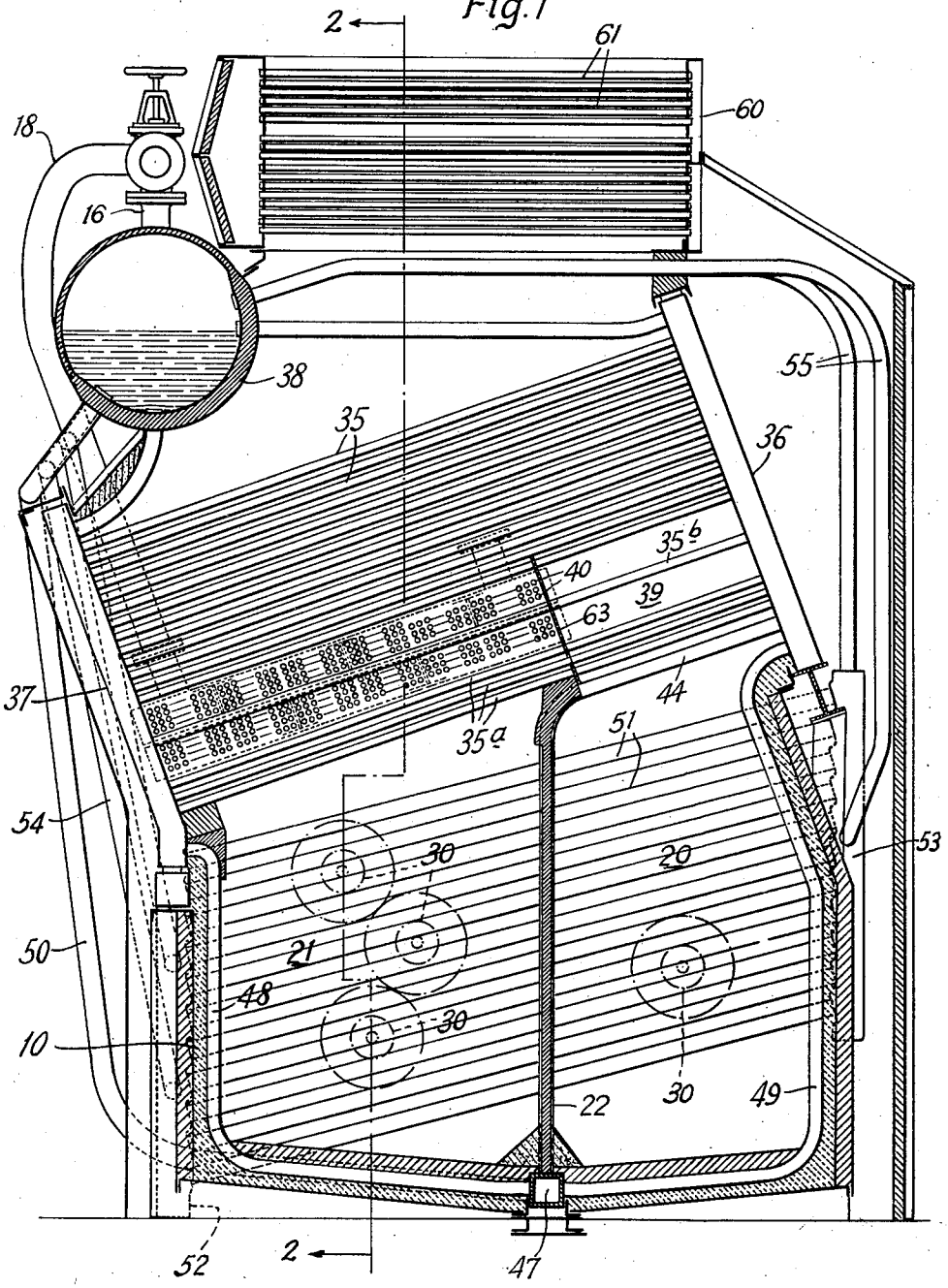
March 13, 1945. G. H. DANIELS 2,371,226

STEAM GENERATOR

Filed Oct. 24, 1941 4 Sheets-Sheet 1

Fig. 1



