Feb. 27, 1940. M. H. KUHNER 2,191,671

STEAM PURIFYING APPARATUS

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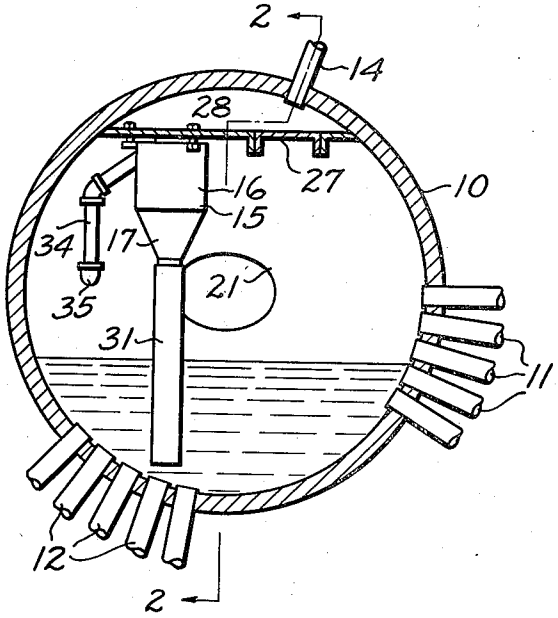
Fig. 1



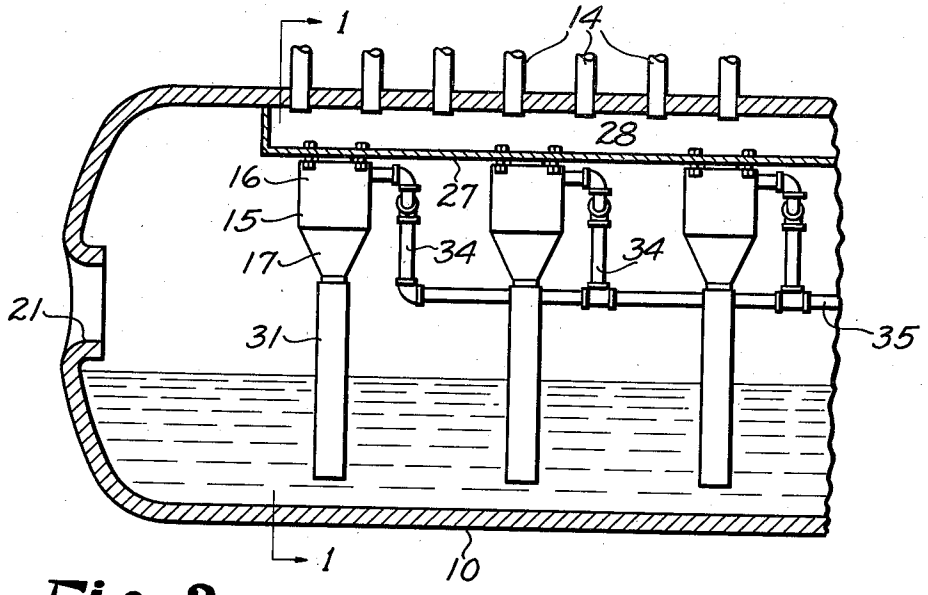


Fig. 2

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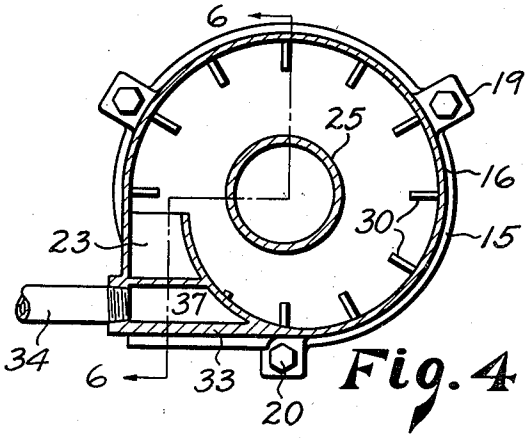

