Aug. 11, 1936. M. H. KUHNER 2,050,615

STEAM BOILER

Filed Oct. 30, 1934 2 Sheets-Sheet 1

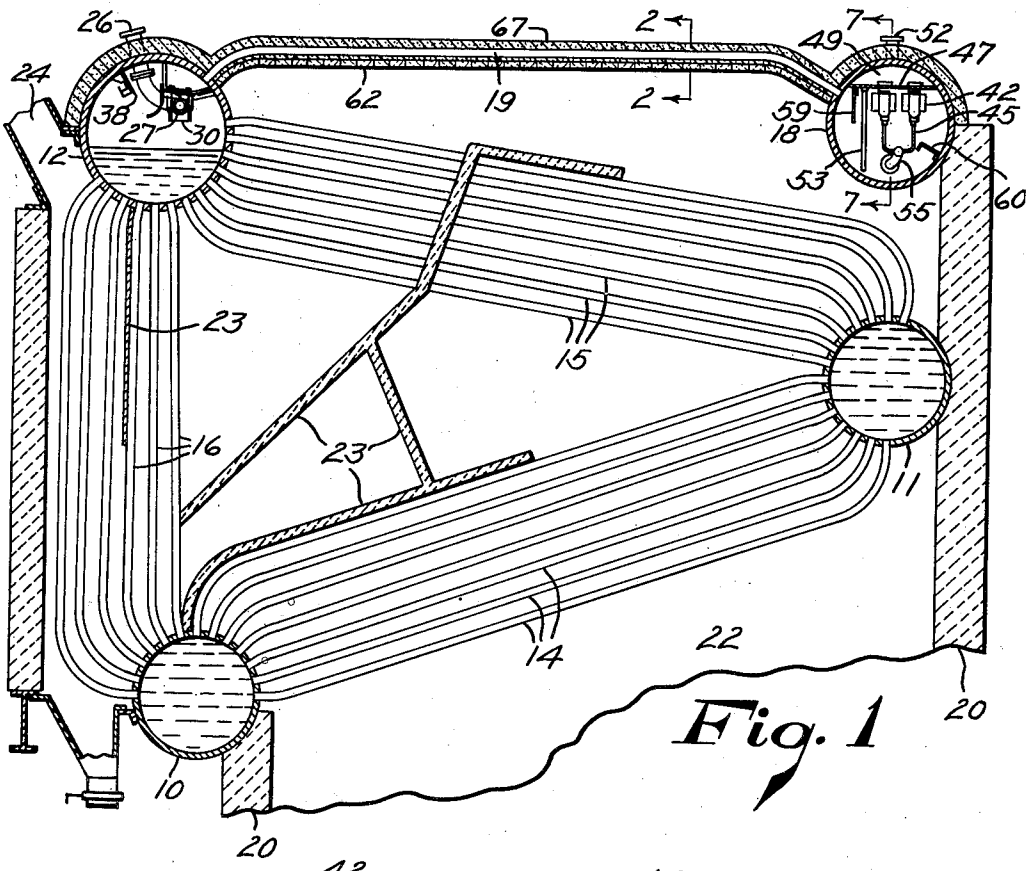


Fig. 1

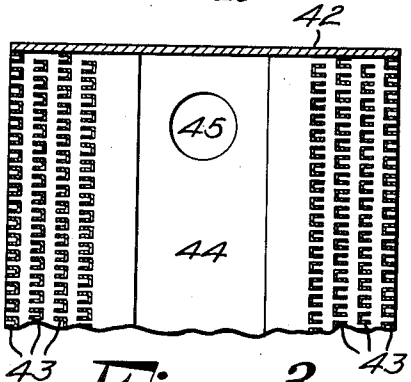


Fig. 3

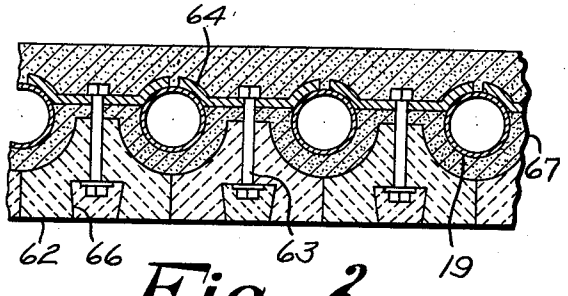


Fig. 2

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STEAM BOILER

Filed Oct. 30, 1934 2 Sheets-Sheet 2

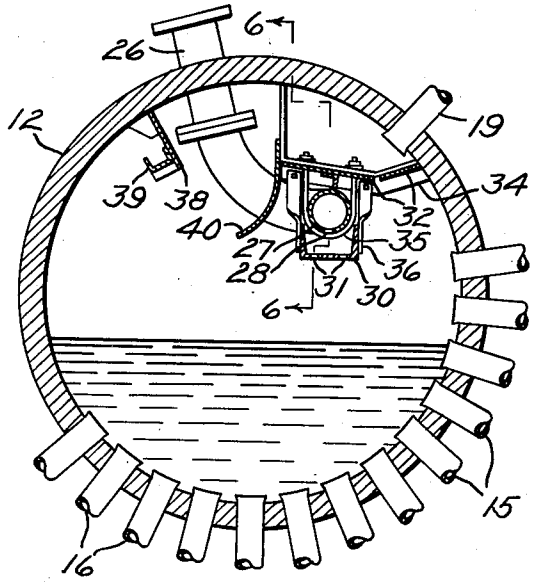


Fig. 4

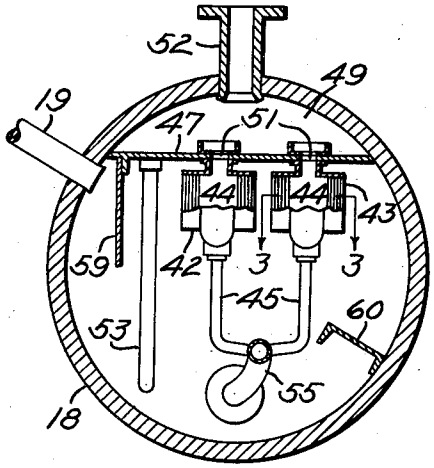


Fig. 5

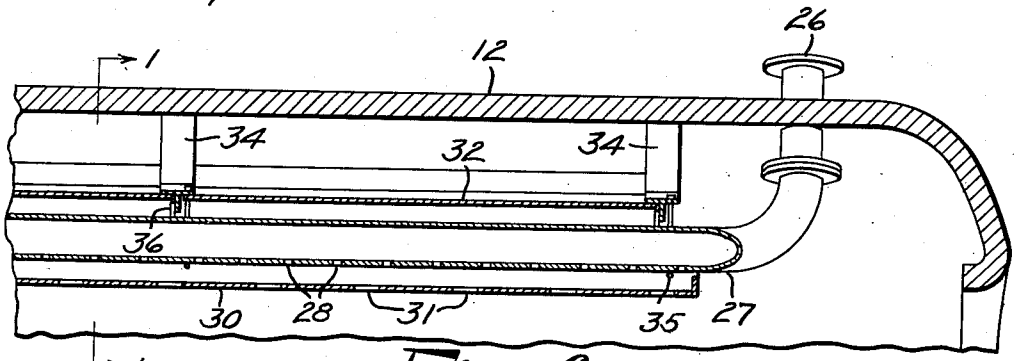


Fig. 6

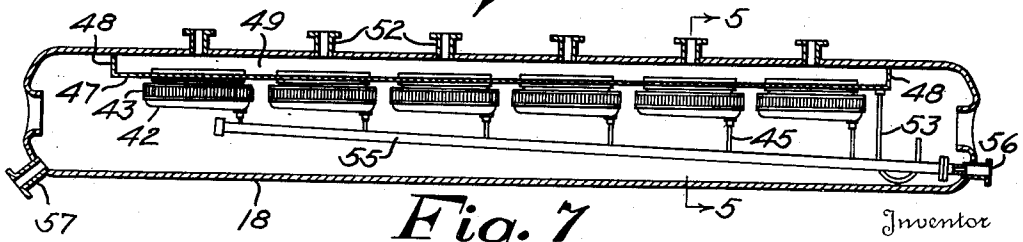


Fig. 7

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UNITED STATES PATENT OFFICE

2,050,615

STEAM BOILER

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Application October 30, 1934, Serial No. 750,685

12 Claims. (Cl. 122—302)

This invention relates to steam boilers, and more particularly to boilers of the type having transverse drums connected by banks of water tubes.

It has been recognized heretofore that the presence of foreign matter in steam is highly objectionable and causes great damage to valves in the steam pipes and particularly to turbine blades. Such foreign matter usually enters the boiler with the feed water, either in solution or in suspension, and a portion thereof escapes from the boiler with the steam. Various constructions have been proposed in the past for purifying the steam, but these prior constructions have in general been bulky, expensive, and ineffective for the purpose intended.

It is accordingly one object of the present invention to provide a steam boiler which will deliver steam comparatively free from foreign matter.

