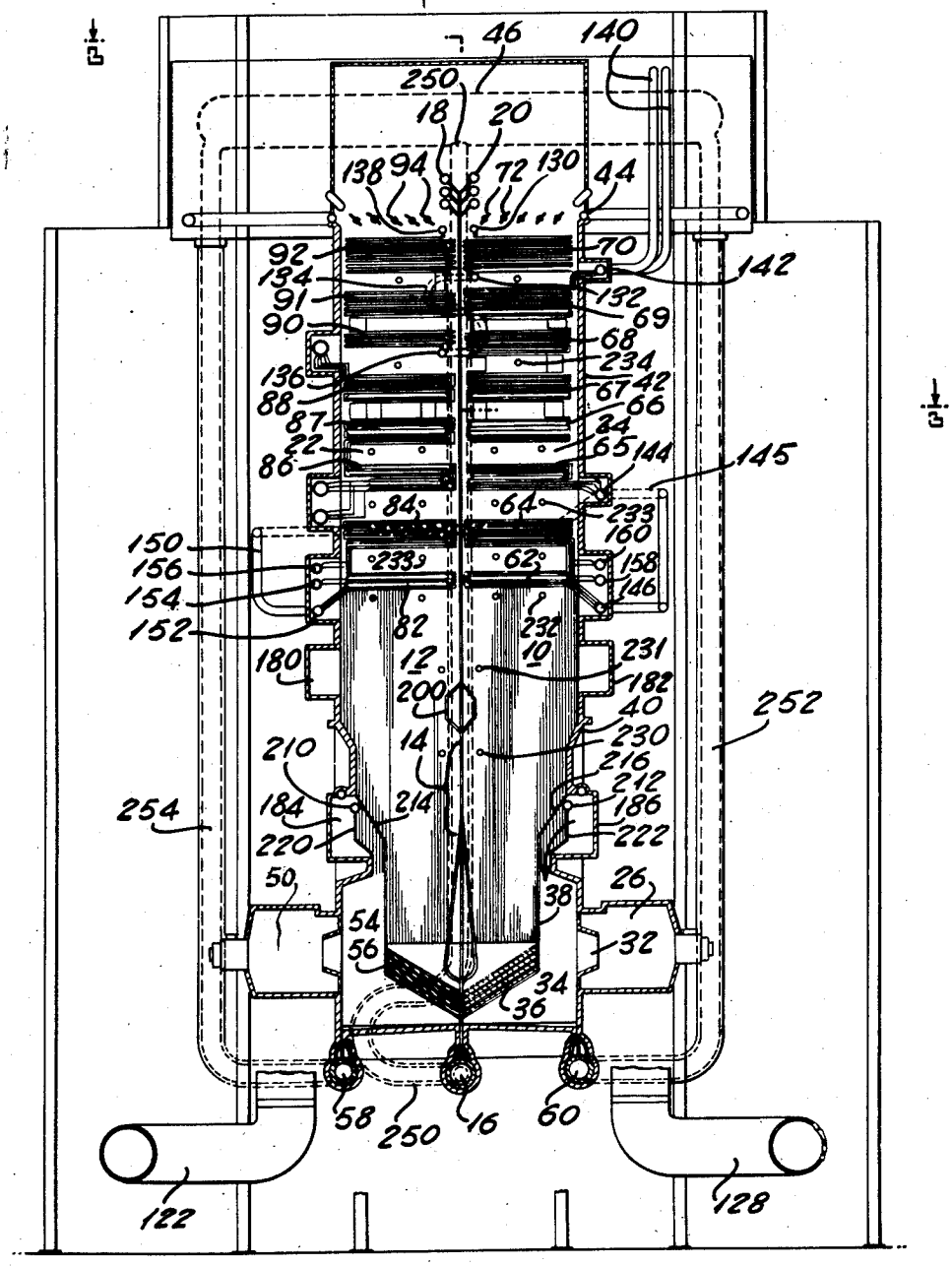
July 23, 1957 A. E. RAYNOR ET AL 2,800,116

STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

Filed Oct. 20, 1954 5 Sheets-Sheet 1

Fig. 1.



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STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

