

May 1, 1945.

J. H. JACOBS

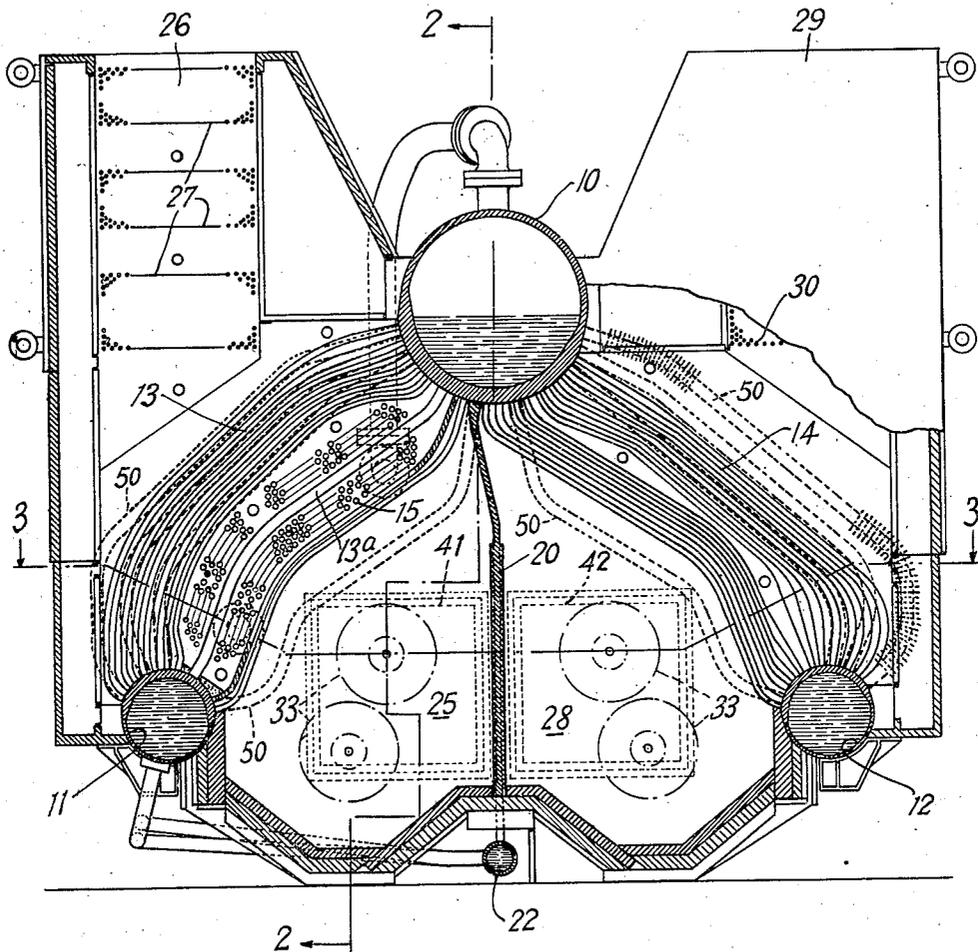
2,374,818

STEAM GENERATOR

Filed Oct. 3, 1941

3 Sheets-Sheet 1

Fig. 1



INVENTOR.
John H. Jacobs
BY *Joseph Moran*
Attorney

May 1, 1945.

