June 22, 1943. G. A. REHM 2,322,390

STEAM GENERATOR

Filed June 18, 1941 3 Sheets-Sheet 1

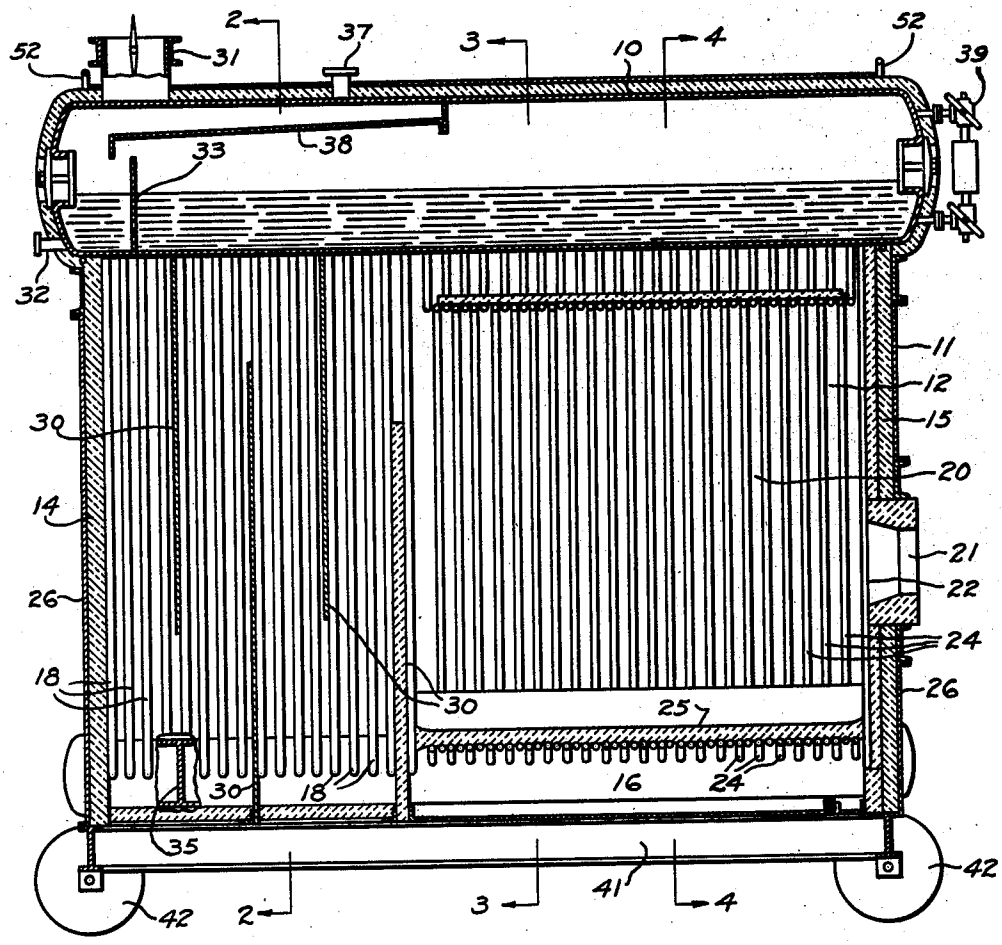


Fig. 1

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