Filed Oct. 20, 1954 5 Sheets-Sheet 2

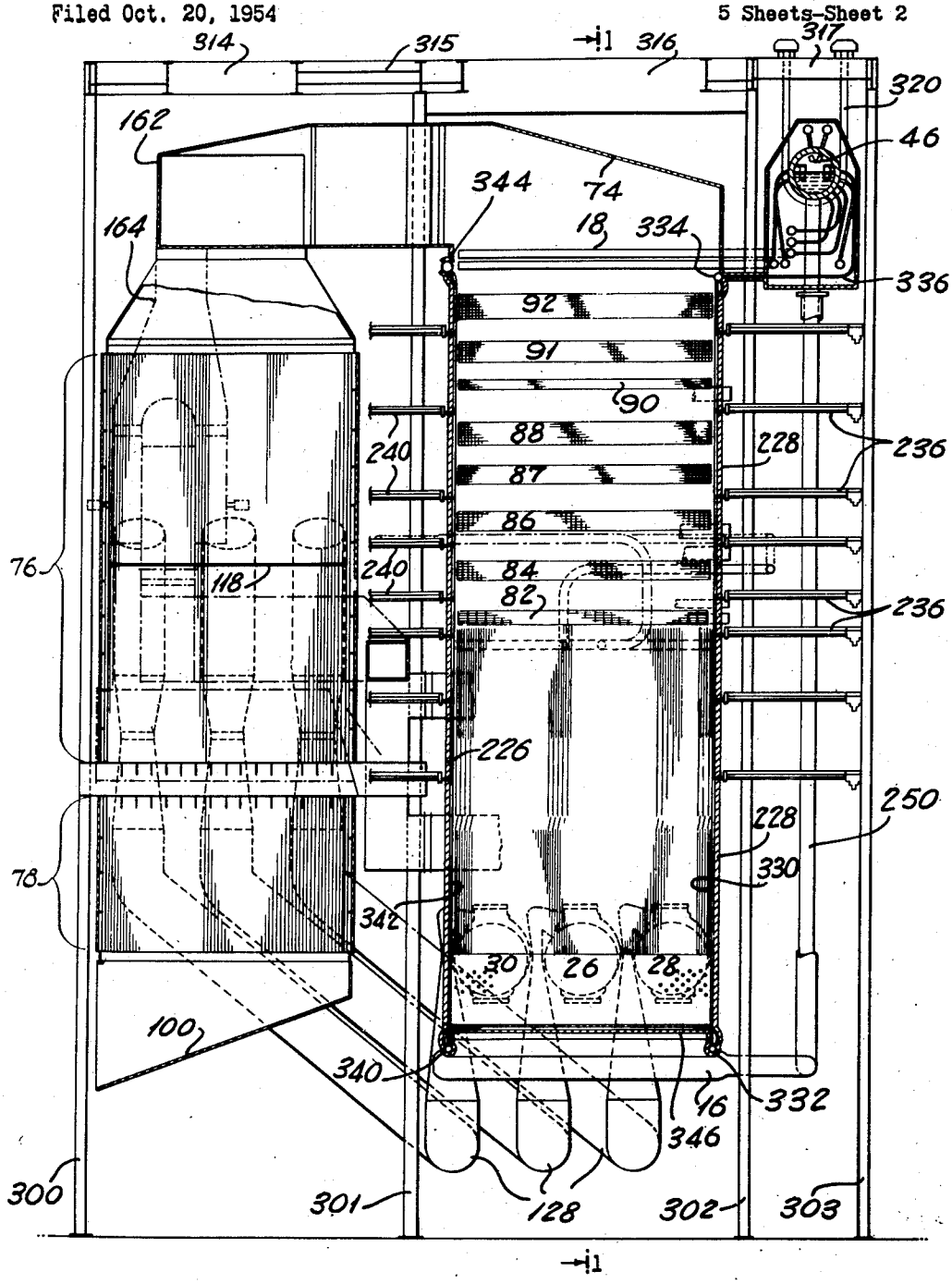


Fig. 2.

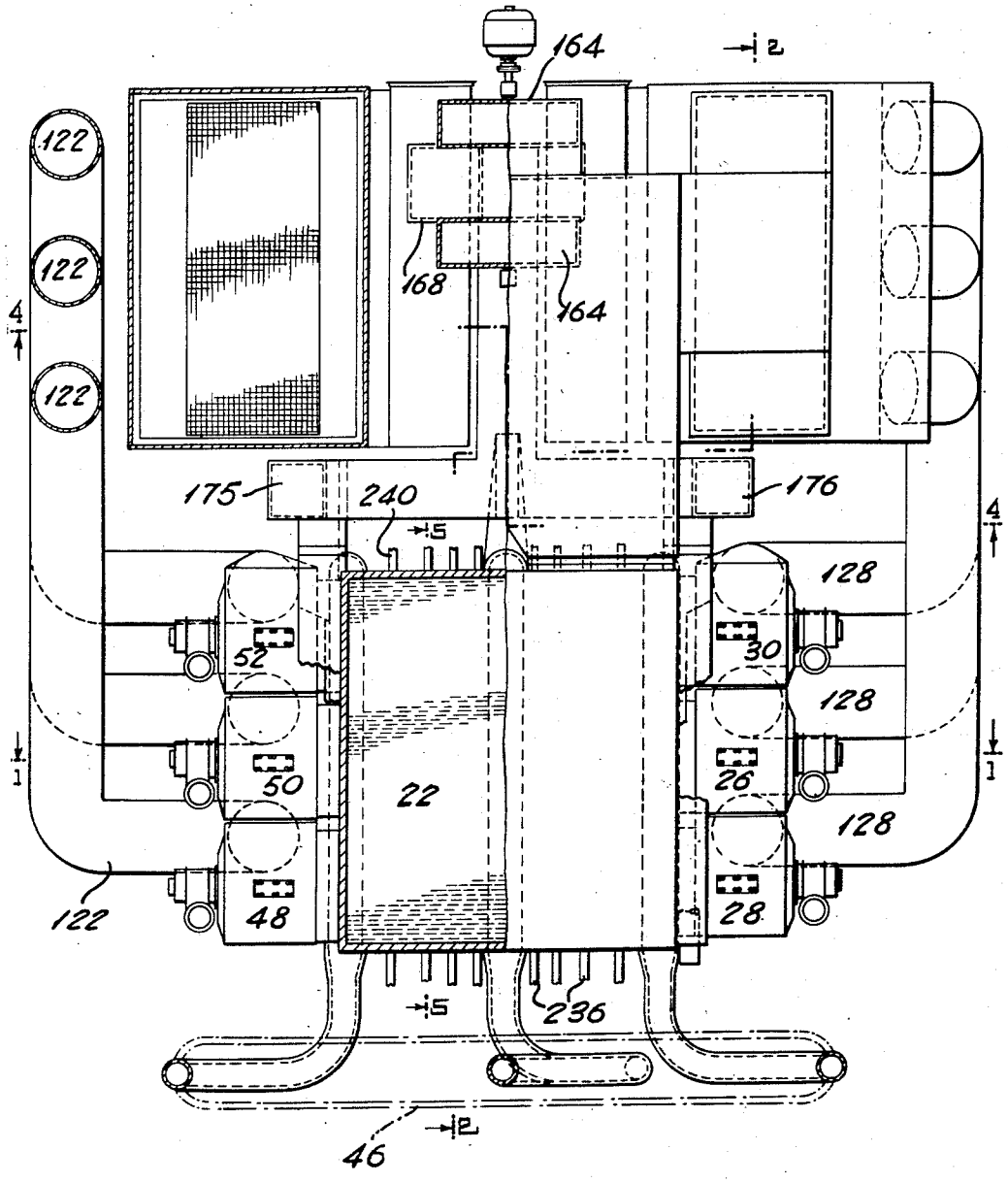
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STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

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Fig. 3.



