

Nov. 4, 1969

R. U. SHEIKH

3,476,090

STEAM GENERATING UNIT

Original Filed Aug. 24, 1967

2 Sheets-Sheet 1

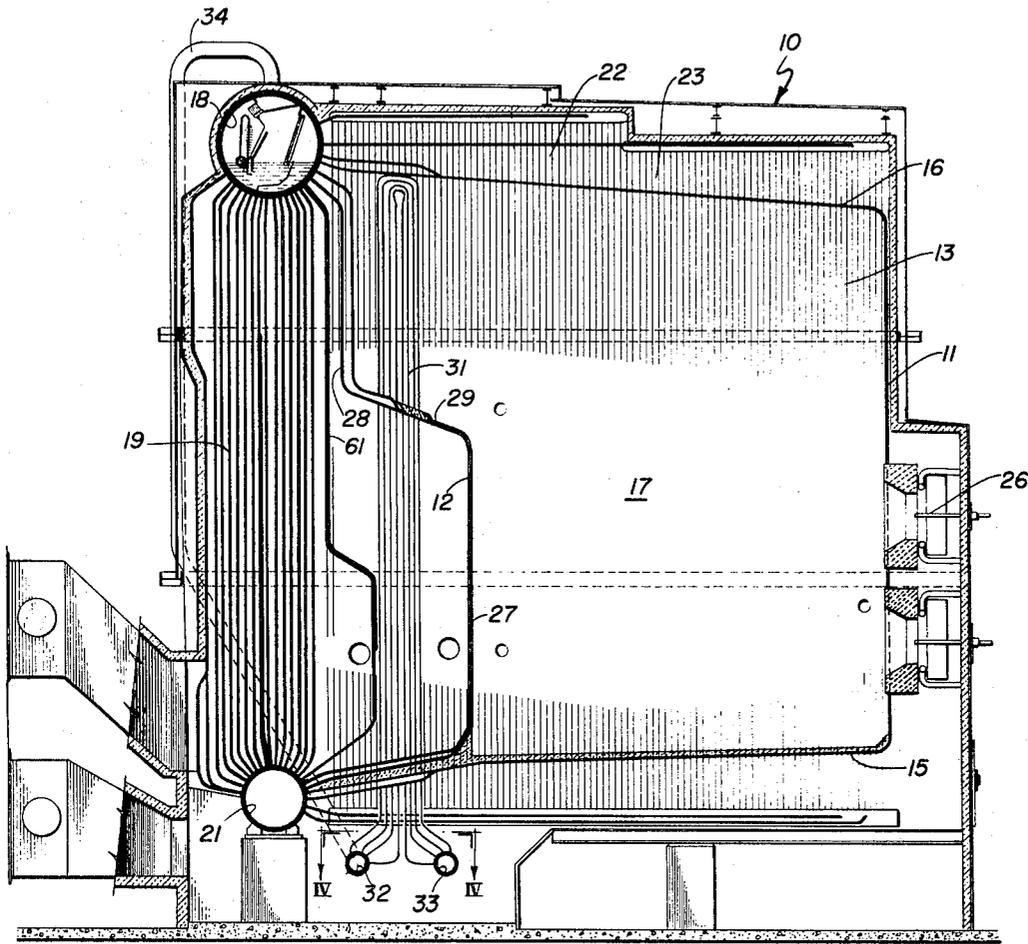


FIG. 1

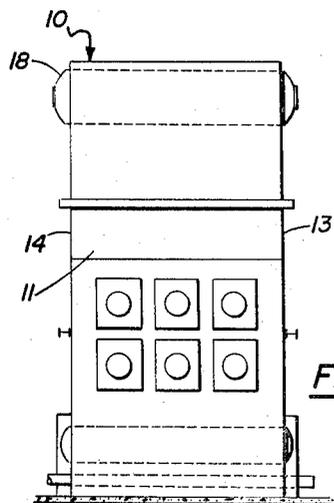


FIG. 3

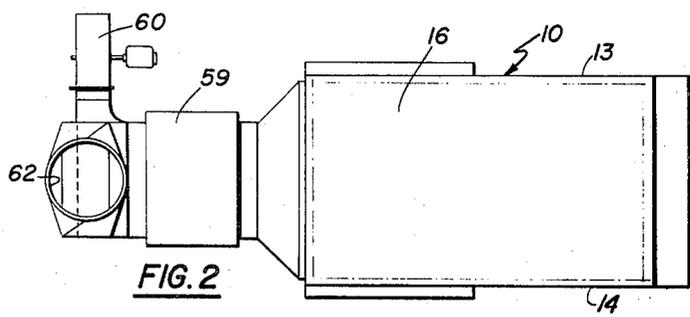