It is a further object of the invention to provide a comparatively simple and inexpensive steam boiler which will deliver substantially pure steam and which will occupy a space small in proportion to its steam-generating capacity.

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.

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

Fig. 1 is a vertical longitudinal section through a steam boiler and furnace, the section being taken on the line 1—1 of Fig. 6;

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

Fig. 3 is an enlarged section on the line 3—3 of Fig. 5;

Fig. 4 is an enlarged view of the steam-and-water drum as shown in Fig. 1;

Fig. 5 is an enlarged section on the line 5—5 of Fig. 7;

Fig. 6 is a section on the line 6—6 of Fig. 4; and

Fig. 7 is a section on the line 7—7 of Fig. 1.

The embodiment illustrated comprises a rear lower water drum 10, a front upper water drum 11, and a steam-and-water drum 12 located above the drum 10. These drums are arranged with their axes parallel and horizontal. The drum 10 is connected to the drum 11 by a bank of upwardly and forwardly sloping water tubes 14, and the drum 11 is connected to the drum 12 by a bank of upwardly and rearwardly sloping water tubes 15. The drums 10 and 12 are connected by a bank of substantially vertical water tubes 16. A steam drum 18 is mounted above the front water drum 11, and the drums 12 and 18 are connected by a row of steam tubes 19 which form a support for the boiler roof. Walls 20 are arranged to provide a furnace chamber 22 beneath the lower tube bank 14, and baffles 23 direct hot gases from the furnace successively across the tube banks 14, 15 and 16 to a gas outlet 24.

It will be apparent that all of the steam generated in the various water tubes will be liberated in the steam-and-water drum 12, whence it will flow through the tubes 19 to the steam drum 18. It will also be clear that a certain amount of entrained moisture will enter the tubes 19 with the steam. The water in the boiler is more highly concentrated than the feed water, that is, the boiler water contains a higher percentage of foreign matter, and it is therefore desirable that such moisture as does escape with the steam shall be obtained from the feed water rather than from the boiler water. I therefore provide means for bringing the steam into direct contact with the feed water within the drum.

For this purpose, the feed water is delivered to a nozzle 26 which connects with a distributing pipe 27 extending longitudinally within the drum 12 and located some distance above the water level. The pipe 27 is provided with a row of openings 28 (Fig. 6) in its lower wall which discharge the feed water into a trough or channel 30 directly therebeneath. The bottom wall of this channel is provided with two rows of openings 31, preferably in staggered arrangement, through which the feed water is discharged downwardly into the main body of water in the drum. Baffle plates 32 extend rearwardly from the front wall of the drum beneath the tubes 19 so that the steam entering the drum from the tubes 15 will be directed rearwardly beneath the feed pipe 27 and in contact with the jets of water flowing from the openings 31. The plates 32 are secured to supporting members 34 formed from T bars and welded at their ends to the wall of the drum. The feed pipe 27 is supported by U-shaped hangers 35 attached to the members 34, and the channel 30 is supported from the members 34 by means of straps 36.

After passing through the jets of feed water, the steam flows upwardly in the rear portion of

the drum and then forwardly to the tubes 19. In order to prevent excessive carry-over of moisture by the steam, a plate 38 is welded to the upper rear wall of the drum and extends inwardly toward the center of the drum. A trough or channel 39 is fastened to the rear wall of the plate 38 to serve as a collecting means for the excess moisture, and this trough slopes longitudinally so that the collected water will be drained therefrom automatically. A downwardly and rearwardly curved plate 40 is fastened to the members 34 in the rear of the feed pipe to deflect the steam and aid in the separation of moisture therefrom.

The final purification of the steam is effected in the steam drum 18, and for this purpose I utilize baffle plates located in the path of the steam to collect any moisture and foreign matter carried thereby. In the preferred construction illustrated I have utilized steam purifiers 42 of the type well-known in the art under the name of "Tracyfiers." Each of these steam purifiers comprises two spaced groups of vertically extending baffle plates 43, each plate being shaped as a channel or gutter with its concave face directed toward the oncoming steam. The baffle plates of each group are arranged in a plurality of rows, the plates in each row being staggered with respect to the plates in the adjacent rows. The steam enters the purifier from opposite sides, and after passing the baffle plates it reaches the central chamber 44, from which it escapes upwardly. The moisture and foreign matter flows downwardly along the baffle plates under the influence of gravity, and collects at the bottom of the chamber 44, from which it is withdrawn through a drain pipe 45.