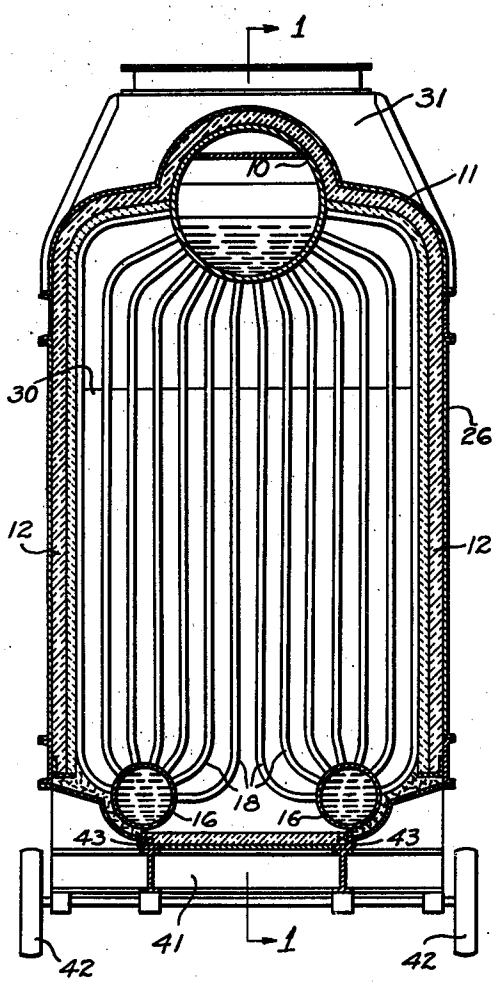


Fig. 2.

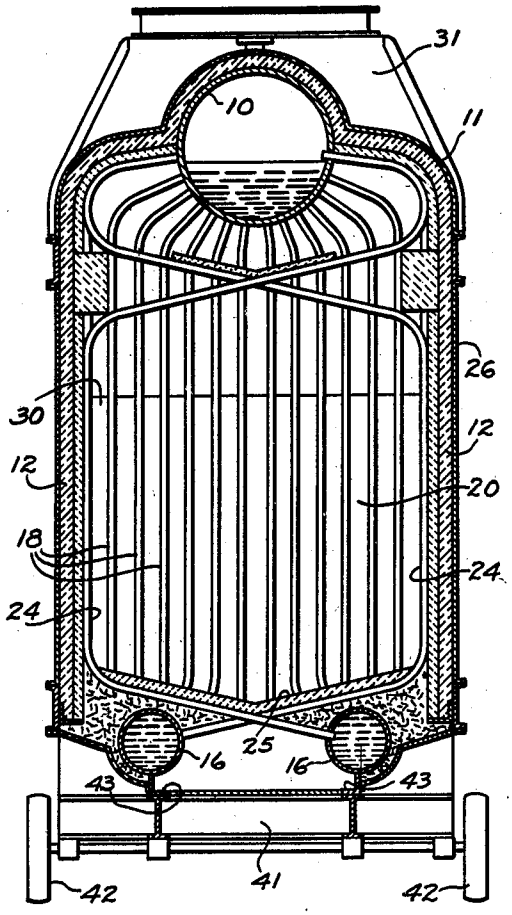


Fig. 3.

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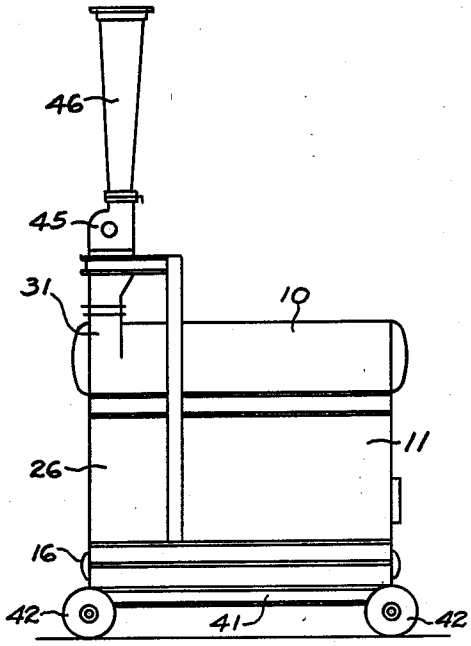