FIG. 2

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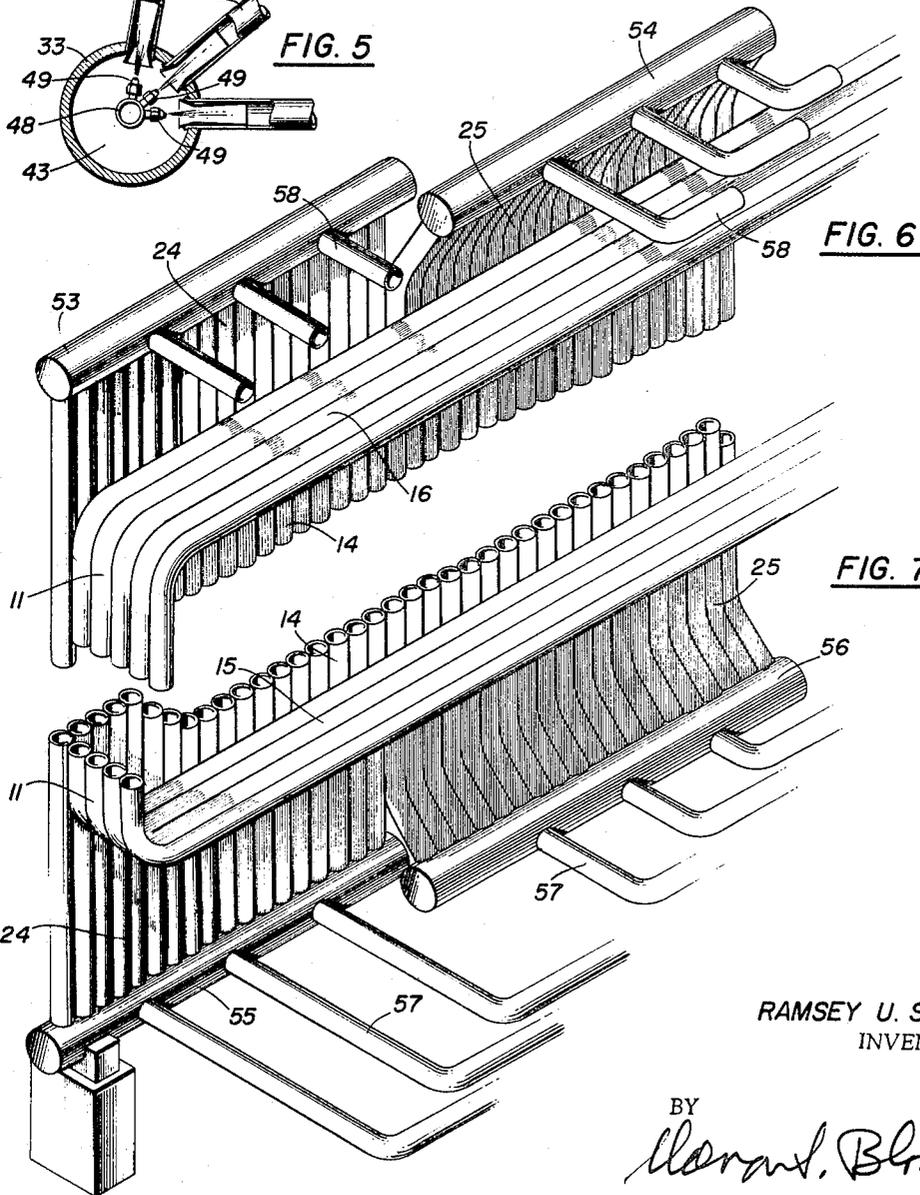
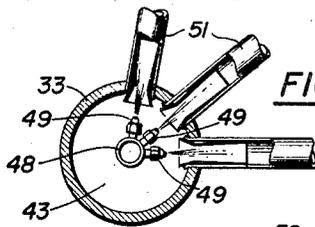
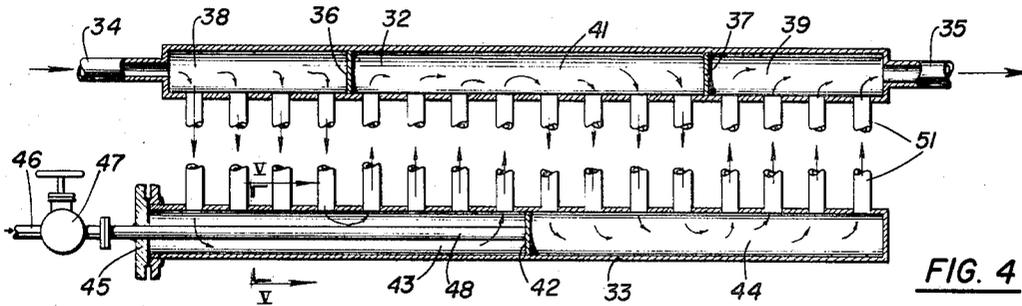
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STEAM GENERATING UNIT