In order to support the steam purifiers 42, I provide a horizontal partition plate 47 which is welded at each side to the inner surface of the drum 18 and located slightly above the discharge ends of the steam delivery tubes 19. The ends of the plate are connected to the upper wall of the drum by means of segmental plates 48 (Fig. 7) so that a chamber 49 is provided. The steam purifiers are fastened to the lower surface of the partition plate 47, and this plate is provided with openings 51 (Fig. 5) which communicate with the central chambers 44 of the purifiers. Steam is delivered from the chamber 49 through nozzles 52. A pipe-loop 53 connects with the chamber 49 to drain the same automatically after the usual hydrostatic test. The drain pipes 45 from the steam purifiers are connected to a collecting pipe 55 leading to a discharge nozzle 56 (Fig. 7). This nozzle may be piped to a steam trap (not shown) in a well-known manner. Any water collecting in the drum 18 may be withdrawn through a nozzle 57.

Baffles are preferably provided to distribute the steam properly in the drum 18 before it enters the steam purifiers. For this purpose I have shown a plate 59 depending from the partition 47 in front of the tubes, and a channel member 60 fastened to the inner surface of the drum at the lower front portion thereof. The plate 59 serves to deflect the entering steam downwardly, and the channel 60 breaks up the steam flow close to the drum wall and directs it toward the center of the drum.

The baffle plates 43 depend upon the presence of moisture in the steam to render them effective in separating foreign matter from the steam. This is believed to be due to the formation of a downwardly flowing water film on the baffles, and the adherence of solid particles to this film. Of course any soluble matter present will be retained in solution in the water. In order to ensure the presence of moisture in the steam entering the drum 18, I provide means to protect the tubes 19 from contact with the hot gases. For this purpose I have shown tiles 62 of a suitable refractory material, such as firebrick, suspended by means of bolts 63 from metal bars 64 which rest on the upper surfaces of the tubes 19, as shown in Fig. 2. The lower ends of the bolts are positioned in dovetail-shaped recesses 66 in the lower surfaces of the tiles, and these recesses may be filled with plastic fireclay to protect the bolts from the heat. The tiles 62 are preferably spaced slightly from the tubes 19, and this space is filled with heat insulating material 67 applied in plastic form, a mixture of expanded mica and asbestos fiber being suitable for this purpose. The heat insulation is preferably applied above the tubes also, in order to reduce the loss of heat by radiation.

The operation of the invention will now be apparent from the above disclosure. Hot gases from the furnace chamber 22 flow in contact with the water tubes, producing a circulation of water upwardly in the tubes 14 and 15, and downwardly in the tubes 16. Steam is generated in the tubes 14 and 15, and this steam is liberated in the front portion of the drum 12 and flows rearwardly beneath the channel 30. The feed water is delivered to the channel by the pipe 27 and escapes through the openings 31 in the form of jets directed downwardly through the steam. These jets wash the concentrated boiler water from the steam and ensure the entrainment of moisture derived from the feed water rather than from the boiler water. Excess moisture is removed by the baffles 40 and 38, and the wet steam enters the tubes 19 and flows to the drum 18. The tiles 62 and the insulation 67 prevent contact of the hot gases with the tubes 19 and reduce the heat transfer to these tubes sufficiently to avoid complete evaporation of the moisture in the steam. The steam therefore enters the drum 18 in a wet condition, and as it flows through the "Tracyfiers" 42 the baffles 43 collect substantially all of the moisture and foreign matter from the steam. The clean steam escapes through the nozzles 52 and may thereafter be superheated if desired, while the water and impurities are withdrawn through the pipe 55 and nozzle 56.

From the above description, it will be apparent that this invention provides a simple, inexpensive and compact steam generator which will deliver substantially pure steam. If a slight amount of moisture does pass the "Tracyfiers", it will be derived from comparatively pure feed water rather than from the highly concentrated boiler water. There is no danger of flooding the "Tracyfiers", since the drum 18 is free from water.

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

1. A steam boiler comprising a steam-and-water drum, a second drum, a row of tubes to deliver steam from the steam-and-water drum to the second drum and arranged to form a support for the roof of the boiler, a group of baffle plates in the path of the steam in the second drum to remove impurities from the steam, and means to remove such impurities from the boiler without mingling the same with the boiler water.

2. A steam boiler comprising a steam-and-water drum, a steam drum, a row of tubes to deliver steam from the steam-and-water drum to the steam drum and arranged to form a support for the roof of the boiler, a group of baffle plates in the path of the steam in the steam drum to remove impurities from the steam, and means to remove such impurities from the boiler without mingling the same with the boiler water.