J. H. JACOBS

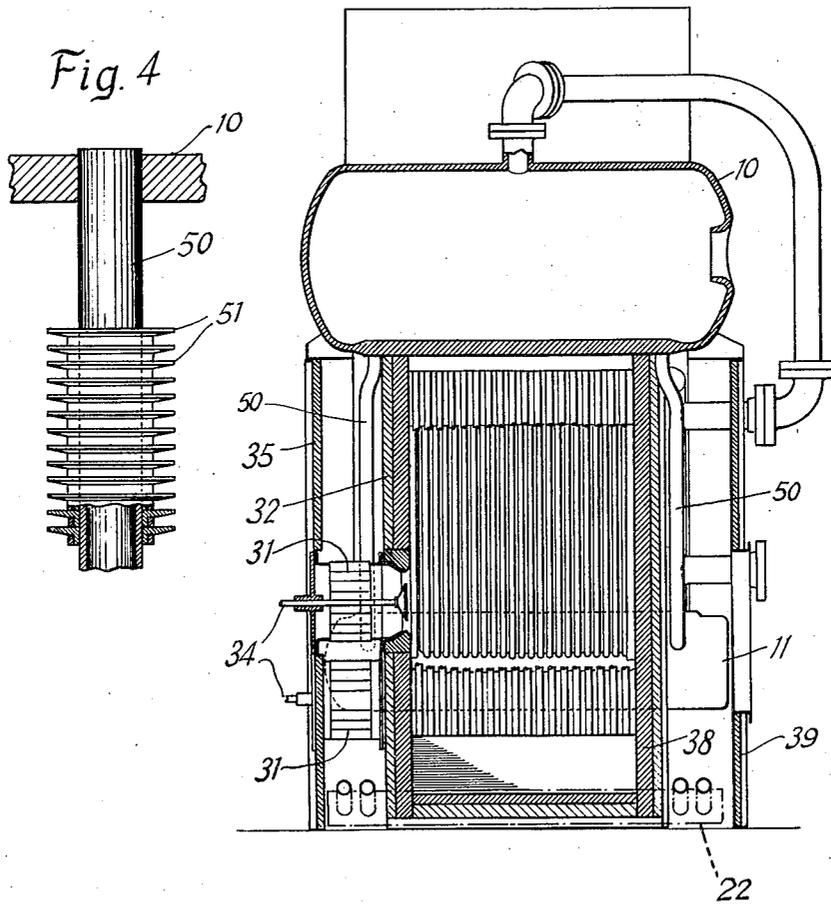
2,374,818

STEAM GENERATOR

Filed Oct. 3, 1941

3 Sheets-Sheet 2

Fig. 2



INVENTOR.
John H. Jacobs
BY *Joseph P. Moran*
Attorney

May 1, 1945.