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Continuation of application Ser. No. 663,048, Aug. 24, 1967. This application Dec. 5, 1968, Ser. No. 781,639 Int. Cl. F22b 37/00; F22g 7/14

U.S. Cl. 122-478

6 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a steam generating unit and, more particularly, to apparatus adapted to produce steam from the hot products of combustion of a fossil fuel, including a combustion chamber having headers which are offset relative to one another and a vertical superheater which is supported against lateral movement by inclined rear wall tubes.

This application is a continuation of application Ser. No. 663,048, filed Aug. 24, 1967, now abandoned.

BACKGROUND OF THE INVENTION

In the art of steam generation, it has been the general practice in the case of small boilers of the size that would be used in a school building or a small manufacturing plant to use a so-called "packaged" boiler. This is a boiler which is absolutely standard in every respect, which is assembled in the factory, and which is small enough to be shipped by railroad car to its ultimate destination. In this field, standardization has been carried to its greatest extent to obtain low price and adequate performance. On the other hand, most steam generating units which are used in large central stations are large enough and expensive enough so that they not only can be custom designed for each application but, because of their size, they must, of course, be assembled on the site. There is, however, a range of boilers of intermediate size which are too large to be shipped in one piece by railroad car and yet are not sufficiently expensive to warrant the custom design which is used in larger units. Attempts to standardize in this area have been somewhat successful, but many problems still present themselves. Many of these problems arise because of the fact that assembly must take place in the field where precision equipment is not available to assure that the parts are put together with the necessary tolerances. Furthermore, the fact that the design must be simplified in order to permit partial factory assembly and partial field erection means that in the past, the boilers of the intermediate or "industrial" type have been inefficient and subject to many maintenance problems. Part of the problem lies in the fact that, because they are not as expensive and as important as the central station unit, the maintenance personnel are not always of the best. These and other difficulties experienced with the prior art devices have been obviated in a novel manner by the present invention.

OBJECTS

It is, therefore, an outstanding object of the invention to provide a steam generating unit to which standardization can be readily applied for partial factory assembly and partial field erection.

Another object of this invention is the provision of a steam generating unit wherein access to wall headers and drums is relatively simple.