Fig. 4

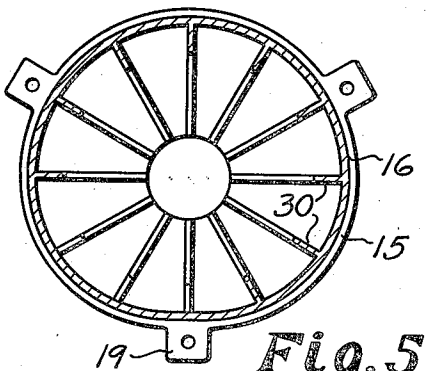

Fig. 5

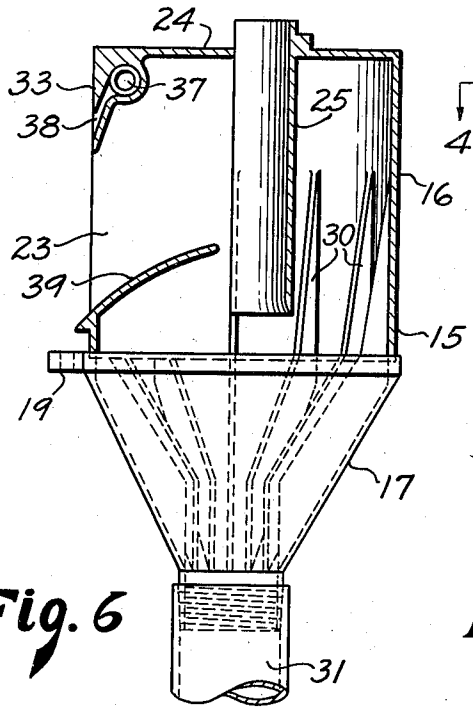

Fig. 6

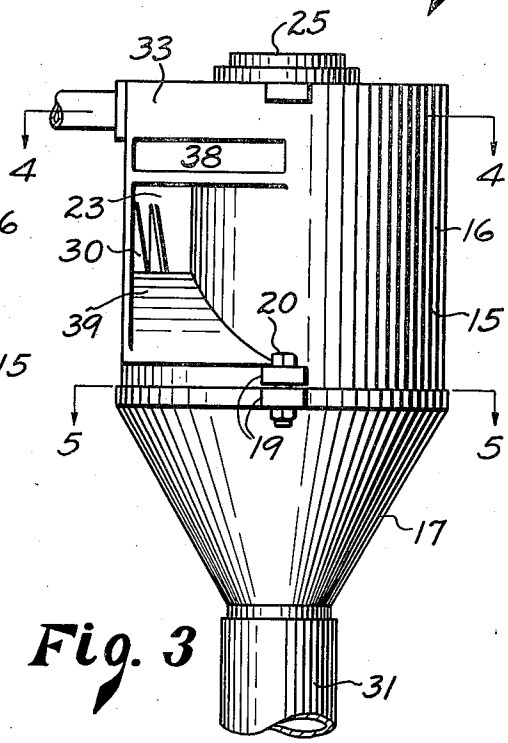

Fig. 3

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UNITED STATES PATENT OFFICE

2,191,671

STEAM PURIFYING APPARATUS

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Application November 26, 1937, Serial No. 176,549

3 Claims. (Cl. 183—24)

This invention relates to steam purifying apparatus, and more particularly to apparatus for washing steam with comparatively clean water and subsequently separating the moisture from the steam.

The steam liberated in a boiler ordinarily carries in suspension an appreciable quantity of insoluble solid matter, as well as a considerable amount of boiler water which is highly contaminated with dissolved impurities. If such steam is delivered to a superheater and thence to a turbine, great difficulties will be encountered by reason of deposits in the superheater tubes and on the turbine blades. This has been recognized, and various attempts have been made to wash the steam by means of the boiler feed water, which is much cleaner than the water in the boiler. However, these prior constructions have in general been complicated and expensive, and in many cases they have failed to produce satisfactory results in service.

It is accordingly one object of the invention to provide a comparatively simple, inexpensive and efficient apparatus for washing the impurities from steam and removing the suspended moisture.

It is a further object of the invention to provide means whereby steam can be purified within the drum of a steam boiler without unduly obstructing the interior of the drum.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

In accordance with my invention in its preferred form, I provide a hollow casing into which the steam is delivered in such a manner as to whirl within the casing, and I provide means for subjecting the steam as it enters the casing to the action of a sheet or spray of comparatively clean water which removes a considerable proportion of the impurities from the steam. As the steam whirls within the casing the remaining impurities and the suspended moisture particles are hurled outwardly by centrifugal force against the casing walls and are discharged from the casing by gravity. The clean steam escapes through a central outlet. A plurality of these casings may be mounted within a horizontal boiler drum in a longitudinal row, and they may be arranged to deliver the washed steam through openings in a partition wall located in the upper part of the drum.

Referring to the drawings illustrating one embodiment of the invention, and in which like reference numerals indicate like parts,

Fig. 1 is a section through the steam-and-water drum of a boiler, taken on the line 1—1 of Fig. 2;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged view in elevation of one of the steam washing elements;

Fig. 4 is a section on the line 4—4 of Fig. 3;

Fig. 5 is a section on the line 5—5 of Fig. 3; and

Fig. 6 is a view partly in elevation and partly in section on the line 6—6 of Fig. 4.

The embodiment illustrated comprises a horizontal steam-and-water drum 10 to which are connected a bank of riser tubes 11 and a bank of down-comer tubes 12. A row of tubes 14 is connected to the upper portion of the drum to withdraw the steam therefrom. This drum may form a part of a complete steam boiler of the type shown in my prior Patent No. 1,990,945 granted February 12, 1935. It will be understood that the riser tubes 11 deliver a mixture of steam and water to the drum 10, the steam being liberated within the drum, and the water flowing downwardly through the tubes 12. The steam carries a considerable quantity of the boiler water in suspension, and since this water is highly concentrated it is important to wash the steam with a comparatively clean water and then remove as much of the moisture as possible, so that a minimum of impurities will remain in the steam when it leaves the drum.