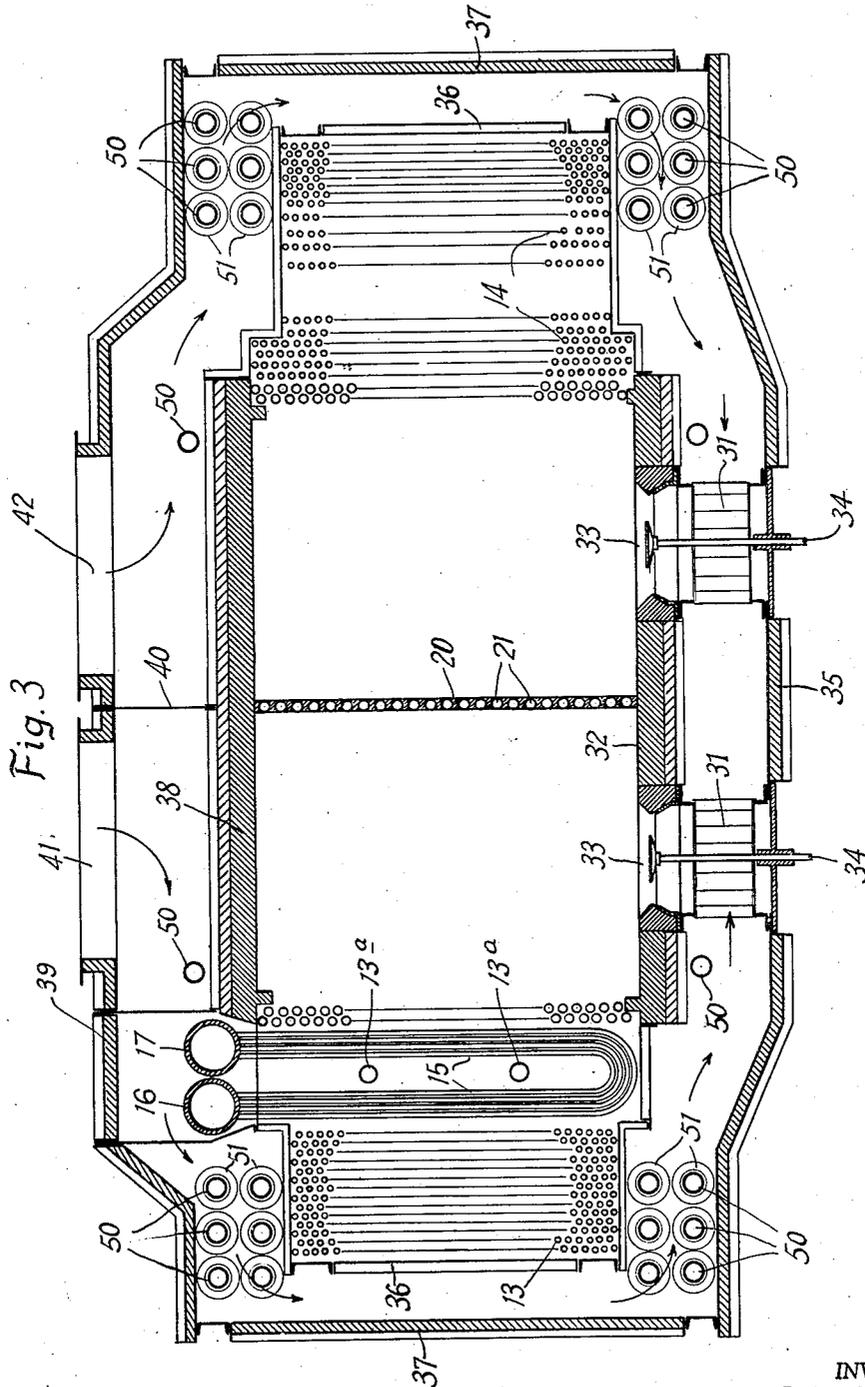
J. H. JACOBS

2,374,818

STEAM GENERATOR

Filed Oct. 3, 1941

3 Sheets-Sheet 3



INVENTOR.
John H. Jacobs
BY *Joseph P. Moran*
Attorney

UNITED STATES PATENT OFFICE

2,374,818

STEAM GENERATOR

John H. Jacobs, Fanwood, N. J., assignor to The Babcock & Wilcox Company, Newark, N. J., a corporation of New Jersey

Application October 3, 1941, Serial No. 413,436

2 Claims. (Cl. 122-406)

My present invention relates to the construction of water tube steam boilers of the natural circulation type having two or more vertically spaced drums or headers connected by downcomer or downflow water pipes for supplying water to a bank of steam generating tubes connecting said drums or headers, and more particularly, to boilers of the type described wherein the boiler casing is double walled and the air used for combustion purposes is preheated while passing through a section of the double walled casing.

The main object of my invention is the provision of an improved construction and location of the downcomer or water supply pipes in a steam boiler of the character described, whereby the boiler fluid circulation is improved and a higher combustion air temperature attained, while increasing the boiler overall efficiency and reducing the cost of construction of the boiler.

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 a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is a sectional elevation of a three-drum marine boiler of the character described and embodying my invention;

Fig. 2 is a vertical longitudinal section taken on the line 2-2 of Fig. 1;

Fig. 3 is an enlarged plan section taken on the line 3-3 of Fig. 1; and

Fig. 4 is a detail showing the arrangement of the fins on one of the downcomer pipes.

While my invention is adapted for use in various types of natural circulation steam boilers in which downcomers or water supply pipes at one or both ends of the steam generating banks are employed to return water from a steam and water drum to a lower drum or header, the invention is particularly applicable to water tube boilers adapted for use in marine installations. The steam boiler illustrated in the drawings is a three-drum divided furnace high pressure boiler of the general type illustrated in U. S. Patent 2,101,106, and comprises an upper steam and water drum 10 and spaced lower water drums 11 and 12, connected to the lower portion of the drum 10 by inclined banks of curved steam

generating tubes 13 and 14 respectively. Some of the tubes in the bank 13 are omitted to permit the installation of a group of horizontally extending U-shaped superheater tubes 15 connected to vertically inclined headers 16 and 17 and supported by spaced water tubes 13^a of the bank. The furnace is arranged between the tube banks 13 and 14 divided into laterally adjoining sections by a closed vertical partition 20 including a row of vertical water tubes 21 connecting the drum 10 to a horizontally arranged lower header 22 below the furnace. The tubes 21 are studded to support the refractory material closing the intertube spaces. The furnace section 25 between the water tube bank 13 and partition 20 is the superheater furnace, and the heating gases therefrom pass across the superheater tubes 15 and steam generating tubes 13 to an outlet flue 26 containing an economizer 27. The furnace section 28 between the tube bank 14 and partition 20 is the saturated furnace and the gases therefrom pass across the steam generating tubes 14 to an outlet flue 29 containing an economizer 30.

Boilers of this type normally have a double front, i. e., a double-walled construction for the front or burner side of the boiler casing. The inner front wall 32 is provided with burner ports 33 in which suitable fluid fuel burners 34 are horizontally arranged to discharge fuel into the furnace sections 25 and 28. The air required for combustion passes through the space between the inner front wall 32 and the outer front wall 35, and the air supply to each burner is controlled by a separate air register 31. With such an arrangement the boiler may be operated to produce either saturated steam only or superheated steam with a controllable range of superheat temperatures.

