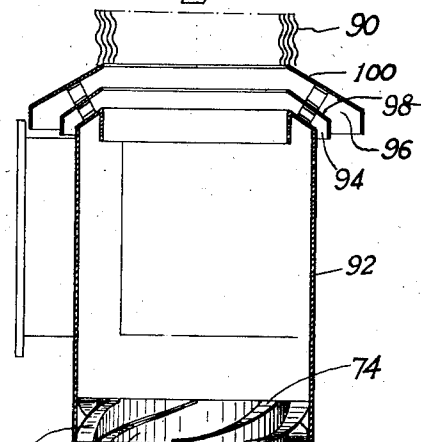


Fig. 5

INVENTOR.
Ernest Carl Hugé
BY *M. Holbrook*
ATTORNEY.

UNITED STATES PATENT OFFICE

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FLUID SYSTEM

Ernest Carl Hüge, Barberton, Ohio, assignor to
The Babcock & Wilcox Company, Newark,
N. J., a corporation of New Jersey

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6 Claims. (Cl. 122—488)

This invention relates to improvements in apparatus employed in fluid systems and the invention may be considered as exemplified in water tube boiler improvements whereby the safe steaming capacities and the water storage capacities of such boilers, for a given drum capacity, are increased.

The invention relates particularly to improvements over the densifiers or steam and water separators disclosed in the pending application of Rowand and Fletcher, Serial No. 210,374, filed May 27, 1938 (now Patent 2,289,970 dated July 14, 1942), this type of apparatus having for its object the effective separation of steam and water with a minimum steam and water separation space; the elimination of priming; decrease of water content in the steam leaving the steam and water drum; and the increase in boiler circulation rates.

Specifically, and referring to the particular densifier or steam and water separator of the Rowand and Fletcher application, the improvement thereof with which this invention is concerned involves an intermediate steam and water separator between the steam outlet of the whirl chamber and the auxiliary scrubber above that outlet. This intermediate separator involves a downwardly extending cap or rim positioned just below the auxiliary scrubber and above an opening through which the upper part of the whirl chamber is in free communication with the steam space of the drum. This improvement permits the operation of the whirl chamber with such velocities that some water will be carried therefrom. Some of this water carried upwardly by the steam is thrown out under the rim and collects on the surface of the rim in large droplets heavy enough to fall by gravity from the lower edge of the rim. Some steam also passes from the opening beneath the rim, and by this amount the capacity of the scrubber is increased. Also, the decrease in velocity between the whirl chamber outlet and the scrubber inlet gives a more uniform loading over the scrubber area. At normal boiler capacities, the velocity of the steam flowing from the whirl chamber and under the rim is relatively low, and it therefore does not interfere with the gravity disposal of water collected on the rim.

The invention will be described with reference to embodiments illustrated in the accompanying drawing, and other objects of the invention will appear as the description proceeds.

In the drawing:

Fig. 1 is a vertical section of a steam generat-

ing installation in which an embodiment of the invention is employed;

Fig. 2 is a transverse vertical section of the steam and water drum of the Fig. 1 installation;

Fig. 3 is a vertical section through a densifier or steam and water separator constructed in accordance with this invention;

Fig. 4 is a horizontal section through the densifier indicated in Fig. 3; and

Fig. 5 is a vertical section through a densifier which constitutes a modified embodiment of the invention.

The invention may advantageously be employed to obtain a high degree of steam and water separation in a steam generating installation such as that shown in Fig. 1. In this installation steam and water mixtures are discharged at high velocity into the drum 12 by the circulators 10. The latter are shown as having their ends communicating with a header 14 which, in turn, receives steam and water from a plurality of steam generating tubes. Some of these tubes define the walls and other boundaries of the furnace 16 and are subject to the high temperatures thereof. Others, such as the tubes 18—20 define the walls of the gas passes 22 and 24 and are subject to high gas temperatures therein.

Steam is separated from the water in the drum 12, the steam proceeding through the tubes 40 to the superheater 42 while the separated water passes through the downcomers 44 to the lower headers 45—47, the screen tubes 50, and the floor tubes 52.

The steam and water discharged into the drum 12 by the circulators 10 enters a separate inlet chamber 54 formed within the drum by a side plate 56 and other co-operating plates. This inlet chamber extend over a portion of the length of the drum corresponding to the width of the bank of circulators 10 and it is in communication with a plurality of densifiers 60 which are preferably secured to the plate 56.

Steam and water mixtures enter the densifiers with a considerable velocity head dependent upon the pressure drop between the inlet chamber 54 and the remainder of the space within the drum 12. The flow of such a mixture through the inlet 64 of a densifier is substantially tangential to the whirl chamber 66 formed by the circular shell 68, the arrangement results in a swirling film or liquid flowing around the wall of the whirl chamber, the centrifugal force thus produced being effective in separating the steam and water. The steam separates from the water and passes up-

wardly through a central opening 70 at the top of the whirl chamber.

The separated water is discharged through restricted outlets limited to an annular zone adjacent the perimeter of the whirl chamber and at its lower end. This zone is defined by the shell 68 and a base or pan 72 of circular shape. The pan and the shell are separated by curved vanes 74 which separate a plurality of water outlets. The forces involved in the flow of water downwardly through these outlets prevent the establishment of water levels in the whirl chambers corresponding to the drum water level and enable the steam generator to effectively operate at drum water levels ranging substantially from the tops to the bottoms of the whirl chambers. The higher of such water levels is indicated by the line AB in Fig. 2.

Spaced above the central steam outlet 70 of the whirl chamber 66 is a scrubber, or multiple plate steam and water separator, 78. The steam passes between the scrubber plates which act to separate drops of water therefrom and allow them to fall back into the water within the densifier.