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STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

Filed Oct. 20, 1954 5 Sheets-Sheet 4

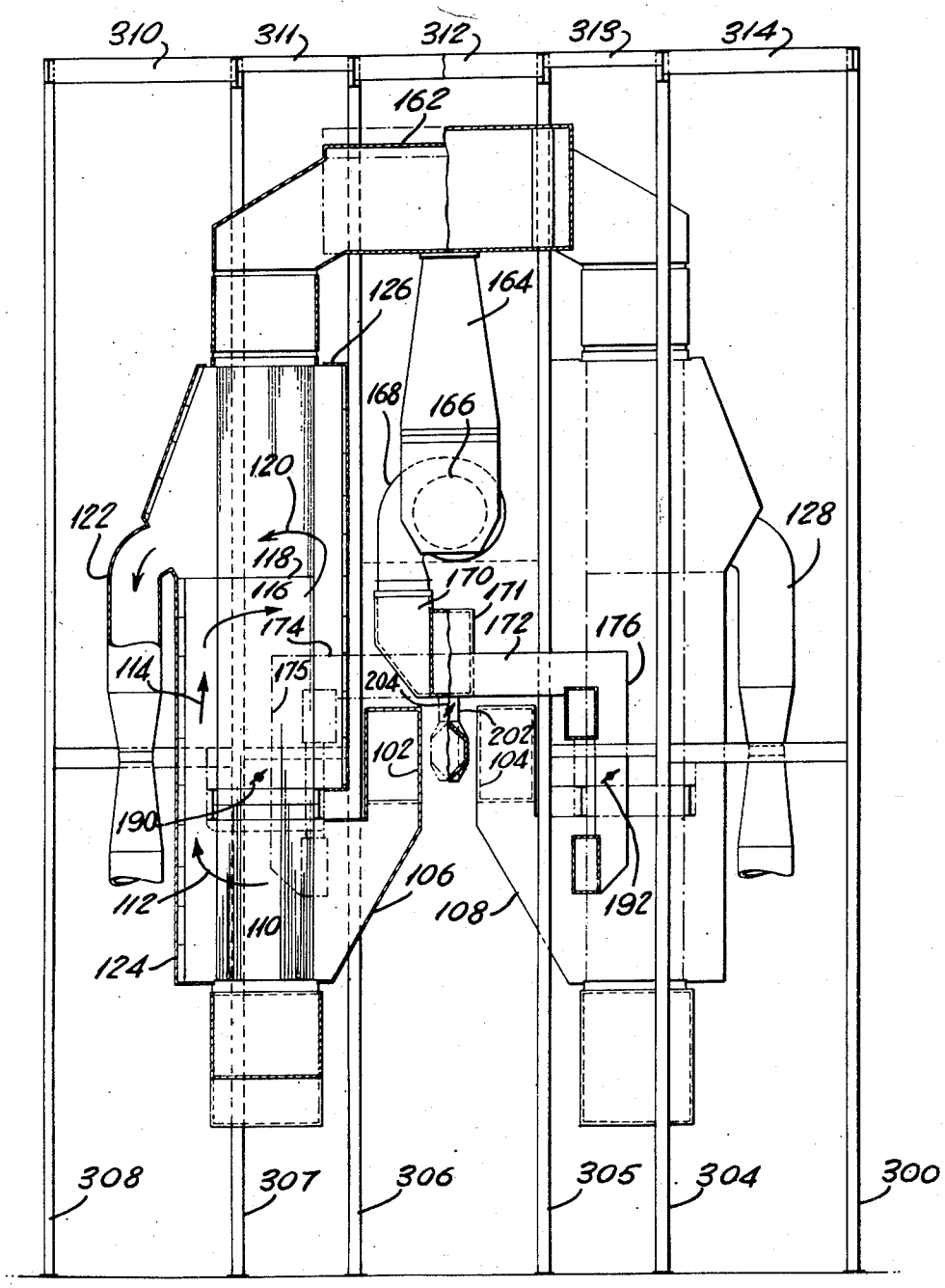


Fig. 4.