A further object of the present invention is the provision of a steam generating unit which is simple in construction, inexpensive to manufacture, and which is cap-

able of a long life of useful service with a minimum of maintenance.

It is another object of the instant invention to provide a steam generating unit of intermediate size having an improved method of superheat regulation.

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.

DESCRIPTION OF THE INVENTION

The character of the invention, however, may be best understood by reference to one of its structural forms, as illustrated by the accompanying drawings in which:

FIG. 1 is a vertical sectional longitudinal view of a steam generating unit embodying the principles of the present invention,

FIG. 2 is a plan view of the unit,

FIG. 3 is a front elevational view of the unit,

FIG. 4 is a sectional view of the unit taken on the line IV-IV of FIG. 1,

FIG. 5 is a sectional view of the unit taken on the line V-V of FIG. 4,

FIG. 6 is a perspective view of a portion of the boiler at the intersection of a side wall and the roof wall, and

FIG. 7 is a perspective view of the unit showing the area of the intersection of a side wall with the floor wall.

Referring first to FIGS. 1, 2, and 3, wherein are best shown the general features of the invention, the steam generating unit, indicated generally by the reference numeral 10, is shown as having a front wall 11, a rear wall 12, two side walls 13 and 14, a bottom wall 15, and a roof wall 16 defining a combustion chamber 17. Located rearwardly of the rear wall 12 is a steam-and-water drum 18 joined by a plurality of heat exchange tubes 19 to a lower mud drum 21. Each side wall is made up of a plurality of tube panels which line the inner surface and face toward the combustion chamber 17. In the present case, the wall 13, for instance, is made up of two tube panels 22 and 23, the tubes of which in general lie in the same vertical longitudinal plane. As will be evident in the description of FIGS. 6 and 7, the side wall 14 is made up of two similar tube panels 24 and 25. The bottom, front, and roof walls are formed of water tubes which originate in the lower mud drum 21, extend generally horizontally to form the bottom wall 15, extend generally vertically to form the front wall 11, extend generally rearwardly in a somewhat inclined manner to form the roof wall 16, and are then connected to the steam-and-water drum 18. On the front wall 11 are mounted a plurality of burners 26 in pairs of two. In the preferred embodiment, as is evident in FIG. 3, six such burners are used.

The rear wall 12 consists of two vertical sections 27 and 28 joined by an inclined portion 29. A superheater 31 is provided consisting of a plurality of tube panels extending vertically in planes each of which lies between the two vertical portions 27 and 28 of the rear wall 12. The panels of the superheater 31 extend through the inclined portion 29 and are substantially supported thereby against lateral movement.

The superheater 31 is provided with two parallel transverse headers 32 and 33 which are located below the bottom wall 15. Each tube of the superheater is of generally hair-pin shape with one end connected to the header 32 and the other end connected to the other header 33. The bight of the tube lies adjacent the roof wall 16.

Referring to FIG. 4, it can be seen that the superheater headers are provided with dividing walls to cause flow of steam seriatim through several sections of the superheater. The header 32 is connected by a pipe 34 to the

steam-and-water drum 18 to receive saturated steam therefrom. The other end of the header 32 is provided with an outlet pipe 35 leading to the turbine or other apparatus using the steam. Extending across the header 32 are walls 36 and 37 dividing into two relatively small end sections 38 and 39 and a relatively large center section 41. The other header 34 is provided with a single dividing wall 42 dividing the header into two equal sections 43 and 44. Mounted on the outer end of the section 43 of the header 33 is a desuperheater apparatus 45 having an inlet pipe 46 connected to a source of water and controlled by a valve 47. A pipe 48 extends coaxially through the section 43 and is welded at its inner end to the dividing wall 42. As is evident in FIG. 5, the pipe 48 is provided with a plurality of spray nozzles 49 each of which is directed into a superheater tube 51. Each tube 51 is provided with a venturi-shaped tube liner 52 located at its connection with the header 33 to protect the welded connection between the tube and the header from thermal shock.