In order to effect the desired purification of the steam there is provided within the drum 10 and above the water line therein a series of hollow casings 15 each comprising a substantially cylindrical upper portion 16 arranged with its axis vertical, and a downwardly converging conical lower portion 17 therebeneath, these parts being formed with cooperating lugs 19 which are fastened together by means of bolts 20. The casings are small enough to permit them to pass through the manholes 21 in the heads of the drum 10. The cylindrical portion 16 of each casing is provided with a tangential inlet passage 23 through which the steam may enter directly from the steam space of the drum 10. Each casing 15 is also provided with an upper wall 24 through which extends a central vertical outlet pipe 25 having its lower end located near the junction of the portions 16 and 17 of the casing. The upper ends of the outlet pipes 25 extend through a horizontal plate or partition wall 27 which in conjunction with the upper wall of the drum serves

to enclose a space 28 from which the steam may flow directly into the tubes 14. This plate 27 is welded or otherwise secured to the drum wall, and the casings 15 are bolted to the plate. The interior surfaces of the casings 15 are provided with vertical ribs 30 which preferably decrease in radial dimensions toward their upper ends and terminate somewhat below the upper wall 24. To the lower end of each conical portion 17 there is connected a vertical pipe 31 which extends downwardly into the water in the lower portion of the drum.

Means is provided to bring the boiler feed water into intimate contact with the steam as it enters the casings 15. For this purpose a nozzle 33 is provided above each inlet passage 23, and feed water is supplied to these nozzles through branch pipes 34 leading from the main feed water supply pipe 35 of the boiler. The nozzles 33 may be constructed as an integral part of the casings, and in the embodiment illustrated each branch pipe 34 leads to a small chamber 37 formed in the upper portion 16 of the casing directly above the inlet passage 23, this chamber having a narrow discharge slot 38 arranged to direct a sheet of water downwardly across the passage 23 and at a slight inclination toward the on-coming steam. The lower wall 39 of the passage 23 is sloped upwardly and inwardly, so that a considerable part of the water falling thereon will flow outwardly by gravity into the drum.

The operation of the invention will now be apparent from the above disclosure. A mixture of steam and water enters the drum 10 through the tubes 11, and most of the water drops out by gravity and flows downwardly through the tubes 12. A considerable amount of water however remains in suspension in the steam, and this water is highly contaminated with impurities. From the steam space of the drum the wet steam enters the passages 23, being compelled to pass through the downwardly directed sheets of feed water issuing from the slots 38. This feed water is comparatively clean, and it serves to wash the boiler water and impurities from the steam, much of this matter being discharged into the drum by gravity from the sloping walls 39. Such moisture as does enter the casings 15 with the steam is largely derived from the feed water. Because of the tangential arrangement of each passage 23 and the velocity of the steam traveling therethrough, the steam will whirl rapidly about a vertical axis as it moves downwardly through the upper portion 16 of the casing, and the moisture will be thrown outwardly by centrifugal force and retained by the ribs 30. The comparatively dry pure steam will escape upwardly through the central pipes 25 to the space 28 and thence to the tubes 14. The separated moisture will descend by gravity through the conical lower portions 17 and pipes 31 to the drum.

The apparatus is comparatively simple and inexpensive, and will remove substantially all impurities from the steam. The interior of the boiler drum is not unduly obstructed. The invention is adapted for use with boilers of various types.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Steam purifying apparatus comprising a hollow casing having a central outlet through which steam may escape upwardly through the upper wall of the casing, means providing an inlet passage connected to the casing tangentially through which steam may be delivered to the casing and caused to whirl therein about the outlet, means to discharge comparatively clean water across the path of the steam in the inlet passage, the lower wall of the inlet passage being shaped to discharge outwardly by gravity water which contacts therewith, and means providing a drain through which water may escape from the casing.

2. Steam purifying apparatus comprising a hollow casing having a central outlet through which steam may escape upwardly through the upper wall of the casing, means providing an inlet passage connected to the casing tangentially through which steam may be delivered to the casing and caused to whirl therein about the outlet, means to discharge comparatively clean water across the path of the steam in the inlet passage, the lower wall of the inlet passage sloping inwardly and upwardly whereby to discharge outwardly by gravity water which contacts therewith, and means providing a drain through which water may escape from the casing.

3. Steam purifying apparatus comprising a hollow casing having a central outlet through which steam may escape upwardly through the upper wall of the casing, means providing an inlet passage connected to the casing tangentially through which steam may be delivered to the casing and caused to whirl therein about the outlet, a nozzle located above the inlet passage and arranged to discharge comparatively clean water downwardly across the path of the entering steam to the lower wall of the inlet passage, the said lower wall sloping inwardly and upwardly whereby to discharge outwardly by gravity water which contacts therewith, and means providing a drain through which water may escape from the casing.

MAX H. KUHNER.