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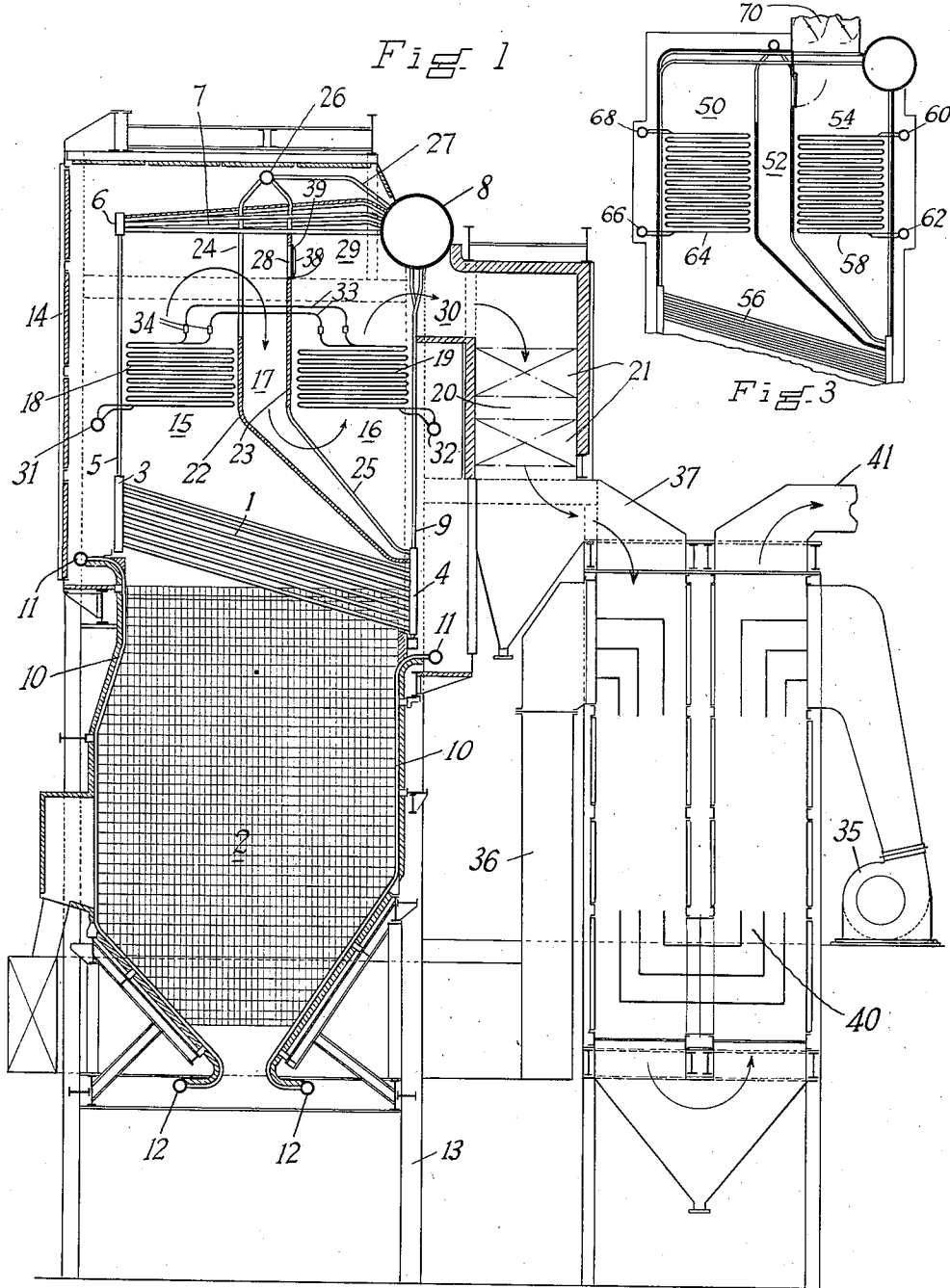
F. S. TOLLOW

2,255,233

FLUID HEAT EXCHANGE APPARATUS

Filed April 22, 1938

2 Sheets-Sheet 1



INVENTOR.

BY *Frederick Sidney Tollow*
Ben. R. Hancock
ATTORNEY.

ATTORNEY.