The velocity of steam between the whirl chamber and the scrubber is decreased and the scrubber is given a more uniform loading over its flow area by the provision of the annular opening 80 between the scrubber and the steam outlet of the whirl chamber. Fig. 3 shows this opening in the form of a passage between an annular rim or cap 82 and a downwardly inclined rim 84 forming the top of the shell 68. The rim 82 extends out beyond the confines of the shell 68 and is provided with a downwardly extending part 85. By reason of this construction some of the water carried by the steam as it leaves the top of the whirl chamber is thrown out under the rim 82 and collects on the surface of that rim in large droplets, heavy enough to fall by gravity from the lower edge of the rim. Some of the steam is also discharged through the passage 80 and underneath the rim 82, and the capacity of the scrubber 78 is increased by this amount.

The embodiment of the invention indicated in Fig. 4 of the drawing differs from that indicated in Fig. 3 by the provision of an opening of greater flow area between the scrubber 90 and the steam outlet at the top of the whirl chamber formed by the casing 92. Also, the Fig. 4 embodiment involves a plurality of annular passages 94 and 96 through which the steam outlet in the whirl chamber is in free communication with the steam space of the drum 12. These annular passages are formed by the rims 98 and 100 which are maintained in their superposed and spaced relationship with reference to the top of the shell 92.

Although the invention has been described with reference to certain specific embodiments it is to be appreciated that it is not limited to all of the details thereof. The invention is rather to be considered as of a scope commensurate with the scope of the sub-joined claims.

What is claimed is:

1. In a fluid separator, means forming an exterior chamber in which there is a liquid level, means forming an upright whirl chamber disposed within the exterior chamber, fluid confining means directing a fluid mixture substantially tangentially into the whirl chamber from a position exteriorly of the first mentioned chamber, an auxiliary separator including elements disposed across an outlet for lower density fluid at the top

of the whirl chamber, there being an auxiliary outlet disposed between the auxiliary separator and said inlet and affording free communication between the whirl chamber and the space of the exterior chamber above said liquid level, and means forming a restricted outlet for separated water at the lower end of the whirl chamber.

2. In a fluid separator, a drum constituting an exterior chamber in which there is a liquid level, a casing forming an upright whirl chamber disposed within the exterior chamber, fluid confining means directing a fluid mixture substantially tangentially into the whirl chamber from a position exteriorly of the drum, an auxiliary separator including spaced vanes disposed across an outlet for lower density fluid at the top of the whirl chamber, there being an auxiliary outlet disposed between the auxiliary separator and said inlet and affording free communication between the whirl chamber and the drum space above said liquid level, means forming a restricted outlet for separated water at the lower end of the whirl chamber, means above said liquid level for the flow of the separated lower density fluid from the drum, and means below said level for the withdrawal of separated liquid from the drum.

3. In a fluid separator, means forming an exterior chamber in which there is a liquid level, a casing forming an upright whirl chamber disposed within the exterior chamber, fluid confining means directing a fluid mixture from a position exteriorly of the first mentioned chamber substantially tangentially into the whirl chamber, an auxiliary separator including upwardly extending spaced plates disposed across an outlet for separated lower density fluid at the top of the whirl chamber, there being an auxiliary outlet disposed between the auxiliary separator and said inlet and affording free communication between the top of the whirl chamber and the space of the exterior chamber above said liquid level, means forming a restricted outlet for separated water at the lower end of the whirl chamber, means communicating with the exterior chamber above said liquid level for the flow of separated lower density fluid from that chamber, and means below said level for the flow of separated liquid from the exterior chamber.

4. In a fluid separator, means forming an exterior chamber in which there is a liquid level, means forming an upright whirl chamber disposed within the exterior chamber, fluid confining means directing a fluid mixture substantially tangentially into the whirl chamber from a position exteriorly of the first mentioned chamber, an auxiliary separator including elements disposed across an outlet for lower density fluid at the top of the whirl chamber, a baffle extending laterally of said outlet and disposed above the top of the whirl chamber and spaced therefrom to provide an auxiliary outlet disposed between the auxiliary separator and said inlet and affording free communication between the whirl chamber and the space of the exterior chamber above said liquid level, means forming a restricted outlet for separated water at the lower end of the whirl chamber.

5. In a fluid separator, means forming an exterior chamber in which there is a liquid level, means forming an upright whirl chamber disposed within the exterior chamber, fluid confining means directing a fluid mixture substantially tangentially into the whirl chamber from a position exteriorly of the first mentioned chamber, an

auxiliary separator including elements disposed across an outlet for lower density fluid at the top of the whirl chamber, an annular cap spaced from the top of the whirl chamber to form an auxiliary outlet disposed between the auxiliary separator and said inlet and affording free communication between the whirl chamber and the space of the exterior chamber above said liquid level, and means forming a restricted outlet for separated water at the lower end of the whirl chamber.

6. In a fluid separator, means forming an exterior chamber in which there is a liquid level, means forming an upright whirl chamber disposed within the exterior chamber, fluid confining means directing a fluid mixture eccen-

trically into the whirl chamber from a position exteriorly of the first mentioned chamber, an auxiliary separator including elements disposed across an outlet for lower density fluid at the top of the whirl chamber, a plurality of vertically spaced caps extending laterally of said outlet and disposed above the top of the whirl chamber and spaced therefrom to provide auxiliary outlets disposed between the auxiliary separator and said inlet and affording free communication between the whirl chamber and the space of the exterior chamber above said liquid level, means forming a restricted outlet for separated water at the lower end of the whirl chamber.

ERNEST CARL HUGE.