INVENTOR.
George H. Daniels

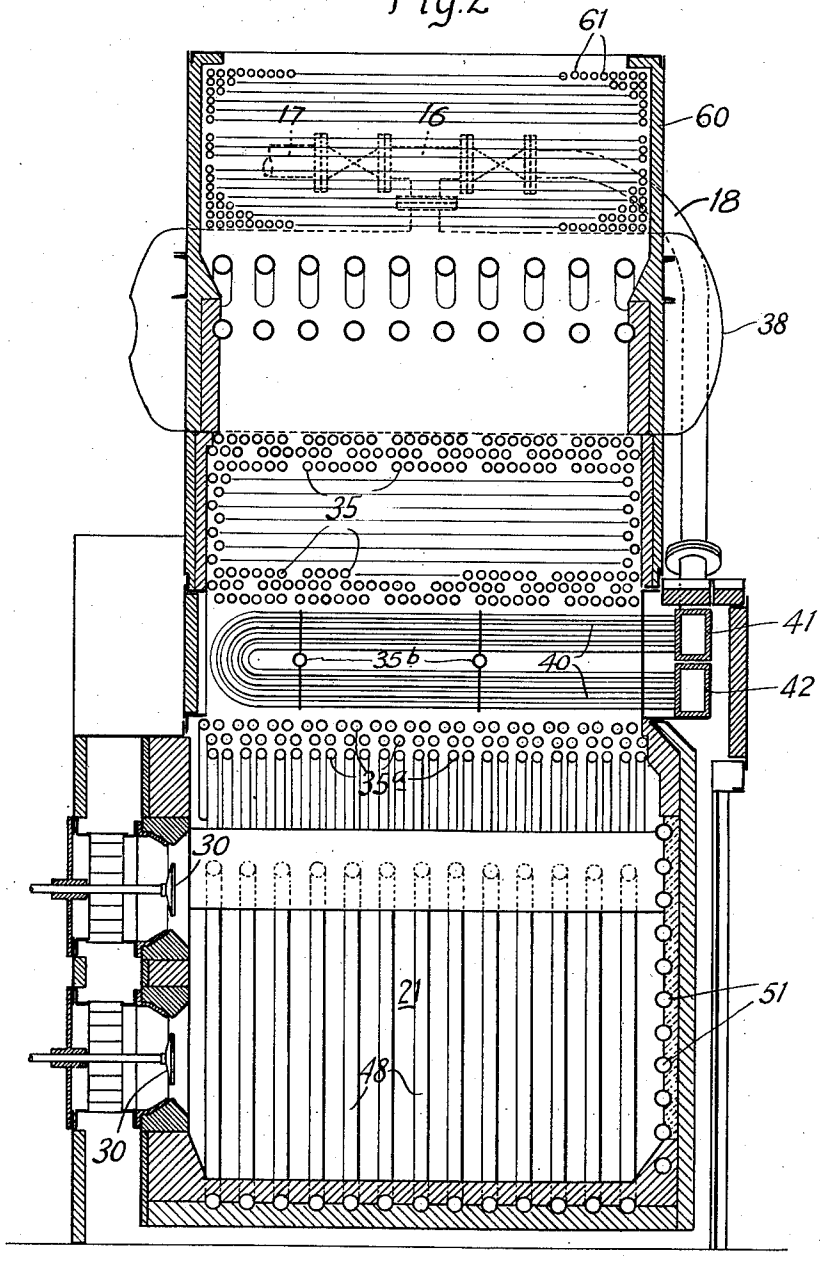
BY Joseph P. Moran
Attorney

March 13, 1945. G. H. DANIELS 2,371,226

STEAM GENERATOR