As is evident in FIG. 6, the tubes making up the panel 24 of the side wall 14 extend straight up past the roof panel and are connected directly to an upper outlet header 53. The tubes making up the panel 25 of the side wall 14, however, extend straight past the roof wall 16 and then are bent inwardly to connect to an upper outlet header 54. The headers 53 and 54, therefore, are non-co-extensive and are displaced from one another so that access may be had to either end of either header for maintenance and ease of assembly.

In the same way, referring to FIG. 7, the tubes of the panel 24 of the side wall 14 extend straight downwardly past the bottom wall 15 and are connected directly to a lower inlet header 55, while the tubes making up the panel 25, although they extend straight past the bottom wall 15, are then bent inwardly in an inclined manner to connect to the lower inlet header 56. The headers 55 and 56 are, therefore, on generally the same horizontal plane but are located laterally of one another so that they are non-coextensive and non-coaxial, thus permitting access to either end of each header for maintenance and ease of assembly. Feeder tubes 57 enter the headers 55 and 56 from the mud drum 21 for supply of water in the side walls 13 and 14. In a similar manner, release tubes 58 leave the upper headers 53 and 54 and connect to the steam-and-water drum for carrying steam thereto.

One of the interesting aspects of the construction of the present steam generating unit is the manner in which air is brought to the burners 26. First of all, referring to FIG. 2, a regenerative air heater 59 receives air from the forced draft fan 60 and carries it under the mud drum 21 around the superheater headers 32 and 33, under the bottom wall 15 and up into the wind box of the burners 26. In this way, one need not worry about leakage of gas through the bottom of the boiler because such leakage of gas and air in either direction is entirely within the boiler setting and does not leave the casing.

OPERATION

The operation of the invention will now be readily understood in view of the above description. With air being provided to the burners 26 by the air heater 59 and the forced draft fan 60 and with fuel being provided in the well-known manner to the burners, combustion takes place in the chamber 17. The hot gas flows rearwardly and upwardly passing over the surfaces of the upper portion of the superheater 31 until it impinges on the upper section 28 of the rear wall 12. It then passes downwardly through the inclined portion 29 of the rear wall which portion is constructed with the tubes spread apart to permit such passage. The gas also passes through the upper section 28 and is directed downwardly by a baffle 61 formed by welding fins between a set of the tubes 19 to form a backpass. The gas is caused to flow back and forth over the superheater 31 and then over the main generating tubes 19. Eventually, the gas passes outwardly

through the air heater to the stack 62. Water is introduced into the steam-and-water drum 18 in the usual manner by a feed pump, passes downwardly through the tubes 19 to the mud drum 21 and picks up heat on the way. It then passes upwardly from the mud drum 21 back to the steam-and-water drum and is converted to steam on the way. The tubes making up the bottom, front, and roof walls as well as those forming the side walls and the rear wall all generate steam and cause it to flow to the steam-and-water drum 18. The steam passes from the steam-and-water drum through the pipe 34 to the superheater 31 where it is superheated and passed through the pipe 35 for further use. The steam enters the super heater 31 through the pipe 34 in the header 32. It first passes into the end section 38, passes upwardly through the tubes and back down to the header 33 into the section 43. It flows lengthwise of the end section 43 of the header 33 and leaves adjacent the dividing wall 42 and flows upwardly through the tubes and around down and into the central section 41 of the header 32. From there it flows lengthwise in a direction from the dividing wall 36 to the dividing wall 37 where it passes upwardly through the tubes and back down again to the other section 44 of the header 33. It passes lengthwise away from the dividing wall 42 and then passes upwardly into the tubes again and back down to the end section 39 of the header 32. From there it flows lengthwise away from the dividing wall 37 into the steam pipe 35 for use in a turbine or the like. Now, while the steam resides in the chamber 43 of the header 33, it is subjected to a desuperheating action. Water flows into the desuperheater apparatus 45 through a pipe 46 under the control of a valve 47. The water flows into the pipe 48 which lies within the chamber and outwardly of that pipe through its spray nozzles 49. The spray nozzles are directed into the tubes 51 causing a reduction, if necessary, in the superheated steam temperature. The welded connection between the tubes 51 and the header 33 is protected by the liners 52 against thermal shock.