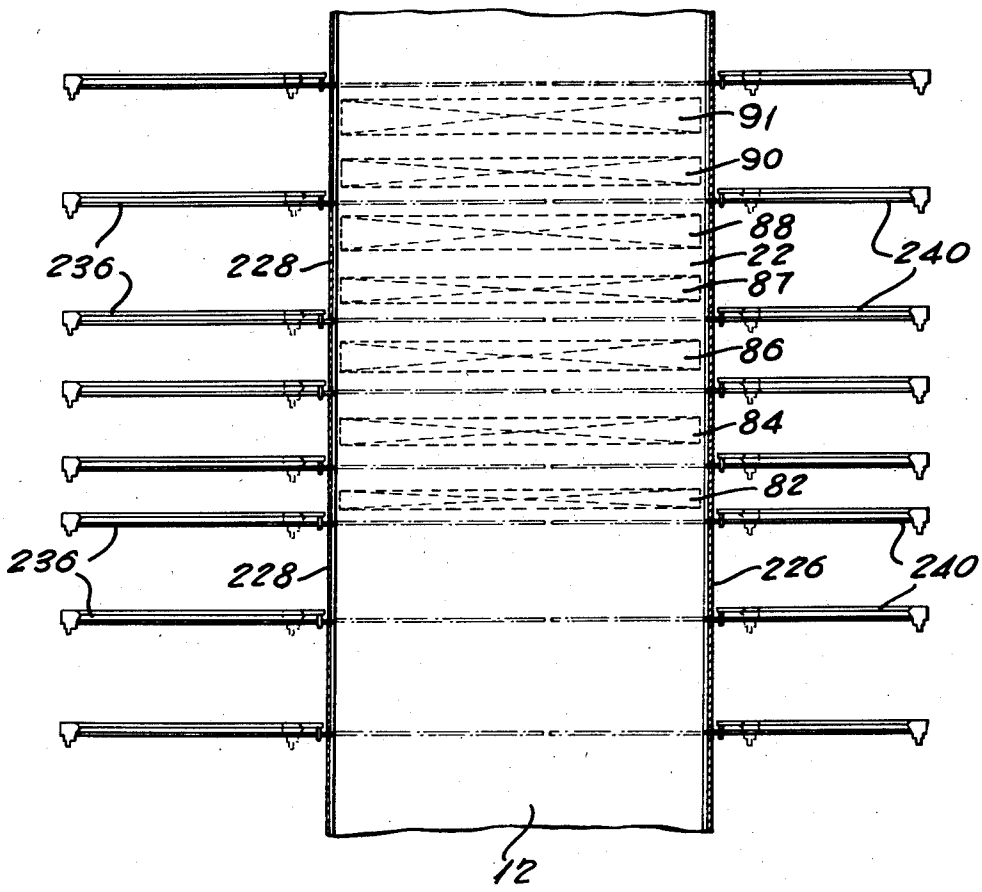
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Filed Oct. 20, 1954 5 Sheets-Sheet 5

Fig. 5.



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United States Patent Office 2,800,116 Patented July 23, 1957

2,800,116

STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

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Application October 20, 1954, Serial No. 463,418

7 Claims. (Cl. 122—240)

This invention relates to high capacity steam generating and superheating units. It is more particularly concerned with improvements in such units operating at high furnace temperatures, high steam temperatures, and high steam pressures, and having a high ratio of steam generating surface to furnace or furnace chamber volume.

A steam generating and superheating unit exemplifying the invention includes a single boiler setting having a twin or duplex furnace arrangement with separately fired furnaces or combustion chambers separated by a common wall of steam generating tubes. The remaining walls of the combustion or furnace chambers separated by this wall have their boundaries defined by other steam generating tubes connected into the circulation of the unit. The furnaces, or furnace sections, are fired by fuel burning means preferably disposed adjacent the lower parts of the separate furnace chambers with the gases flowing upwardly therethrough on opposite sides of the division wall and then over the surfaces of separate convection sections. One of these sections preferably includes a reheater, as well as some economizer and superheater surface, while the other includes other superheater and economizer surfaces. In a preferred embodiment of the invention the gases exiting from the different gas flow paths join beyond the convection sections and pass over an air heater disposed at one side of that part of the setting including the furnace chambers and the convection sections. This side may be considered as a side connecting the two sides of the setting along which the opposite sets of fuel burning means are arranged.

The pertinent arrangement of elements promotes better mixing of recirculated gases ahead of the superheater elements because of the smaller throat width just ahead of the superheater. It also minimizes unbalanced gas temperatures across the unit, and minimizes the amount of supporting steel required for a unit of a certain capacity.

Preferably, the opposite furnace chambers, separated by the division wall, receive gases from independent sets of coal burning cyclone furnaces. There is a primary furnace chamber disposed on the opposite side of each of the first mentioned furnace chambers which may be considered as secondary furnace chambers. A plurality of coal burning cyclones discharge into each primary furnace chamber.

For control of steam heating and for control of heat absorption of the steam generating furnace wall tubes, over a wide load range, as well as for promoting the effecting of optimum combustion by operation of the fuel burning means at highest optimum temperatures, partially cooled furnace gases are withdrawn from positions, or a position, in the gas flow path downstream of the convection section, and are introduced at one or more selected positions with reference to gas flow. Preferably, for maintaining an optimum temperature of superheated steam as the load on the unit decreases, an increasing amount of recycled gases are caused to flow into the primary furnace chambers and thence through the secondary chambers and then over the convection sections to increase the mass flow of gases and thereby relatively increase the heat absorption of the convection section. At the high loads, or in the upper part of the load range, the temperature of the gases at the gas entrances of the convection section may be decreased or held at a permissible value by the introduction of controlled amounts of recycled gases as tempering gases, at positions just ahead of the convection sections.

For increasing the effectiveness of the introduction of tempering gases just ahead of the convection sections, the division wall has some of its tubes (i. e. one-third) bent to the right of the division wall and some of the remainder of the division wall tubes bent oppositely to the left of that wall to define a tempering gas duct, or tempering gas entry chamber. Some of the bent-out parts of the tubes may have inter-tube flat studs welded thereto to better form this tempering gas duct. In this way the tempering gases are introduced at the opposite sides of each furnace section, to promote optimum mixing of the recirculated gases with the other gases.

The invention will be concisely and clearly set forth in the claims appended hereto, but for a better understanding of the invention, its advantages, and uses, recourse should be had to the following description which refers to the accompanying drawings in which a preferred embodiment of the invention is shown.