Filed Oct. 24, 1941 4 Sheets-Sheet 2

Fig. 2



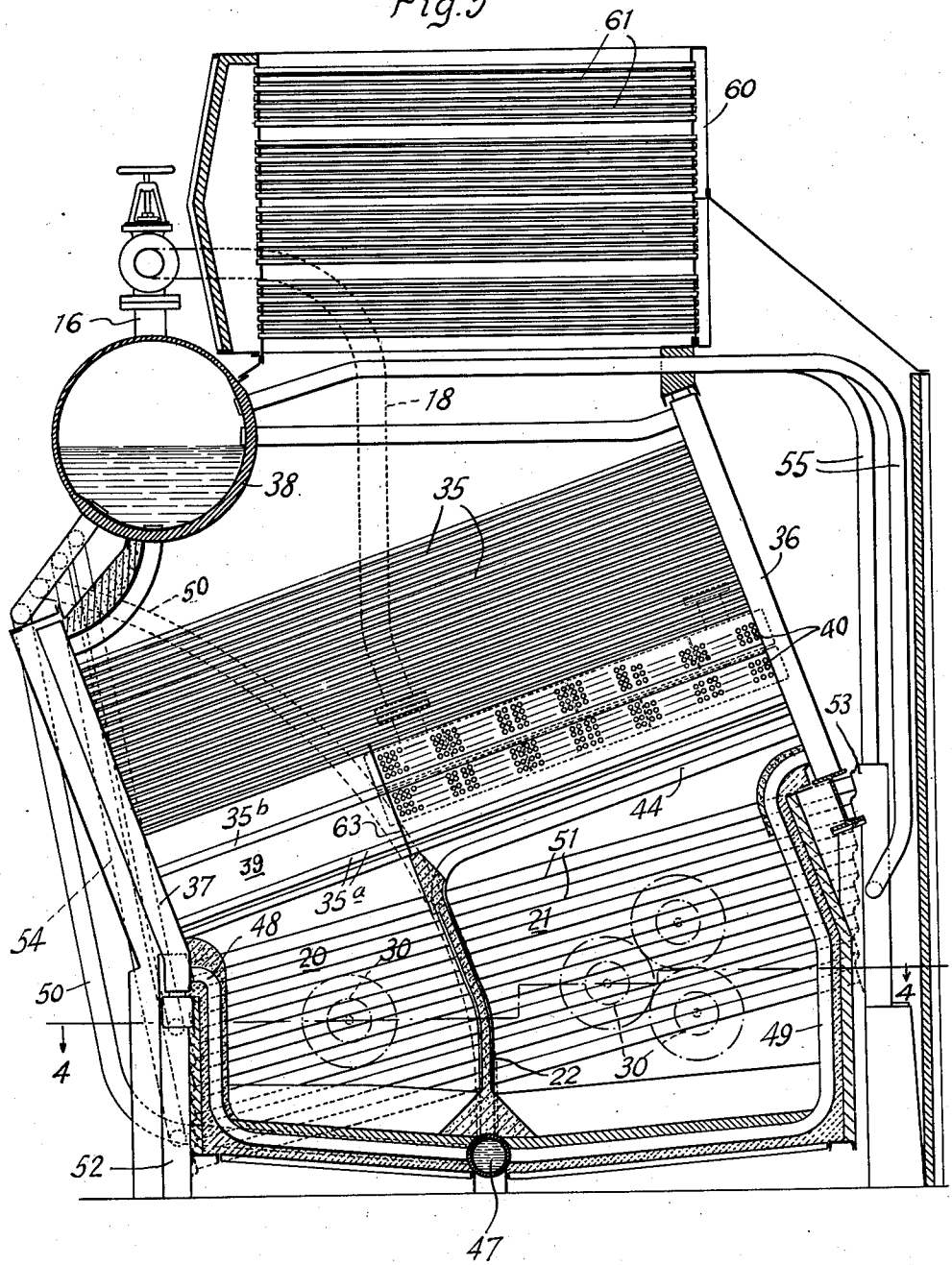
INVENTOR.
George H. Daniels
BY Joseph Brown
Attorney