Fig. 5

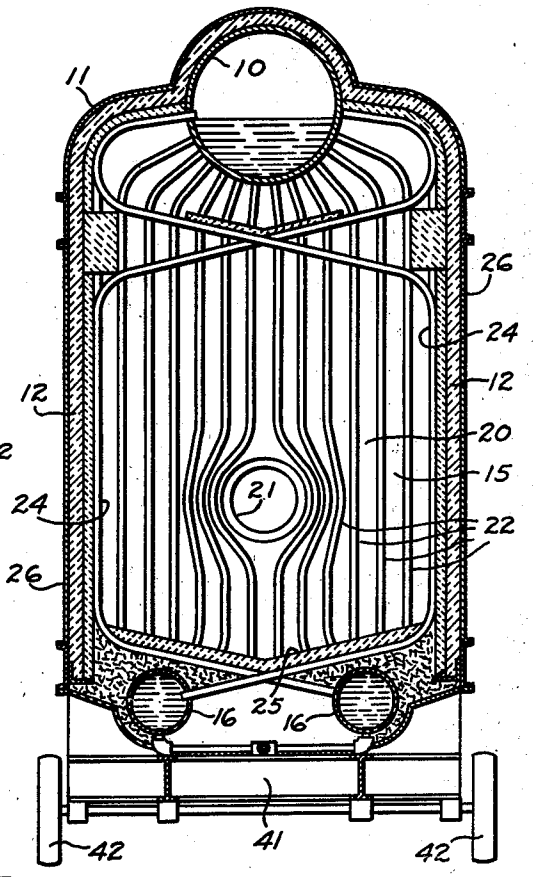


Fig. 4

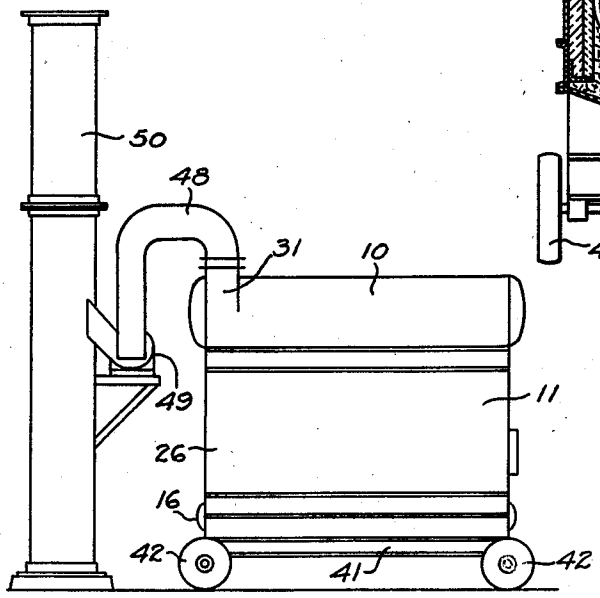


Fig. 6

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UNITED STATES PATENT OFFICE

2,322,390

STEAM GENERATOR

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Application June 18, 1941, Serial No. 398,651

2 Claims. (Cl. 122—347)

This invention relates to steam generators, and more particularly to water tube steam generators adapted to be fired with fluent fluids such as, for example, oil or gas.

There is a demand in the oil fields for an efficient steam generator of appreciable capacity which can be readily moved from place to place. Most water tube steam generators as heretofore constructed require one or more walls of self-supporting brickwork, and this fact renders them useless for service of this nature, since these walls are not only very heavy but they are also incapable of withstanding the jolts and vibrations incident to movement of the apparatus. A similar problem is presented in boilers for marine service, where the pitching and rolling of the ship render brick walls highly undesirable.

It is accordingly one object of the invention to provide a water tube steam generator of appreciable capacity and so constructed and arranged that self-supporting brickwork will not be required.

It is a further object of the invention to provide a water tube steam generator which is particularly suited for use as a portable apparatus in the oil fields or as a marine boiler.

It is a further object of the invention to provide a water tube steam generator which will operate efficiently at relatively high capacities and deliver steam comparatively free from moisture.

It is a further object of the invention to provide an efficient water tube steam generator of appreciable capacity which can be completely assembled in the shop.

It is a further object of the invention to provide a water tube steam generator in which a rapid circulation of water will be maintained through all the steam generating tubes without the need for special water supply conduits.