Of the drawings:

Fig. 1 is mainly a vertical section through a steam generating and superheating unit, on the line **1—1** of Fig. 2;

Fig. 2 is a vertical section at right angles to the plane of the Fig. 1 section and taken on the dual plane section line **2—2** of Fig. 3;

Fig. 3 is a plan section on the dual level section line **3—3** of Fig. 1;

Fig. 4 is a vertical section on the dual plane section line **4—4** of Fig. 3; and

Fig. 5 is a fragmentary vertical section through one of the convection sections, on the line **5—5** of Fig. 3.

Fig. 1 shows two opposite secondary furnace chambers **10** and **12** separated by a division wall **14** consisting of wall aligned steam generating tubes extending from the lower header **16** to the upper headers **18** and **20**. The upper part of this division wall also separates the gas passes **22** and **24** for the separate convection sections. The gases flowing through the furnace section **10** originate in a coal burning cyclone **26**, having steam generating tubes in its boundaries, and otherwise of a type indicated in the U. S. patent to Bailey et al. 2,357,301. There may be three of these cyclones, including the other cyclones **28** and **30**, all discharging combustion gases through throats similar to the throat **32**, into a primary furnace chamber **34** common to the three cyclones, **26**, **28** and **30**. The combustion gases exit from the primary furnace chamber **34** across and between the widely spaced and inclined tube sections forming the screen **36**. These screen forming tube sections are parts of steam generating tubes extending from the lower header **16** and upwardly from the screen along the left hand wall of the primary furnace chamber **34** and then upwardly along the right hand wall **40** of the secondary furnace chamber **10**. They may be further extended along the right hand wall **42** of the gas

pass 24 to the header 44 which is appropriately connected to the steam and water drum 46.

At the opposite side of the unit there is a similar arrangement of cyclones 48, 50 and 52 discharging combustion products into the primary furnace chamber 54 for flow therefrom across the screen 56, and thence into the secondary furnace chamber 12.

The floor and outer walls of the primary furnace chambers 34 and 54 preferably include steam generating tubes connected at their lower ends to the lower headers 58 and 60, and extending upwardly therefrom for appropriate connection to the drum 46.

Gases flowing upwardly from the secondary furnace chamber 10 pass over the banks of tubes 62 and 64 constituting a part of the secondary, or high temperature superheater. The gases then pass in succession over the banks of tubes 65—69 constituting the primary, or low temperature superheater. Beyond this superheater the gases pass over the bank of tubes 70, constituting the first section of the economizer. They continue past the gas flow control dampers 72 into the breeching or ductwork 74 leading to the air heater having two sections 76 and 78, each including a bank of tubes through which the gases flow.

From the other secondary furnace chamber 12 the gases flow upwardly across the banks of tubes 82 and 84 constituting the other section of the secondary or high temperature superheater, and thence across the banks of tubes 86—88 constituting the steam reheater. Following the reheater the gases pass over the banks of tubes 90—92 constituting the second section of the economizer. From the economizer the gas flow continues past the gas flow control dampers 94 to the ductwork component 74, and thence to the air heater including the sections 76 and 78.

The separate gas flows from the separate secondary furnace chambers 10 and 12 are combined in the ductwork 74 for flow through the air heaters. From the air heaters the gases enter the breechings or ductwork components 100 from which the gases flow to a stack.

Air, to support combustion in the cyclones passes from an appropriate forced draft fan, or fans, to the air inlet ducts 102 and 104 (Fig. 4), thence through connected ductwork 106 and 108, and then through a first pass 110, as indicated by the arrow 112 across the gas conducting tubes of the section 78 of the air heater, whence they continue then upwardly as indicated by the arrow 114 to the second pass 116 in which they flow to the right transversely of the lower part of the tubes of the air heater section 78. These parts of these tubes are separated by a division plate 118 (Fig. 2 and Fig. 4) from the upper parts of the tubes between which the air passes in a third pass as indicated by the arrow 120. From this third pass the gases pass downwardly through one or more ducts 122 to the air inlets of the respective cyclone coal burners. The ductwork or chamber 124 provides for the turning of the air stream as it emerges from the pass 112, and its entry into the pass 116, and similar ductwork or chamber 126 provides for the passage of gases from the pass 116 through the last pass 120.

It is to be understood that the arrangement of air heater components just described is duplicated on the other side of the unit, with the ducts 128 directing heated air to the different cyclones 26, 28 and 30.

Feedwater is conducted from an appropriate source to the inlet header 130 or the first economizer 70. From this economizer the feedwater flows from the outlet header 132 through an appropriate conduit 134 to the inlet header 136 of the second economizer, including the banks of tubes 90—92. From the outlet header 138 of the second economizer the heated feedwater flows through appropriate connections to the steam and water drum 46.

Steam and water mixtures fed into the drum 46 by all of the steam generating tubes are subject to steam and water separation (preferably by cyclone separators of the

type shown in the Rowand et al. Patent 2,289,970), with the separated steam passing through tubes 140 to the inlet header 142 of the primary superheater. Thence the steam passes through the return bend tubes forming the bank of tubes 65—69 and to the outlet header 144. From this outlet header part of the steam passes through the tube 145 to the inlet header 146 of a part of the secondary superheater, including the banks of tubes 62 and 64. The remainder of the steam from the header 144 passes through the tube 150 to the inlet header 152 of the banks of tubes 82 and 84 constituting the other part of the secondary superheater.