March 13, 1945. G. H. DANIELS 2,371,226

STEAM GENERATOR

Filed Oct. 24, 1941 4 Sheets-Sheet 3

Fig. 3



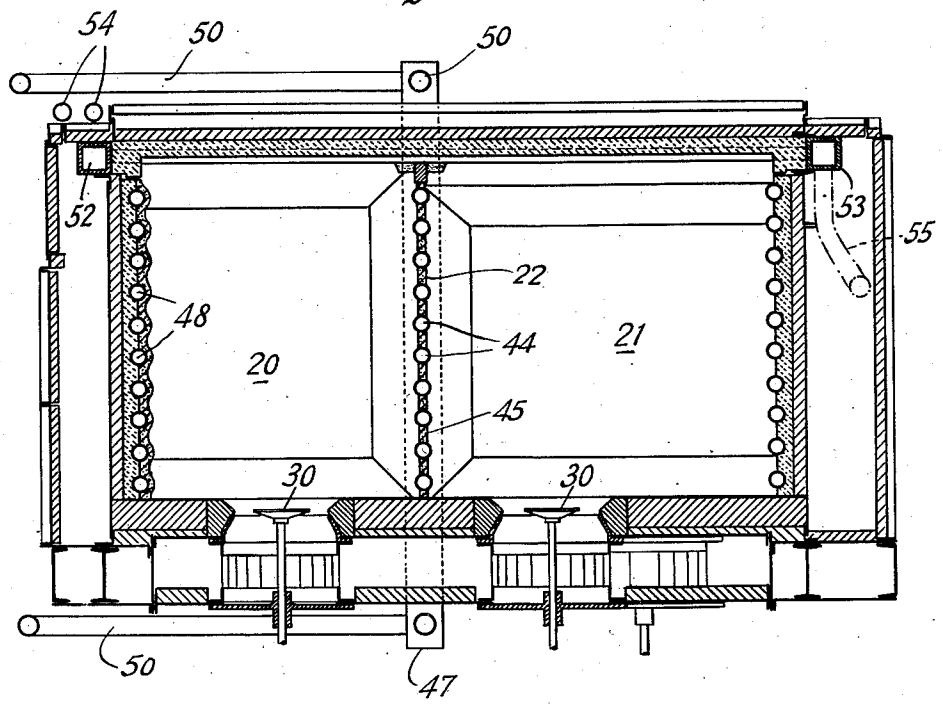
INVENTOR.
George H. Daniels
BY Joseph Morgan
Attorney

March 13, 1945. G. H. DANIELS 2,371,226

STEAM GENERATOR

Filed Oct. 24, 1941 4 Sheets-Sheet 4

Fig. 4



INVENTOR.
George H. Daniels
BY Joseph P. Moran
Attorney

Patented Mar. 13, 1945 2,371,226

UNITED STATES PATENT OFFICE

2,371,226

STEAM GENERATOR

George H. Daniels, Westfield, N. J., assignor to The Babcock & Wilcox Company, Newark, N. J., a corporation of New Jersey

Application October 24, 1941, Serial No. 416,391

2 Claims. (Cl. 122—478)

The present invention relates in general to the construction and operation of vapor generating units, and more particularly, to water tube steam generating units especially adapted for use in the marine field and of the type in which a steam superheater is in position to receive heating gases from an independently fired auxiliary furnace chamber incorporated in the generator setting and operable to control the steam superheat temperature, whereby the unit can be operated to deliver saturated or superheated steam.

The main object of my invention is the provision of a steam generating unit of the general type described which is characterized by its simplicity and low cost of construction and installation, low space and headroom requirements, efficient combustion conditions in the main and auxiliary furnace chambers, adequate protection of the superheater during periods of saturated steam production and at starting-up, control of the superheat temperature from zero to a relatively high temperature, low draft loss, and a high overall efficiency.

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 several embodiments of my invention.