In the boiler illustrated, the front, rear and side walls of the casing have a double walled sectional construction consisting of the spaced front walls 32 and 35, inner and outer side walls 36 and 37, and inner and outer rear walls 38 and 39 respectively, with the spaces therebetween communicating throughout their height to provide a divided air flow path of low flow resistance. The side wall spaces are closed at their bottoms at the approximate level of the drums 11 and 12. The front and rear casing spaces are each divided by a central vertical partition 40 to prevent air flow between the saturated and superheated sides of the unit. The outer rear wall 39 is provided with relatively large rectangular air inlet openings 41 and 42 arranged at opposite sides of the

corresponding partition 40 and substantially opposite the burner openings at the front side of the unit. The air inlet openings 41 and 42 are connected to a suitable source of combustion air, such as separate forced draft fans (not shown). With this construction air enters the air inlets 41 and 42 and flows upwardly and outwardly through the rear section of the casing, and thence downwardly and inwardly through the front walls of the casing to the air registers 36 and burner ports 33, being preheated during its passage by radiation from and contact with the walls of the casing. Preheating the combustion air in this manner reduces the radiation losses of the unit and correspondingly increases its overall efficiency.

With the fluid heating surface of the boiler arranged for a single pass flow of heating gases thereover from the furnace to the outlet flue, substantially all of the tubes in the banks 13 and 14 will generate steam and have an upward fluid flow therein. To insure an adequate supply of water to the generating tube banks in boilers of this type, external downcomer or water supply pipes are normally provided at each end of each bank to connect the water space of the drum 10 to the drums 11 and 12, and the drum 11 to the header 22 to insure a water supply to the tubes 21. Such external supply pipes are usually insulated to reduce radiation losses and this location of the downcomers requires a corresponding increase in the length of the drums 10, 11 and 12. In some cases the downcomers have been arranged inside the inner walls of the casing and enclosed to avoid contact with the heating gases.

In accordance with my invention, the water space in the drum 10 is separately connected to the drums 11 and 12 by downcomer tubes 50 arranged in groups at opposite ends of the drums and having their entire length in the path of combustion air flow in the space between the double walls of the casing. As shown, seven downcomer tubes are arranged at each end of each tube bank. Most of the downcomer tubes are provided throughout substantially their entire length with extended surface in the form of annular metallic fins 51, preferably of copper or aluminum, suitably secured thereon in heat transfer relation. The relative arrangement of the air inlets, burner ports, and downcomer tube fins is such as to provide an air flow across the downcomer tubes substantially in the planes of the fins, thus providing an effective heat transfer relation and a relatively low pressure drop in the air flow path. An effective preheating of the combustion air supply is thus provided, which is particularly desirable for efficient combustion conditions when the boiler is operated at low ratings. The heat absorbed by the incoming air from the downcomer tubes and fins tends to condense any steam bubbles present in the down-flowing water in the downcomers, thereby increasing the density of the fluid therein and the

natural circulation effect. In this location no insulation is required for the downcomers and the boiler radiation losses are minimized. The downcomers are readily accessible for inspection and repairs by removing the corresponding section of the outer wall of the casing.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of the invention now known to me, 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.

I claim:

1. A natural circulation steam boiler comprising an upper steam and water drum, a lower water drum, a bank of steam generating tubes connecting said drums, a furnace adjacent one side of said tube bank, a fluid fuel burner at one end of said furnace arranged to discharge fuel into said furnace, a casing enclosing said furnace and tube bank and having spaced inner and outer side and end walls arranged to form a passage for combustion air to said fuel burner, an air inlet to said casing air space at the furnace end opposite said fuel burner, downcomer tubes connecting the water space of said steam and water drum to said lower drum and arranged in the path of combustion air flow between said casing walls, metallic heat transfer fins mounted on said downcomer tubes in planes transversely of the axes of said downcomer tubes, and said air inlet, fuel burner and downcomer tubes being relatively arranged to provide an air flow across said downcomer tubes substantially in the planes of said fins.
2. A natural circulation steam boiler comprising an upper steam and water drum, a lower water drum, an inclined bank of steam generating tubes connecting said drums, a furnace adjacent one side of said tube bank, a fluid fuel burner at one end of said furnace arranged to discharge fuel into said furnace, a casing enclosing said furnace and tube bank and having spaced inner and outer side and end walls arranged to form a passage for combustion air to said fuel burner, an air inlet to said casing air space at the other furnace end and substantially opposite said fuel burner, inclined downcomer tubes connecting the water space of said steam and water drum to said lower drum and arranged at opposite ends of said tube bank in the path of combustion air flow between said casing walls, metallic heat transfer fins mounted on said downcomer tubes in planes transversely of the axes of said downcomer tubes, and said air inlet, fuel burner and downcomer tubes being relatively arranged to provide an air flow across said downcomer tubes substantially in the planes of said fins.

JOHN H. JACOBS.