From the outlet ends of the serially connected return bend tubes constituting the banks of tubes 82 and 84, the superheated steam passes through the outlet headers 154 and 156, and thence to a point of use. Similarly at the other side of the unit the steam superheated in the serially connected return bend tubes constituting the banks of tubes 62 and 64 of the first part of the secondary superheater passes from those tubes to the outlet headers 158 and 160 whence the steam may pass to junction with the steam exiting from the headers 154 and 156, and then pass to a point of use.

Convection superheaters and reheaters such as those shown in the drawings tend to give too high a steam temperature at loads above their control point loads. They also tend to give too low steam temperature at loads below their control point loads, and inasmuch as it is highly important that these inherent tendencies be overcome in order that a predetermined superheat temperature and a predetermined reheat temperature may be maintained over a wide load range, the invention includes means for compensating for these inherent tendencies.

For effecting a predetermined superheat temperature and a predetermined reheat temperature over a wide load range the illustrative unit involves various means for controllably varying gas temperature and gas mass flow over the superheaters and the reheater as the load changes. Spray attemperation of the superheated steam, for superheat control purposes, is also involved, preferably at a position between the outlets of the primary superheater and the inlets of the secondary superheater.

Control of gas temperature and gas mass flow over the superheater and the reheater is effected by a recycled or recirculated gas system which withdraws partially cooled combustion gases from a position downstream of the economizer and effects the entry of the returned gases into the secondary furnace chambers at a position just ahead of the secondary superheater. Effective mixing of the returned gases at this position with the gases issuing directly from the fuel burning means not only promotes superheat and reheat control by regulation of the gas temperature and gas mass flow over the convection surfaces, but it also permits the operation of the fuel burning means at gas temperatures which would otherwise be too high under some conditions of operation, for safe contact with the convection surfaces. This return of partially cooled combustion gases and the mixing of such gases with the other furnace gases at positions just ahead of the convection surfaces may be referred to as gas tempering. Such returned gas flow for gas tempering purposes will be usually at a maximum at high load and high rates of fuel burning, and a reduction of this tempering effect may be combined with a change of the amount of spray attemperation as a load decreases, to be effective in the over-all steam temperature control.

At low loads, or in the lower part of the load range the returned combustion gases are caused to enter the primary furnace chambers for flow through and along walls of those chambers, before entering the secondary furnace chambers. This recirculated gas flow has a double effect toward maintaining a predetermined steam temperature in the lower part of the load range. One part of this effect is the increase in gas mass flow over the convec-

tion surfaces, and the other part of the effect is the reduction of heat transfer to the heat absorbing surfaces of the furnace chambers.

Another part of the over-all superheat control system involves separately regulable sets of dampers **72** and **94**, for the separate gas flows through the gas passes leading from the secondary combustion chambers and across the convection surfaces.

Referring to Figs. 4 and 2 of the drawings the partially cooled combustion gases are withdrawn from a ductwork component **162** in the path of the gases leading from the outlets of the separate convection gas passes to the air heater. Communicating with the ductwork component **162** is a duct **164** leading to the inlet **166** of a recirculated gas fan, the outlet **168** of which is connected to the tempering gas outlet chambers **180** and **182** and with the recirculated gas outlet chambers **184** and **186** by ductwork components **170—176**. These ductwork components are appropriately dampered as at **190** and **192**, and otherwise, in order that recirculated gas flow to the chambers **184** and **186** may be shut off or appropriately controlled throughout a desired range, and in order that a tempering gas flow to the chambers **180** and **182** may be shut off or appropriately controlled throughout a desired load range.

For effective entry of tempering gas at a position just ahead of the convection sections and for effective mixing of the recycled and unrecycled gases the tubes of the division wall **14** are so constructed and arranged to provide an additional tempering gas outlet chamber or duct **200** at a level adjacent to the level of the tempering gas outlet chambers **180** and **182**. This tempering gas outlet chamber **200** may be defined by bending some of the division wall tubes **14** to the right out of their wall forming alignment, and then returning them to that alignment, others of the division wall tubes being bent to the left in a similar manner. The bent out portions of the division wall tubes may have inter-tube stud plates welded thereto to sufficiently define the duct or chamber **200**, with distributed openings for the exit of gases. This chamber or duct **200** extends through the wall of the secondary furnace chamber facing the observer in Fig. 1 and is connected to a vertical duct **202** comunicating with the outlet of the recirculating gas fan through the ductwork components **170—172**. The duct **202** is appropriately dampered at **204** for the control of tempering gas flow to the outlet duct of chamber **200**.

For the flow of tempering gas from the chambers **180** and **182** into the secondary furnace chambers **12** and **10** some of the wall tubes along the inner sides of these chambers **180** and **182** are bent out of their wall alignment to provide openings through which the tempering gas may flow.

The recirculated gases entering the chambers **184** and **186** flow therefrom downwardly into the primary furnace chambers **34** and **54**. This flow may take place in openings provided between the headers **210** and **212** and adjacent steam generating tube sections **214** and **216** which are integral with the tube sections forming the primary furnace chamber screens **36** and **56**. The headers **210** and **212** are connected to the lower headers or drums **58** and **60**, respectively, by steam generating tubes **220** and **222**. Some of the tubes **220** and **222** may be bent out of their wall forming alignment to provide openings through which the recirculated gases flow into the primary furnace chambers **34** and **54**. The headers **210** and **212** for these tubes are appropriately connected into the circulation of the unit, preferably by direct connections to the drum **46**.

As to the control of returned or recycled gases for tempering purposes through the outlet chambers **180**, **182** and **200**, it is contemplated that there shall be a maximum flow of gases at maximum load, when there will be a minimum flow of recirculated gases through the chambers **184** and **186** into the primary furnace chambers **34** and **54**. As the load and firing rate decrease from the maximum, the flow and entry of the tempering gases will be decreased and the flow of recirculated gases through the chambers **184** and **186** will be increased to a maximum at a predetermined low load value.