Of the drawings:

Fig. 1 is a sectional elevation of a sectional header steam boiler constructed in accordance with my invention;

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

Fig. 3 is a sectional elevation of a modified sectional header steam boiler; and

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

In the steam boiler illustrated in Figs. 1 and 2, an insulated casing or setting 10 surrounds the boiler pressure parts, which comprise a horizontally inclined bank of straight steam generating tubes 35 extending between vertically arranged longitudinally spaced groups of uptake headers 36 and downtake headers 37, the upper ends of these headers being connected to the steam and water spaces respectively of a transverse steam and water drum 38 adjacent to and above one end of the tube bank. The tube bank 35 extends across the upper part of the setting and the setting space therebelow is occupied by the furnace portion of the unit. The lowermost tube rows of the bank are spaced from the remaining rows to provide an interdeck space 39 for a steam superheater, consisting of nested rows of horizontally extending U-shaped tubes 40 supported at spaced points on water utbes 35^b extending between the header groups and with the opposite ends of the superheater tubes opening into superjacent external headers 41 and 42 arranged for a two-pass steam flow. The steam drum 38 has a valved outlet 16, to which is connected a saturated steam branch line 17 and a superheater supply branch pipe 18. The rows of generating tubes 35^a below the superheater form a water tube screen between the superheater and the subjacent furnace section. The superheater is arranged in the portion of the tube bank space adjacent the downtake headers 37, the superheater tubes extending transversely across substantially the full width of the bank and being removable through one of the side walls of the unit.

The lower part of the setting is divided into separate laterally adjoining furnace sections 20 and 21 by a vertically extending fluid cooled wall or partition 22, formed by a row of water tubes 44 with refractory material closing the intertube spaces. The partition extends upwardly to the lowermost row of the main bank 35, where the tubes 44 are bent laterally to connect to the uptake headers 36. The lower ends of the tubes 44 are connected to a transverse header 47. Opposite walls and the floors of the furnace sections 20 and 21 are fluid cooled by rows of tubes 48 and 49, respectively, the tubes 48 being connected to the downtake headers 37 and serving as water supply tubes for the header 47, while the tubes 49 serve as generating tubes. The tube rows 48 and 49 may be wholly or partly covered with refractory depending upon the furnace temperature conditions desired to be maintained. External downcomer tubes 50 also supply the header 47 from the steam and water drum 38. This additional generating surface in the path of the heating gases from the furnace 20 aids in maintaining a uniform temperature at the gas outlet when both furnaces are in operation.

With the described construction the furnace section 20 will serve as the main or "saturated" furnace, and the furnace section 21 as the auxliary or "superheater" furnace. Each furnace is provided with one or more liquid fuel burners 30 in one of its side walls, the saturated furnace

burners being preferably controlled in response to steam pressure, and the superheater furnace burners in response to superheater outlet temperature. The furnace wall opposite the burner wall is preferably fluid cooled by a row of horizontally inclined water tubes 51 lining that wall and extending between vertical headers 52 and 53, the header 52 being directly connected to the water space of the drum 38 by downcomer tubes 54, while the header 53 is directly connected to the steam space of that drum by riser tubes 55 which extend across the gas outlet of the unit.

In the construction shown in Figs. 1 and 2 the superheater furnace section 21 is located directly below the superheater tubes 40. The saturated furnace 20 is thus located below the uptake end of the tube bank 35, so that when the saturated furnace alone is in operation the heating gases therefrom will advantageously flow across only the uptake ends of the tubes 44 and 35. A metallic baffle 63 extends upwardly from the upper end of the partition 22 along the inner end of the superheater, terminating at the upper level of the superheater, to protect the superheater tubes from contact with and radiation from the heating gases from the saturated furnace, while at the same time allowing these gases to contact with a substantial length of the superjacent generating tubes 35.

At starting up or when saturated steam only is desired, the saturated furnace burners alone are used, the heating gases generated flowing across the upper portion of the generating tube bank in a single pass flow. When superheated steam is desired the superheater furnace burners are operated, alone or in conjunction with the saturated furnace burners, the heating gases generated flowing successively across the screen tubes 35a, the superheater tubes 40, and the remaining tube rows of the generating bank. When either set of burners is operated alone the heating gases tend to flow over a major portion of the length of the generating tubes above the superheater. When both sets of burners are operated, the heating gas streams from the two furnaces join in the upper part of the unit and flow to a common gas outlet flue 60, in which for boiler economy a tubular air heater 61 is located.