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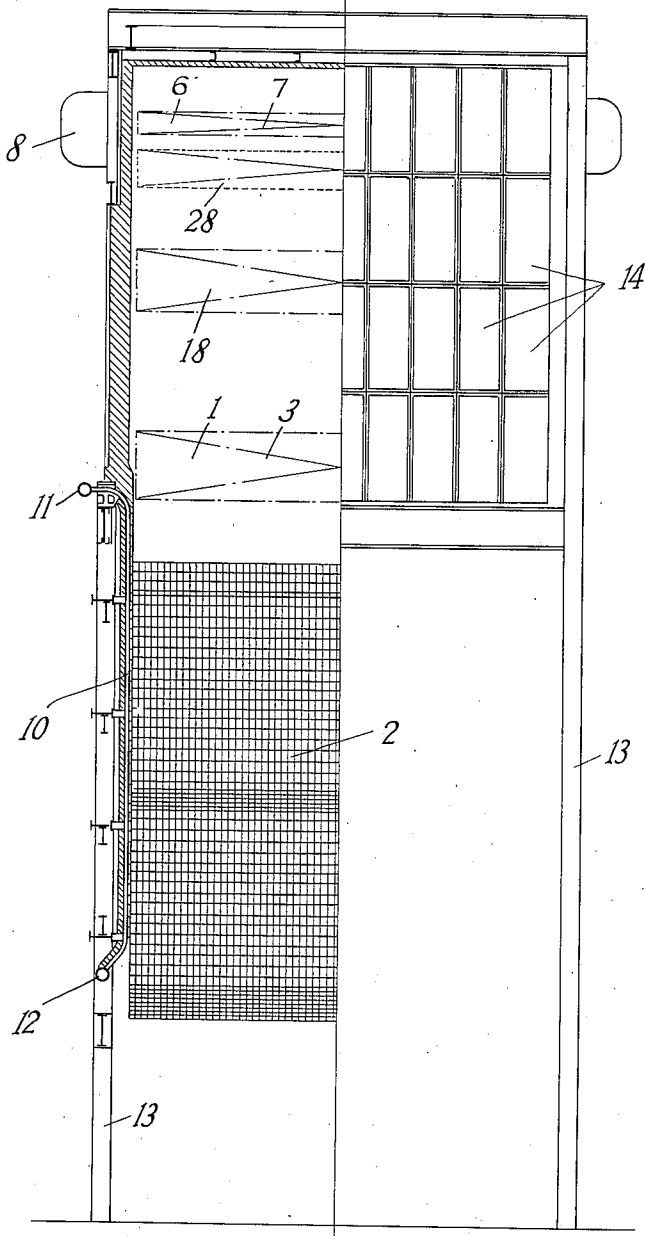
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INVENTOR.

BY *Frederick Sidney Tollow*
Frederick S. Tollow ATTORNEY.

ATTORNEY.

UNITED STATES PATENT OFFICE

2,255,233

FLUID HEAT EXCHANGE APPARATUS

Frederick Sidney Tollow, Whyteleafe, England,
 assignor to The Babcock & Wilcox Company,
 Newark, N. J., a corporation of New Jersey

Application April 22, 1938, Serial No. 203,556
 In Great Britain June 11, 1937

4 Claims. (Cl. 122-486)

This invention relates to vapor generators and superheaters.

More particularly, the invention relates to a vapor generator which is provided with means of a particular type for effecting the regulation of superheat. Such a means includes tubes presenting superheater surfaces, a bypass for the gas pass in which some of those surfaces are arranged, and means for varying the total gas flow over said surfaces.

In a boiler provided with such means for bypassing superheating surfaces for the purpose of regulating superheat, it is desirable that the superheater and the baffles for controlling the gas flow be effectively disposed relative to the remainder of the boiler. When the superheater includes a plurality of sections, it is also important to be able to effect a proper distribution of steam flow through the tubes of the respective sections.

An object of the invention is to provide a vapor generator accomplishing the above indicated results and also maintaining a relatively high rate of gas flow over the superheating surfaces in order that adequate superheat may be attained at low loads, using a convection superheater of reasonable size. A further object of the invention is to provide a combined vapor generator and multiple-section superheater installation which effectively utilizes economizer surfaces at all loads.

One form of the invention is represented by a vapor generator which comprises an economizer, separate superheaters or steam heaters, and a bypass for the gas pass in which one of the superheaters is located. The invention also presents means for varying the proportion of the total gas flow over the superheater surfaces.

The arrangement of the economizer is such that the complete economizer is subjected to the flow of all of the furnace gases regardless of the proportion of the total gas flow passing over the bypassed superheater or steam heater surface.

The invention also relates to a vapor generator including a casing which houses a superheater and vapor generating tubes, the space within the casing beyond the generating tubes, and in the direction of gas flow, being divided into a plurality of series-connected gas passes of reduced cross section. One of these gas passes always has the entire gas flow passing through it, and in this pass is arranged one of the superheater sections. In another of the gas passes there is located another section of the superheater around which the gases may be bypassed to an adjustable extent.