It is contemplated that the flow of tempering gases to the upper parts of the secondary furnace chambers **10** and **12** shall be automatically controlled from registered and recorded variables, such as gas temperatures at the upper parts of the secondary furnace chambers, representations of load and steam temperatures. Similarly, it is contemplated that the flow of recirculated gas from the outlet chambers **184** and **186** shall be automatically controlled from registered representations of load and steam temperatures.

Gas flow through the gas pass **22** leading upwardly from the secondary furnace chamber **12** and over the reheater including the banks of tubes **86—88** may be controlled by operation of the dampers **94** at the outlet of this gas pass. The control of these dampers as well as the control of the dampers **72** at the outlet of the gas pass **24** leading from the secondary furnace chamber **10** not only may be such as to prevent gas flow over the reheater during starting up of the unit when no steam flows through the reheater, for the purpose of protecting the reheater, but may also be such as to limit all attemperation to superheated steam only. In this event, and when the dampers **72** and **74** are automatically operated one of the predominant influences in such operation will be the steam temperature at or adjacent the outlet of the reheater.

For the purpose of periodically removing accumulations of solids upon the heat absorptive surfaces in the secondary furnace chambers **10** and **12**, and in the convection section, retractible soot blowers are operated through openings indicated at **230—234** in Fig. 1. Such retractible soot blowers are indicated at **236** as operable through openings in the side wall **228**, in Figs. 2 and 5. The opposite wall **226** is indicated as having a similar arrangement of retractible soot blowers **240** operated therethrough. Because of the twin furnace construction of the illustrated unit with its division wall of steam generating tubes, the transverse dimension of the convection section and the secondary furnace chambers across which the retractible soot blowers are operated, is materially reduced, in order that soot blowers of reduced lengths may be used. This increases the availability of the unit by increasing the life of the soot blowers, because of their shorter length. The longer soot blowers used in the illustrated unit have a length of the order of 20 feet. Referring to the disclosure of Fig. 2, it will be noted that the air heater including the sections **76** and **78** is spaced sufficiently from the wall **226** of the secondary furnace chamber and the convection section to permit the operation of the soot blowers **240** between the facing walls of the air heater and the furnace and convection section component of the unit.

The lateral spacing of the soot blowers **236** operated through openings in the wall **228** is such that they do not place any substantial limitation upon the location of downcomers intermediate the length of the steam water drum **46**. The downcomer **250**, together with the end downcomers **252** and **254** lead directly downwardly from the drum **46** to the level of the lower headers or drum **16**, **58** and **60**. The intermediate downcomer **250** is joined directly to the lower drum **16**, and the downcomers **252** and **254** are integral with the lower drums **60** and **58**, respectively.

The drum **46**, with its depending downcomers **250**, **252** and **254**, as well as the remainder of the main components of the unit are pendently supported from the top of steelwork including the uprights **300—308** joined at their upper ends by horizontals **310—317**. The beams, or horizontal elements of the steelwork **317** are preferably disposed in pairs along the top of the steelwork and in

the direction of the length of the drum **46**, with the drum straps **320** disposed between the elements **317**, of each of said pair. In this way, and with the arrangement of elements shown and described, the drum may be supported at a plurality of positions distributed lengthwise of the drum, to the end that drum bending stresses are materially reduced, or minimized.

Fig. 2 of the drawings indicates the furnace walls **226** and **228** as lined by rows of steam generating tubes. The tubes **330**, along the wall **228** have their lower ends connected to the lower header **332** which is preferably in appropriate connection with one or more of the lower drums or headers **16**, and **60**. The upper ends of these steam generating wall tubes are connected to the upper header **334** which, in turn, is connected to the drum **46** by the tubes **336**. At the opposite side of the furnace chambers there is a similar arrangement of tubes and headers including the lower header **340** from which the wall tubes **342** extend along the wall **226** to the upper header **344**. The latter is appropriately connected to the drum **46**. The lower headers **332** and **340** may be directly connected by floor tubes **346**.

Although the invention has been shown and described with reference to the specific details of one embodiment, it is to be understood that the invention is not to be taken as limited to all of the details shown and described. It is rather to be taken as a scope commensurate with the scope of the subjoined claims.

What is claimed is:

1. In a high capacity steam generating and superheating unit of the radiant type, a furnace chamber having steam generating tubes along its walls, fuel burning means for producing high temperature gases for passage through the furnace chamber, a convection section including a tubular steam heater receiving gases from the furnace chamber, means normally conducting steam to the steam heater, a division wall including steam generating tubes dividing the furnace chamber into two sections with portions of said tubes outlining a recycle gas outlet chamber or duct communicating with both sections of the furnace chamber at a position remote from the fuel burning means, the division wall so dividing the furnace chamber that the sections of the latter are subject to parallel flow of gases from the fuel burning means, the steam heater having different parts exposed to the gas flows from the different furnace sections, and a recycled gas system including a fan with its inlet communicating with the gas flow path downstream of the steam heating means and its outlet connected with said chamber or duct.

2. In a high capacity steam generating and superheating unit of the radiant type, a furnace chamber having steam generating tubes along its walls, fuel burning means for producing high temperature gases for passage through the furnace chamber, a convection section including a steam heater receiving gases from the furnace chamber, means normally conducting steam to the steam heater, a division wall including steam generating tubes dividing the furnace chamber into two sections with oppositely bent out portions of said division tubes near the gas outlet of the furnace chamber outlining a recycled gas outlet chamber or duct, the division wall so dividing the furnace chamber that the sections of the latter are subject to parallel flow of gases from the fuel burning means, the steam heater having different parts exposed to the gas flows from the different furnace sections, and a recycled gas system including a fan with its inlet connected with the gas flow path downstream of the steam heating means and its outlet connected with said chamber or duct.