The described construction due to the relative arrangement and construction of the main generating bank and furnace sections, provides a unit of simple design and relatively low cost of construction and installation. Its inherent low space requirements, operation of all the burners from the same operating level, single gas outlet in the upper part of the unit, and ease of replacement of the generating and superheating tubes renders the unit especially adapted for marine service. The described superheater location within the lower part of the tube bank and close to the furnace 21 permits a high superheat temperature to be attained and a correspondingly wide range of superheat temperature control, as well as a low center of gravity for the unit and simplification of the superheater header supports. The single pass flow of heating gases over the main generating bank and the substantial absence of baffles in that bank insures a low draft loss through the unit and an effective utilization of the heating gases relative to the available fluid heating surface.

In the modified construction shown in Figs. 3 and 4, however, the furnace sections 20 and 21 are reversed as to location and the superheater 40 positioned in the uptake section of the interdeck space 39. In many installations the number of liquid fuel burners required in the superheater furnace will be greater than necessary in the saturated furnace. The relative arrangement of the superheater and furnace sections shown in Figs. 3 and 4 satisfies combustion space requirements under such conditions, while at the same time lowers the headroom requirements of the unit. The operating advantages set forth in connection with the construction shown in Figs. 1 and 2, are also present in the modified construction shown in Figs. 3 and 4.

While in accordance with the provisions of the statutes I have illustrated and described herein the best forms 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. In the claims, "water" is used generically to also include other vaporizable liquids of different boiling points, such as diphenyl and diphenyl oxide, and "steam" to generically include the vapor produced from such a liquid.

I claim:

1. A steam generator comprising a setting, a bank of horizontally inclined steam generating tubes extending across said setting, a furnace chamber arranged below one end portion of said tube bank, a second furnace chamber arranged below the opposite end portion of said tube bank, means for independently firing said furnace chambers, a group of steam superheater tubes positioned within said tube bank and confined to the portion thereof above said first furnace chamber, generating tubes in said tube bank arranged to support said superheater tubes, the major portion of the tubes of said tube bank being arranged to extend across said setting above said superheater tubes, a transverse steam and water drum connected to said steam generating tubes and having a saturated steam connection to said superheater tubes, a second saturated steam outlet connection from said drum, a single heating gas outlet flue in the top of said setting arranged to receive all of the heating gases from both of said furnace chambers, said outlet flue being so located that the heating gases from said first furnace chamber flow upwardly across said superheater tubes and substantially all of the steam generating tubes of said bank in a single pass flow before entering said flue and the heating gases from said second furnace chamber flow upwardly across only the steam generating tubes of said bank before entering said flue, and a vertically extending partition separating said furnace chambers and terminating adjacent the upper level of said superheater and arranged to shield said superheater tubes from radiation from said second furnace chamber.

2. A steam generator comprising a setting, a bank of horizontally inclined steam generating tubes extending across said setting, a furnace chamber arranged below the upper end portion of said tube bank, a second furnace chamber arranged below the lower end portion of said tube bank, means for independently firing said furnace chambers, a group of steam superheater tubes positioned within said tube bank and confined to the uper end portion thereof above said first furnace chamber, generating tubes in said

tube bank arranged to support said superheater tubes, the major portion of the tubes of said tube bank being arranged to extend across said setting above said superheater tubes, a transverse steam and water drum connected to said steam generating tubes and having a saturated steam connection to said superheater tubes, a second saturated steam outlet connection from said drum, a single heating gas outlet flue in the top of said setting arranged to receive all of the heating gases from both of said furnace chambers, said outlet flue being so located that the heating gases from said first furnace chamber flow upwardly across said superheater tubes and substantially all of the steam generating tubes of said bank in a single pass flow before entering said flue and the heating gases from said second furnace chamber flow upwardly across only steam generating tubes before entering said flue, and a vertically extending partition separating said furnace chambers and terminating adjacent the upper level of said superheater and arranged to shield said superheater tubes from radiation from said second furnace chamber.

GEORGE H. DANIELS.