The invention will be described with reference to the accompanying drawings, in which:

Fig. 1 is a sectional side elevation of the illustrative boiler provided with an air heater;

Fig. 2 is a front elevation of the steam generator with the left-hand half of the boiler shown in vertical section; and

Fig. 3 is a sectional side elevation of a modification of the illustrative installation.

The steam generator illustrated in the drawings includes the bank of steam generating tubes 1 disposed across the gas outlet of the furnace 2. These tubes are associated with sectional headers 3 and 4 which are connected with the drum 8 by the downcomers 9, the risers 5, and circulators 7. The risers and circulators are in communication by reason of their connection with the header 6.

The walls of the furnace 2 include water tubes 10 connecting upper headers 11 to lower headers 12 and suitably connected into the circulatory system of the steam generator, the tubes being suitably covered, as, for example, by Bailey blocks.

The steam generator is provided with structural-supporting members including the uprights 13, and the furnace and the gas space above the furnace are provided with a suitable casing the elements of which adjacent the headers 3 and adjacent the space above the furnace at the front of the steam generator are in the form of the removable panels 14.

The superheater space above the steam generating tubes 1 is divided into two upflow passes 15 and 16, and a connecting downflow pass 17. One section, 18, of the superheater is disposed in the gas pass 15 and a second superheater section 19 is disposed within the gas pass 16. The latter superheater section is adapted to be bypassed to an adjustable extent, as described below. Arranged beyond the gas pass 16 and the superheater section 19 therein is a gas pass 20 which is subjected to the entire gas flow regardless of the extent of the bypassing of the superheater section 19. An economizer 21 is arranged within the gas pass 20.

The gas passes 15 and 17 are separated by the baffle 22, a similar baffle 23 separating the gas passes 16 and 17. The tubes 24 and 25 supporting and forming parts of these baffles are connected at their lower ends to the headers 4 and at their upper ends to a header 26 which is in communication with the steam space of the drum 8 by means of the tubes 27. In forming the baffles the spaces between the tubes 24 and 25 may be

closed, at the locations of the baffles, with suitable refractory material, and the baffle 23, near the upper part thereof, is provided with bypass apertures 28 through which gases may be allowed to flow into the space 29, thereby bypassing the superheater section 19.

The superheater section 18 is always subjected to the entire gas flow, and that portion of the gases which is not bypassed through the apertures 28 flows downwardly through the bypass 17, between the lower portions of the tubes 25, and then upwardly through the gas pass 16 in the upper part of which it joins the bypassed gases to form a common stream which then passes between the upper portions of the downcomers 9 and through an outlet 30 leading to the economizer 21.

The primary superheater section, or primary superheater, 18, consists of a bank of tubes connected by return bends disposed in vertical planes. These tubes are arranged between and supported by the risers 5 and the baffle tubes 24, and the lower ends of these superheater tubes are connected to the superheater outlet header 31 through which this section of the superheater is drainable.

The secondary section of the superheater, or secondary superheater, 19, is similarly arranged between the tubes 25 and the downcomers 9, the lower ends of the tubes of this section being connected with the superheater inlet header 32 through which this section of the superheater may be drained.

It will be observed that the tubes of the superheater section 19 are connected in series with the respective tubes of the superheater section 18, these connections being effected by the tubes 33 and the connectors 34. The header 32 is suitably connected with the steam space of the drum 8, the arrangement being such that the steam flows from the drum through the secondary superheater section 19 and then through the primary superheater section 18, in counter-flow with reference to the gases.

Steam is admitted to the header 32 by connecting the steam space of the drum to a plurality of points in the length of the header, so that a substantially uniform distribution of steam is established in the tubes of the secondary superheater section 19, and since the tubes of the primary superheater section 18 are severally connected in series with the tubes of the section 19 proper distribution of steam flow is also obtained in the primary superheater section.

The gases from the economizer gas pass 20 pass by way of a duct 37 to an air heater 40 disposed below the economizer. After passing through the air heater the gases are discharged from the duct 41. A forced draft fan 35 forces air through the air heater and then through the ducts 36 to the furnace 2.

For the purpose of controlling superheat, gas flow regulators 38 are provided for the apertures 28 in the baffle 23. They are preferably hinged at 39 along their upper edges and are adapted to open inwardly into the space 29. With this arrangement of elements the devices for operating the regulators, and the hinges for the latter, are conveniently arranged at positions substantially outside of the path of the gases.