3. A steam boiler comprising a steam-and-water drum, a second drum, a row of tubes to deliver steam from the steam-and-water drum to the second drum and arranged to form a support for the roof of the boiler, means to protect the tubes from contact with hot gases, a group of baffle plates in the path of the steam in the second drum to remove entrained moisture and foreign matter from the steam, and means to remove such moisture and foreign matter from the boiler without mingling the same with the boiler water.

4. A steam boiler comprising a steam-and-water drum, a steam drum, means to deliver steam from the steam-and-water drum to the steam drum, means to deliver feed water to the steam-and-water drum and effect a direct contact between the steam and the feed water, a group of baffle plates in the path of the steam in the steam drum to remove entrained moisture and foreign matter from the steam, and means to remove such moisture and foreign matter from the boiler without mingling the same with the boiler water.

5. A steam boiler comprising a steam-and-water drum, a steam drum, a conduit to deliver steam from the steam-and-water drum to the steam drum, said conduit being out of contact with hot gases, means to deliver feed water to the steam-and-water drum and effect a direct contact between the steam and the feed water, and a group of baffle plates in the path of the steam in the steam drum to remove entrained moisture and foreign matter from the steam.

6. A steam boiler comprising a steam-and-water drum, a second drum, a row of tubes to deliver steam from the steam-and-water drum to the second drum and arranged to form a support for the roof of the boiler, means to deliver feed water to the steam-and-water drum and effect a direct contact between the steam and the feed water, and a group of baffle plates in the path of the steam in the second drum to remove entrained moisture and foreign matter from the steam.

7. A steam boiler comprising a steam-and-water drum, a second drum, a row of tubes to deliver steam from the steam-and-water drum to the second drum and arranged to form a support for the roof of the boiler, means to protect the tubes from contact with hot gases, means to deliver feed water to the steam-and-water drum and effect a direct contact between the steam and the feed water, and a group of baffle plates in the path of the steam in the second drum to remove entrained moisture and foreign matter from the steam.

8. A steam boiler comprising a rear lower water drum, a front upper water drum, a steam-and-water drum located above the rear lower water drum, water tubes connecting the drums to form a circulatory system, a steam drum located above the front upper water drum, steam delivery tubes connecting the steam-and-water drum with the steam drum and arranged to form a support for the roof of the boiler, a group of baffle plates in the path of the steam in the steam drum to remove entrained moisture and foreign matter from the steam, and means to remove such moisture and foreign matter from the boiler without mingling the same with the boiler water.

9. A steam boiler comprising a rear lower water drum, a front upper water drum, a steam-and-water drum above the rear lower water drum, water tubes connecting the drums to form a circulatory system, a steam drum located above the front upper water drum, steam delivery tubes connecting the steam-and-water drum with the steam drum and arranged to form a support for the roof of the boiler, means to protect the steam delivery tubes from contact with hot gases, a group of baffle plates in the path of the steam in the steam drum to remove entrained moisture and foreign matter from the steam, and means to remove such entrained moisture and foreign matter from the boiler without mingling the same with the boiler water.

10. A steam boiler comprising a steam-and-water drum, a second drum, a row of tubes to deliver steam from the steam-and-water drum to the second drum, tiles supported by the tubes and spaced therefrom, heat insulating material between the tubes and the tiles, and a group of baffle plates in the path of the steam in the second drum to remove entrained moisture and foreign matter from the steam.

11. A steam boiler comprising a rear lower water drum, a front upper water drum, a steam-and-water drum above the rear lower water drum, water tubes connecting the drums to form a circulatory system, a steam drum located above the front upper water drum, steam delivery tubes connecting the steam-and-water drum with the steam drum, tiles supported by the steam delivery tubes and spaced therefrom, heat insulating material between the steam delivery tubes and the tiles, and a group of baffle plates in the path of the steam in the steam drum to remove entrained moisture and foreign matter from the steam.

12. A steam boiler comprising a rear lower water drum, a front upper water drum, a steam-and-water drum above the rear lower water drum, water tubes connecting the drums to form a circulatory system, a steam drum located above the front upper water drum, steam delivery tubes connecting the steam-and-water drum with the steam drum and arranged to form a support for the roof of the boiler, means to protect the steam delivery tubes from contact with hot gases, means to deliver feed water to the steam-and-water drum and into direct contact with the steam before it enters the steam delivery tubes, and a group of baffle plates in the path of the steam in the steam drum to remove entrained moisture and foreign matter from the steam.

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