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 longitudinal section through a portable water tube steam generator, the section being 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 a section on the line 3—3 of Fig. 1;

Fig. 4 is a section on the line 4—4 of Fig. 1;

Fig. 5 is a side elevation showing one means for producing draft for operation of the apparatus; and

Fig. 6 is a view similar to Fig. 5 but showing a modification.

The embodiment illustrated comprises a longitudinal steam-and-water drum 10 mounted centrally in the upper portion of a rectangular setting 11, the latter having two side walls 12, a rear wall 14 and a front wall 15. The drum 10 extends throughout the entire length of the setting. Two laterally spaced water drums or headers 16 are mounted in the lower portion of the setting, these drums being parallel with the drum 10 and of substantially the same length. In the rear portion of the setting the drums 16 are joined to the drum 10 thereabove by means of upright water tubes 18 which form a convection tube bank. Although the lower drums 16 are comparatively small in diameter, they are spaced inwardly from the side walls 12 so that water tubes can be connected to each drum throughout the upper half of its circumferential surface. Thus a considerable number of the tubes 18 may be provided to ensure an adequate heating surface. In the particular embodiment illustrated there are fourteen of these tubes in each transverse row. The drums 16 are preferably spaced apart a distance approximately equal to one-half the width of the setting.

The front portion of the setting 11 encloses a combustion chamber 20 into which a suitable fluid fuel is introduced through a burner opening 21 in the front wall 15. The rear or inner face of this wall 15 is cooled and protected by a row of upright water tubes 22 which extend upwardly from the lower drums 16 to the upper drum 10. Certain of these tubes 22 are bent laterally, as shown in Fig. 4, to avoid interference with the burner opening 21. Except for this lateral bending, the tubes 22 are preferably of the same shape as the convection water tubes 18.

The side walls 12 are likewise cooled and protected. For this purpose a row of water tubes 24 extends from each water drum 16 upwardly along the inner surface of one side wall and thence to the upper drum 10. Preferably the lower portions of the two tube rows cross beneath the combustion chamber 20 and are covered with refractory material 25 to form a water cooled floor. The upper portions of these tube rows likewise cross above the combustion chamber and beneath the upper drum, their upper ends entering this drum from opposite sides and above the normal water level.

It will now be apparent that each wall of the setting 11 is cooled and supported against inward movement by a row of water tubes. The front wall 15 rests against the water tubes 22, and the rear wall 14 rests against the rearmost row of water tubes 18. The front portions of the side walls 12 are supported by the water tubes 24, and the rear portions of these walls are supported by the outermost rows of water tubes

18. In order to hold these several walls inwardly against the water tubes and at the same time minimize the infiltration of air, the entire setting is enclosed in a sheet metal casing 26. Each wall is preferably formed with an inner layer of refractory tile and an outer layer of a suitable heat insulating material, the weight and thickness being far less than would be required for a wall of self-supporting brickwork.

Referring now to Fig. 1, it will be seen that the gaseous products of combustion flow rearwardly from the combustion chamber 20 into the convection tube bank 18, where these gases are deflected into a tortuous path by means of upright transverse baffles 30 located among the rows of tubes. In the particular embodiment illustrated, there are four baffles and four gas passes, the rearmost or final pass leading upwardly to a gas outlet duct 31. Preferably, the four rows of tubes in this final gas pass constitute an economizer to preheat the feed water. For this purpose the feed water is introduced through a nozzle 32 into the rear end of the drum 10, and a plate 33 extends across this drum immediately in front of the second row of tubes 18 (counting from the rear), the top of this plate extending somewhat above the normal water line. In addition, each of the lower drums 16 is provided internally with a transverse plate 35 in transverse alignment with the rearmost of the baffles 30. Thus the feed water is forced to descend through the two rearmost rows of tubes 18 to the drums 16, and then to ascend through the remaining tubes in the last gas pass before returning to the upper drum and mingling with the main body of boiler water therein. A steam outlet nozzle 37 is provided at the top of the drum 10, and a baffle plate 38 is mounted beneath the nozzle to prevent moisture particles from reaching the same. The usual water column 39 is mounted on the front end of the upper drum.