It can be seen, then, that what has been obtained is an inexpensive, simply constructed boiler which is not only easy to erect by partial assembly in the manufacturing plant and finish erection in the field but which is easy to maintain during its lifetime. All of the headers are readily accessible from their ends and no one header is of any very great length. The superheater tubes are, of course, drainable at the bottom and the flow arrangement which is staggered by means of the dividing walls in the headers assures even distribution of steam flow to the superheater tubes. The arrangement of the superheater in this way means that there is high steam velocity, high mass flow circulation, thus maintaining safe metal temperatures. The superheater is a combination of a radiant and convection type which serves to maintain a flat steam temperature characteristic curve from 30% to 100% of full load. The fact that the tubes are drainable simplifies the startup procedures in the boiler. The symmetrical design of the present steam generating unit assures uniform heat absorption through the entire system. Gases flow over the superheater surfaces in three cross-flow patterns and the boiler banks are of the two-pass vertical flow design with cross-flow at entrance, top, and lower exists. Gas pass baffles are all welded water-cooled panels and are an integral part of the boiler convection system. The boiler is fully water-cooled and all welded, using a panelized construction which encloses the entire unit from the furnace front to the rear wall of the boiler convection passes. This reduces boiler and furnace wall heights as well as foundation requirements. Each furnace side wall panel has its own top and bottom headers and the headers are arranged in an offset staggered arrangement for easy access for inspection and cleaning.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, de-

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sired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

1. A steam generating unit, comprising
 - (a) a furnace having a front, a rear, two sides, a bottom, and a roof wall defining a combustion chamber, the rear wall consisting of two vertical sections joined by an inclined portion,
 - (b) a boiler including a plurality of tubes adapted to receive hot products of combustion from the combustion chamber,
 - (c) a plurality of tube panels lining the inner surface of the side walls, each panel having a lower inlet header and an upper outlet header, each group of lower headers and each group of upper headers being located laterally of one another, so that access is available to each end of each header, and
 - (d) a superheater consisting of a plurality of tube panels extending vertically in planes lying between the two vertical portions of the rear wall, the panels extending through the inclined portion and being substantially supported thereby against lateral movement.
2. A steam generating unit as recited in claim 1, wherein the superheater is provided with two parallel transverse headers located below the bottom wall, each tube of the superheater being of generally hair-pin shape with one end connected to one header and the other end connected to the other header, the bight residing adjacent the roof wall.
3. A steam generating unit as recited in claim 2, wherein the superheater headers are provided with dividing walls to cause flow of steam seriatim through several sections of the superheater.
4. A steam generating unit as recited in claim 2, wherein a desuperheater apparatus enters one end of one

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of the headers, the apparatus consisting of a pipe that extends coaxially into the header and is provided with radially-extending spray nozzles, each of which is directed into a superheater tube.

5. In a steam boiler, the combination including a plurality of tubes secured together in closely spaced parallel relationship to form at least a portion of a furnace wall, a group of adjacent ones of said tubes being bent out of the plane of said wall in the vicinity of one end thereof so that the ends of said group of tubes are laterally displaced from the corresponding ends of the other tubes, a pair of headers extending along said one end of said furnace wall, one of said headers having the laterally displaced ends of the tubes in said group connected thereto, and the other header having the corresponding ends of the other tubes connected thereto.

6. A combination according to claim 5 wherein said plurality of tubes further includes a group of adjacent ones thereof bent out of the plane of said wall in the vicinity of the other end thereof and a further pair of headers connected to the other end of said tubes in a manner similar to the connection of said tubes to said one and said other header.

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KENNETH W. SPRAGUE, Primary Examiner

U.S. Cl. X.R.

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