Superheat may be maintained at a constant value while the boiler is operating over a wide range of capacities, by operating the regulators 38 in response to variations in certain pertinent factors. This may be accomplished by control

mechanism which includes temperature responsive elements functioning in conjunction with other means responsive to steam flow.

In the embodiment of the invention illustrated in Fig. 3 of the drawings, the arrangement of the gas passes 50, 52, and 54 is similar to the arrangement of passes in the Fig. 1 steam generator and these gas passes are similarly arranged above a bank of steam generating tubes 56 corresponding to the bank of steam generating tubes 1 in Fig. 1. However, in the up-pass 54, an economizer 58 is provided. This economizer includes the headers 60 and 62 connected by return bend tubes which extend across the gas pass. In the up-pass 50 the superheater 64 is arranged. This includes the headers 66 and 68 connected by an arrangement of tubes similar to the tubes 1 in the superheater 18 of the Fig. 1 embodiment. Beyond the economizer, and above it, is the flue 70 through which the gases may pass to an air heater.

While the invention has been described with reference to the particular embodiment shown in the drawings, it is to be appreciated that it is not limited to all of the details thereof. The invention is rather of a scope commensurate with the scope of the subjoined claims.

What is claimed is:

1. A vapor generator comprising, in combination, vapor generating tubes, a superheater, a casing wherein the space beyond the vapor generating tubes in the direction of gas flow is divided into three side-by-side and series-connected passes of reduced cross section, the first of said passes being arranged to always be subject to the total gas flow from the furnace and having one separate section of the superheater therein, another separate section of the superheater being arranged in the third of the gas passes, means forming a gas outlet at the discharge end of the last of said passes, baffles or walls separating said passes, a gas flow regulator associated with an opening in the wall between the second and third of said passes and adjacent the gas entrance to the second of said passes, said outlet being disposed on the downstream side of said other separate superheater section relative to the flow of gases over that superheater section, said opening establishing communication between the upstream and downstream sides of the second superheater section, and means connecting said superheater sections for series steam flow therethrough.

2. A vapor generator comprising, in combination, a furnace, a bank of vapor generating tubes beyond the furnace relative to the direction of gas flow, a superheater, and a casing affording a space for the superheater beyond the vapor generating tubes, baffles or walls whereby the said space is divided into first and second upflow passes and an intermediate downflow pass in series with the upflow passes, means forming a furnace gas outlet at the discharge end of the second upflow pass, the superheater having one separate section thereof disposed in the first upflow pass, a second separate section disposed in the second upflow pass, and a gas flow regulator operating across an opening in the wall dividing the second upflow pass from the intermediate pass to cause furnace gases to by-pass the intermediate pass and the second superheater section, the path of gas flow from the dampered opening to a position beyond the second superheater section having a pressure drop less than the pressure

drop of the gas path through (or over) the second superheater section.

3. A vapor generator comprising, in combination, vapor generating tubes, a superheater, a casing wherein the space beyond the vapor generating tubes in the direction of gas flow is divided into three successive and side by side gas passes of reduced cross-section connected for gas flow in series therethrough, means forming a gas outlet at the discharge end of the last of said passes, one of said passes being arranged to always be subject to the total gas flow from the furnace and having superheater tubes disposed transversely of gas flow therein, a second superheater section disposed transversely of gas flow in one of the last two gas passes, and a gas flow regulator disposed across an opening between the second and third passes to cause a controlled proportion of the gases to bypass said second superheater section and the last two of said gas passes, said regulator being so arranged between the exit of the first pass and said gas outlet as to afford direct gas flow therebetween during said by-passing, the path of gas flow from the dampered opening to a position beyond the second

superheater section having a pressure drop less than the pressure drop of the gas path through (or over) the second superheater section.

4. In a superheater and steam generator installation, steam generating tubes, means forming at least three successive and parallel gas passes connected in series as to gas flow, a superheater section in the first of said passes, a second superheater section in the third of said passes, said means including baffles or walls dividing said passes, means forming a gas outlet at the discharge end of said last gas pass, means connecting the superheater sections in series as to steam flow, and a gas flow regulator operating across an opening in the wall between the second and third gas passes to control superheat by permitting a variable proportion of the furnace gases to by-pass the second superheater section and pass directly from the exit of the first of said passes to said gas outlet, the path of gas flow from the dampered opening to a position beyond the second superheater section having a pressure drop less than the pressure drop of the gas path through (or over) the second superheater section.

FREDERICK SIDNEY TOLLOW.