The steam generator as so far described is particularly suitable for use in the oil fields, and in this service it must occasionally be moved from place to place. In order to facilitate such movements, the entire structure is mounted on a frame or chassis 41 having four wheels 42 adapted to rest upon the ground. The lower drums 16 may be welded to angles 43 (Figs. 2 and 3) extending longitudinally beneath the drums and bolted to the top of the frame. With this construction the steam generator can readily be drawn from one location to another by a tractor or other suitable apparatus. As shown in Fig. 5, an induced draft fan 45 and stack 46 may be mounted directly above the gas outlet duct 31 to form a permanent part of the steam generator. In the modified arrangement shown in Fig. 6, the gas outlet duct is connected by a breeching 48 to an induced draft fan 49 mounted on a fixed stack 50. With this construction the breeching will be disconnected from the duct 31 before the steam generator is moved. To further facilitate the handling of the apparatus hanger loops 52 may be provided around the ends of the upper drum 10, as shown in Fig. 1, so that the entire steam generator may be suspended from an overhead crane when required for loading or unloading purposes.

The operation of the invention will now be apparent from the above disclosure. Fuel and air will be delivered through the opening 21 by a suitable burner, and combustion will take place in the chamber 20. The hot gases will flow rearwardly among the convection water tubes 18, with the baffles 30 deflecting these gases into a tortuous path before they reach the outlet duct 31. The feed water will enter the drum 10 through the nozzle 32, and then flow through the tubes 18 in the fourth or rearmost gas pass before mingling with the main body of boiler water, so that these tubes will serve as an economizer to preheat the feed water and to reduce the gas temperature further than would otherwise be possible. The tubes 18 in the third gas pass will serve as downcomers to supply water from the drum 10 to the two lower drums 16. The remaining tubes will all serve as steam generating tubes delivering steam directly to the upper drum. A very large part of the total steam will be generated in the side water wall tubes 24, and since these tubes enter the upper drum high up on the sides thereof and above the normal water line there will be a minimum of commotion in the drum and very little tendency toward priming even at high loads.

The apparatus is particularly adapted for complete shop assembly, and for use as a portable unit or in marine service. No self-supporting brickwork is required, all the walls being supported by water tubes adjacent their inner surfaces and the steel casing 26 adjacent their outer surfaces. The water circulation is rapid and positive, and no special circulating tubes or headers are required. The structure is simple and compact, and so shaped as to minimize the cost of the casing. The tubes 24 shield the upper drum from the hot gases, and this drum can therefore be safely made with relatively thick walls suitable for high steam pressures.

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

1. A steam generator comprising a setting having two side walls, a front wall, and a rear wall, a steam-and-water drum located in the upper portion of the setting and extending substantially the entire length thereof, two water drums located in the lower portion of the setting and extending substantially the entire length thereof, the water drums being spaced inwardly from the side walls, water tubes extending upwardly from the rear portions of the water drums to the upper drum to form a convection tube bank, and water wall tubes extending upwardly from the front portions of the water drums and along the side walls, the water wall tubes crossing beneath the upper drum and entering the same from opposite sides above the normal water line.

2. A steam generator comprising a setting having two side walls, a front wall, and a rear wall, a steam-and-water drum located in the upper portion of the setting and extending substantially the entire length thereof, two water drums located in the lower portion of the setting and extending substantially the entire length thereof, the water drums being spaced inwardly from the side walls, water tubes extending upwardly from the rear portions of the water drums to the upper drum to form a convection tube bank, and a row of water wall tubes extending laterally from the front portion of each water drum and above the other water drum, the water wall tubes then extending upwardly along the side walls, the two rows of water wall tubes then crossing beneath the upper drum and entering the same from opposite sides above the normal water line.

GUSTAV A. REHM.