3. A high capacity steam generating and superheating unit operating at high steam pressures, walls including steam generating tubes defining a furnace chamber, a convection section including a convection steam heater receiving furnace gases from the furnace chamber, means normally conducting steam to the steam heater, fuel burning means producing combustion gases for passage through the furnace chamber and then through the convection section, a division wall including steam generating tubes dividing the furnace chamber into two separate furnace chamber sections, the division wall so dividing the furnace chamber that the sections of the latter are subject to parallel flow of gases from the fuel burning means, the steam heater having different parts exposed to the gas flows from the different furnace sections, some of said division wall tubes being bent outwardly from one side of the division wall for a short vertical length and then returned to the wall alignment below that position, others of the division wall tubes being bent in the opposite direction from said first bent division wall tubes and returning to the wall alignment at a similar lower position, said bent portions of the division wall tubes outlining a chamber or outlet duct extending into the furnace chamber sections from an opening in a wall of the furnace chamber section, and a recycled gas system including a fan and an inlet duct leading to the inlet of the fan from a position in the gas flow path downstream from the steam heating means, said recycled gas system also including outlet duct means leading from the outlet of the fan to positions along the furnace chamber walls confronting said recycle gas outlet chamber formed by the bent division wall tubes and at a position remote from the fuel burning means, and means for varying the flow of recycled gases through said system to decrease said flow from a maximum at maximum load.

4. A high capacity steam generating and super-heating unit operating at high steam pressures, walls including steam generating tubes outlining a furnace chamber, a convection section including a convection steam heater receiving furnace gases from the furnace chamber, fuel burning means producing combustion gases for passage through the furnace chamber and then through the convection section, means normally conducting steam to the steam heater, division wall including steam generating tubes dividing the furnace chamber section into two tubes dividing the furnace chamber section into two separate furnace chamber sections, the division wall so dividing the furnace chamber that the sections of the latter are subject to parallel flow of gases from the fuel burning means, the steam heater having different parts exposed to the gas flows from the different furnace sections, some of said division wall tubes being bent outwardly from one side of the division wall for a short vertical length and then returned to the wall alignment below that position, said bent portions of some of the division wall tubes combining with other division wall tubes to outline a chamber or outlet duct extending into the furnace chamber sections from an opening in a wall of the furnace chamber, and a recycled gas system including a fan and an inlet duct leading to the inlet of the fan from a position in the gas flow path downstream from the steam heating means, said recycled gas system also including outlet duct means leading from the outlet of the fan to positions along the furnace chamber walls confronting said recycled gas outlet chamber formed by the bent division wall tubes and at a position remote from the fuel burning means, and means for varying the flow of recycled gases through said system to decrease said flow from a maximum at maximum load.

5. In a high capacity steam generating and super-heating unit of the radiant type, a furnace chamber having steam generating tubes along its walls, fuel burning means for producing high temperature gases for passage through the furnace chamber, a convection section including a steam heater receiving gases from the furnace chamber, means normally conducting steam to the steam heater, a division wall including steam generating tubes dividing the furnace chamber into two sections with portions of said tubes remote from the fuel burning means defining a recycled gas duct, the division wall so dividing the furnace chamber that the sections of the latter are subject

to parallel flow of gases from the fuel burning means, the steam heater having different parts exposed to the gas flows from the different furnace sections, a recycled gas system including a fan with its inlet connected with the gas flow path downstream of the steam heating means and its outlet connected with said recycled gas duct, the recycled gas duct having openings for recycled gas flow into each furnace section, and means in each of the furnace walls opposite the division wall connected with the recycled gas system outlet and having openings through which recycled gas flows toward the division wall.

6. A vapor generating and superheating unit having walls defining a furnace chamber and a superjacent convection section arranged to receive heating gases therefrom, vapor generating tubes lining walls of said furnace chamber, vapor superheating tubes arranged in said convection section, means providing a heating gas flow through said furnace chamber and convection section, vapor generating tubes arranged to define a vertically extending division wall dividing the furnace chamber into two side-by-side sections having a parallel flow of heating gases therethrough, a gas recirculation system including a fan with its inlet communicating with said convection section downstream of said vapor superheating tubes, portions of said division wall tubes being bent to define opposite sides of a gas outlet duct opening to both sections of said furnace chamber, and conduit means connecting the outlet of said fan to said gas outlet duct.

7. A vapor generating and superheating unit having walls defining a furnace chamber and a superjacent convection section arranged to receive heating gases therefrom, vapor generating tubes lining walls of said furnace chamber, vapor superheating tubes arranged in said convection section, means providing a heating gas flow through said furnace chamber and convection section, vapor generating tubes arranged to define a vertically extending division wall dividing the furnace chamber into two side-by-side sections having a parallel flow of heating gases therethrough, a gas recirculation system including a fan with its inlet communicating with said convection section downstream of said vapor superheating tubes, portions of said division wall tubes being bent to define opposite sides of a gas outlet duct opening to both sections of said furnace chamber, conduit means connecting the outlet of said fan to said gas outlet duct, and means in each of the furnace chamber walls opposite said division wall connected to said fan outlet and arranged to discharge recirculated gas towards said division wall.

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U. S. DEPARTMENT OF COMMERCE

PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,800,116 Arthur E. Raynor et al. July 23, 1957

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 38, after "heater," insert -- a --; line 40, strike out "tubes dividing the furnace chamber section into two".

Signed and sealed this 17th day of June 1958.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents