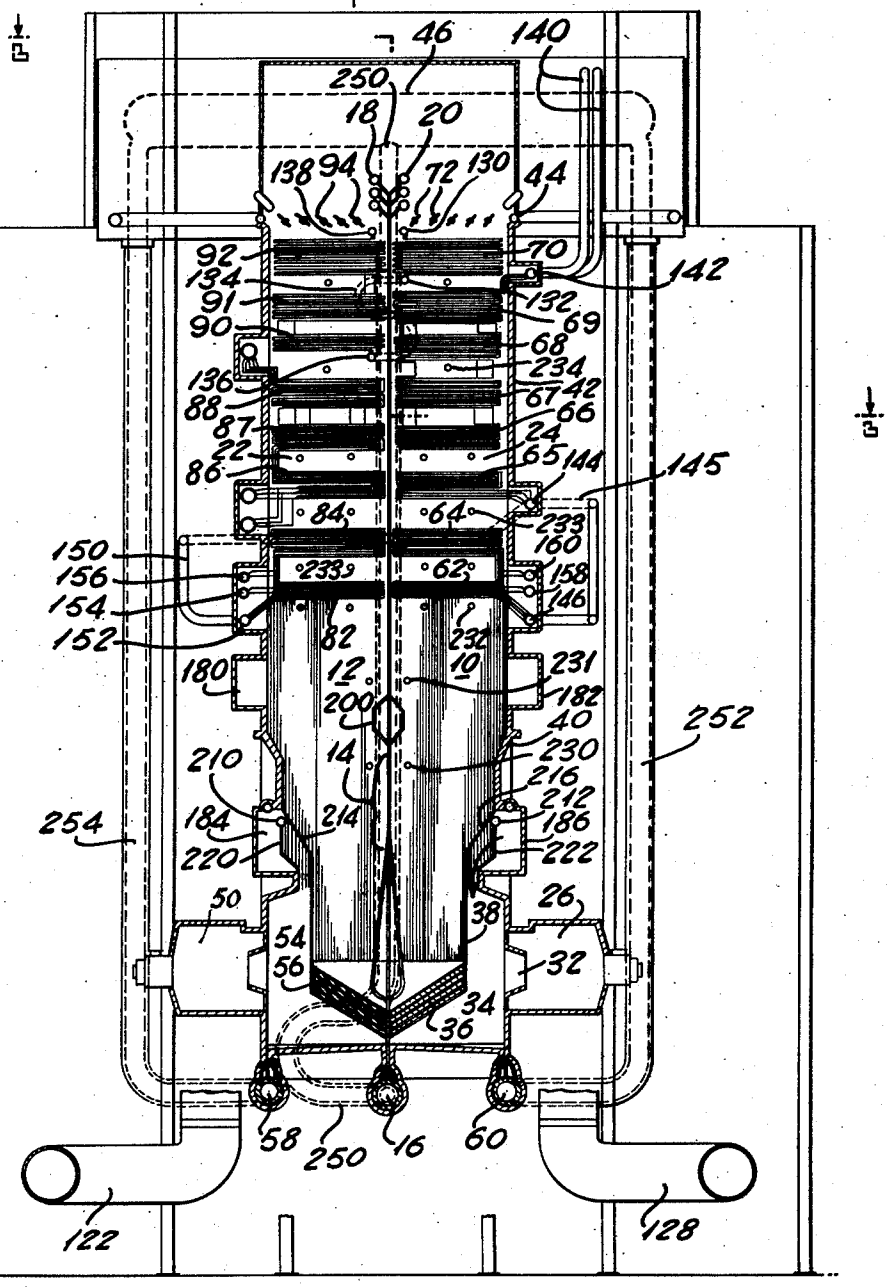
July 23, 1957 C. R. CHAN ET AL 2,800,115

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

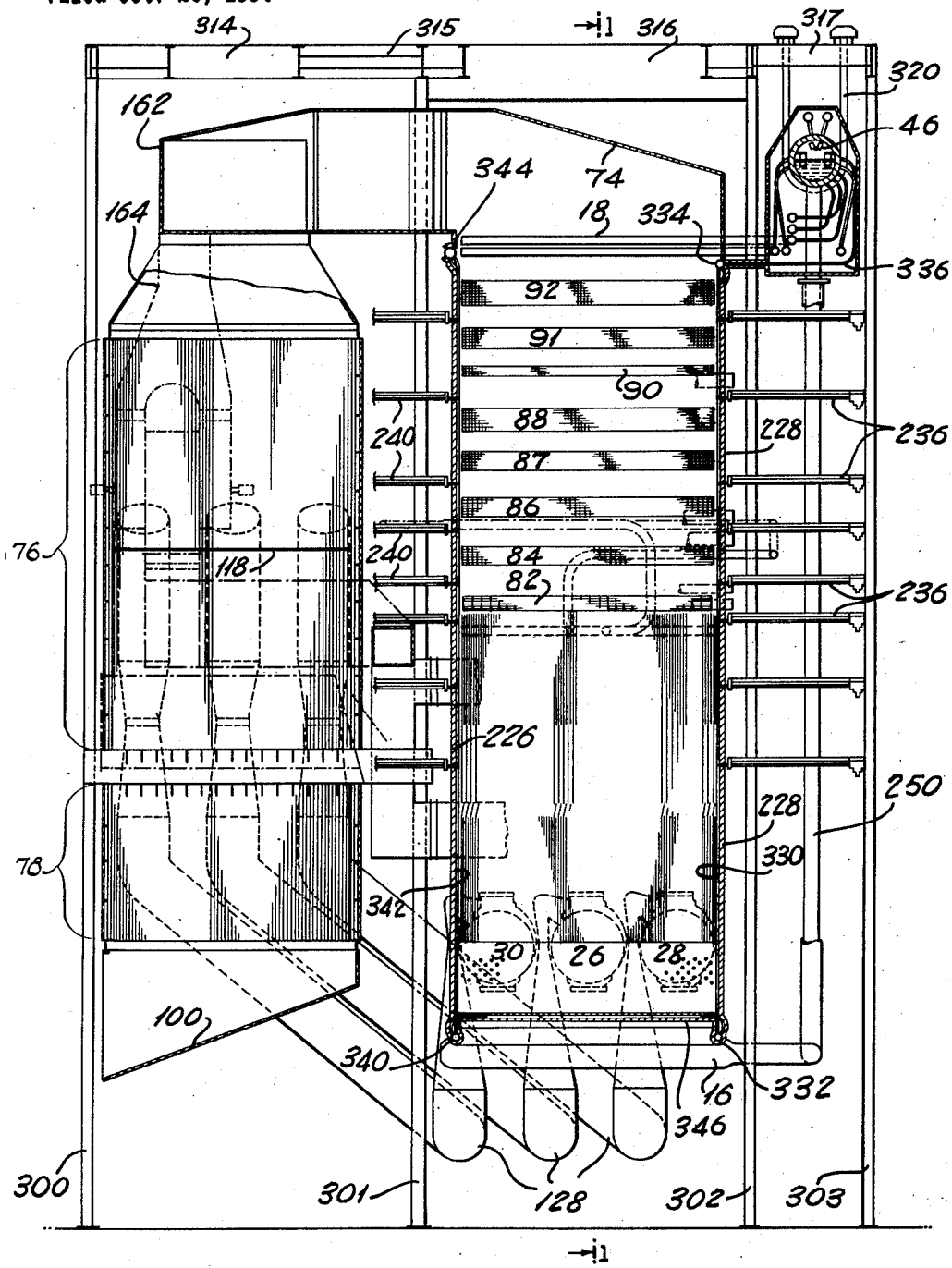


Fig. 2.

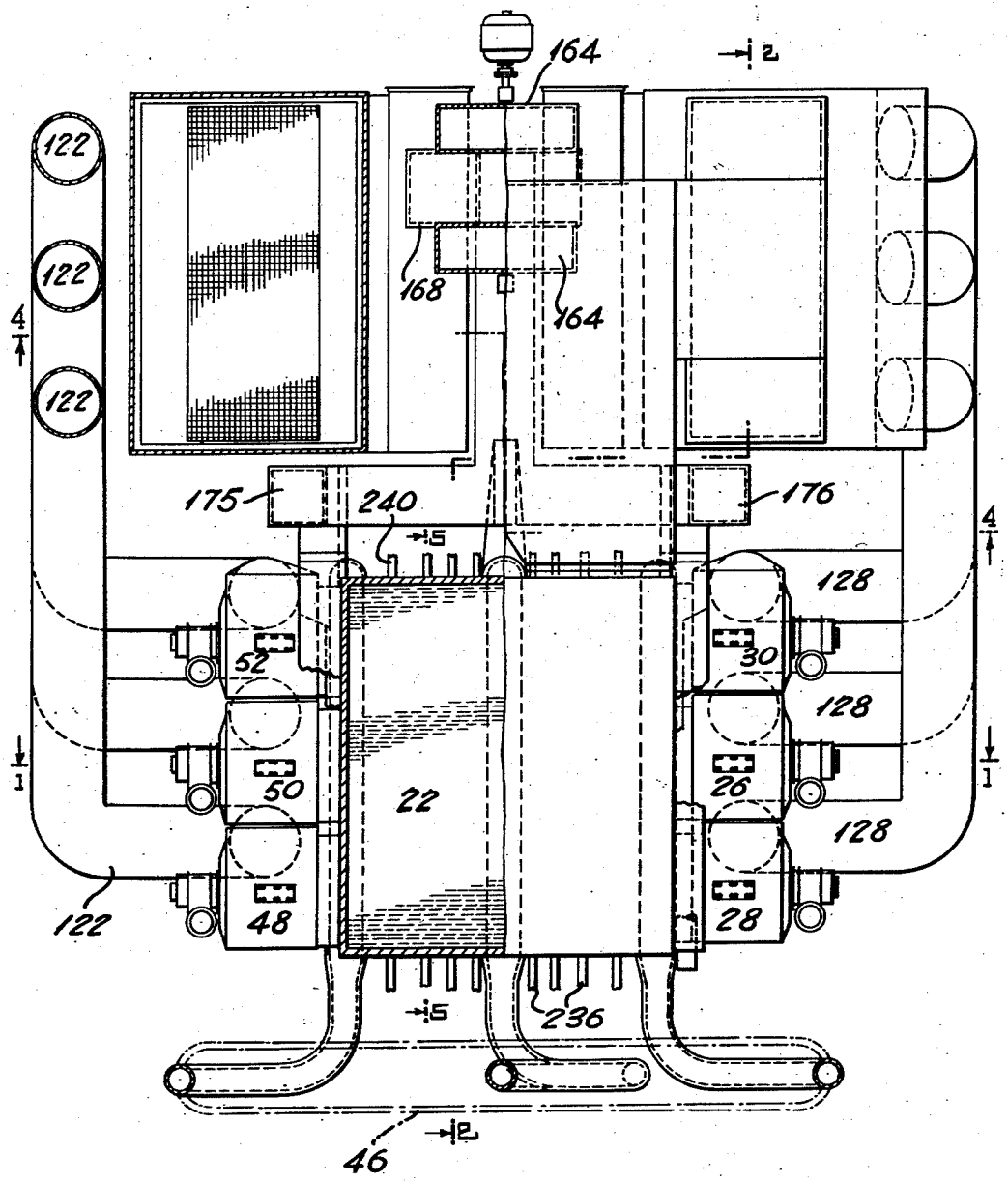
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STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

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Fig. 3.



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STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

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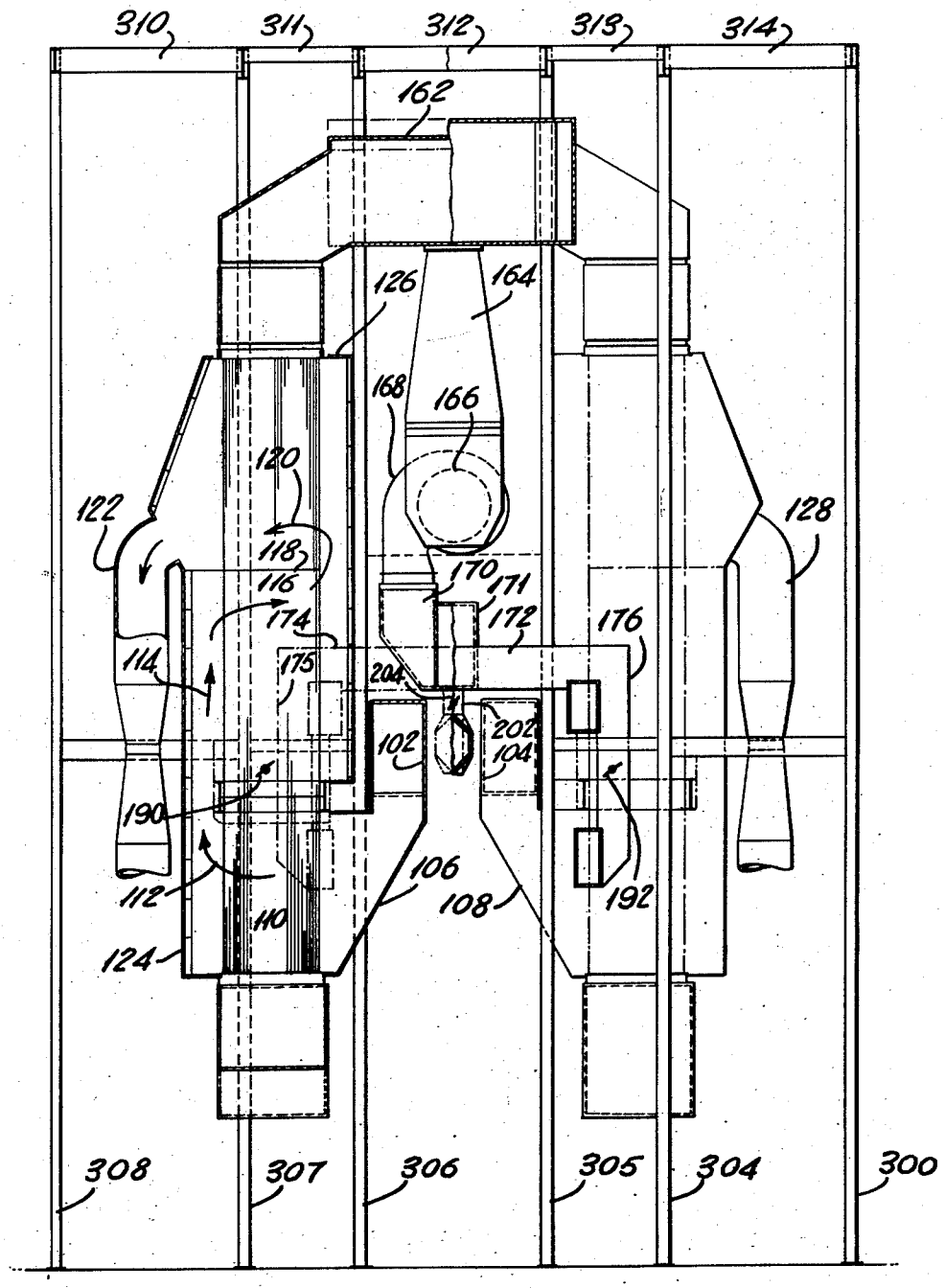


Fig 4.

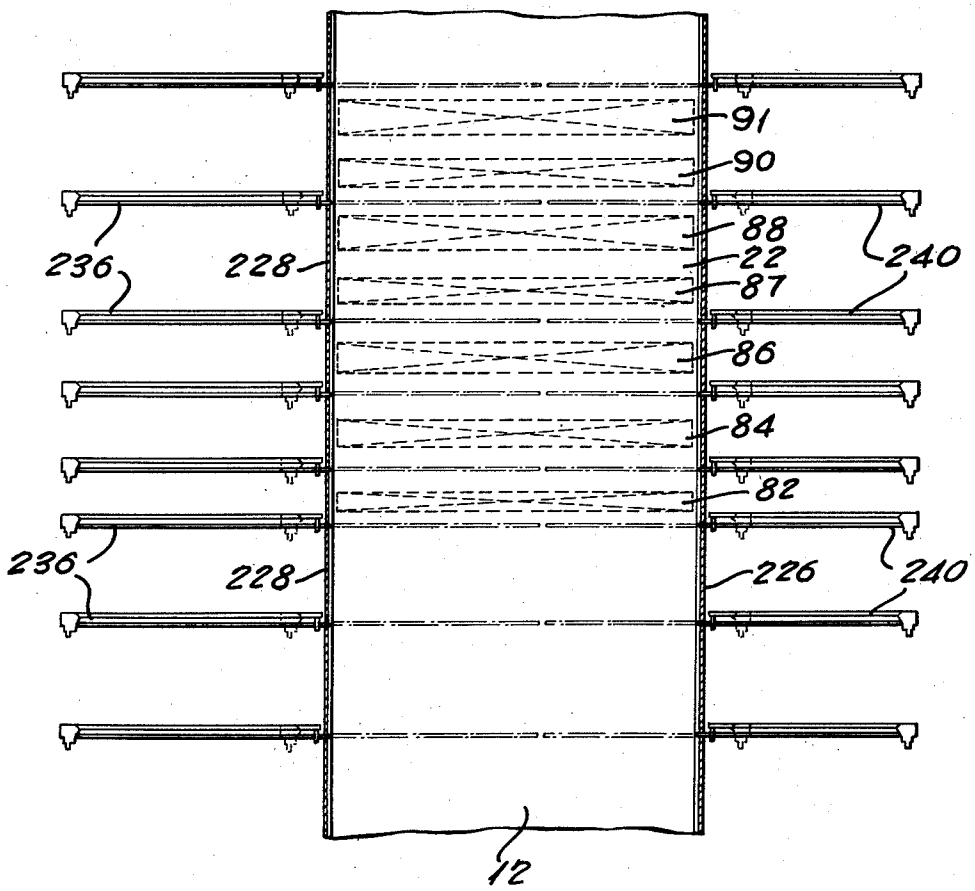
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STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

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Fig. 5.



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United States Patent Office 2,800,115 Patented July 23, 1957

2,800,115

STEAM GENERATING AND SUPERHEATING UNIT WITH RECYCLED GAS FLOW

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Application October 20, 1954, Serial No. 463,368

3 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.

Arranged along, and at the upper portion of the fourth side of the unit, is a steam and water drum to which the outlets of the steam generating tubes are connected. With this arrangement, and with no fuel burners or air heaters or other appurtenances arranged along the fourth side of the unit, the drum may be provided with a plurality of large diameter downcomers distributed along the length of the drum, and each of these downcomers may lead directly to a position at the bottom of the unit and adjacent the lower drums or headers from which the steam generating division wall tubes and side wall tubes extend upwardly. With this arangement of downcomers and, particularly, with downcomers at positions intermediate the length of the drum, the drum weight, cost and diameter, are reduced for a unit of a certain capacity because of the reduction in the flow of water lengthwise of the drum. Such cost reduction is a material factor in steam generating units having a capacity in excess of 1,000,000 pounds of steam per hour and operating at pressures in excess of 2,000 pounds per square inch. Drums for such installations have wall thicknesses ranging from 5½" to 8", and the total weight of such a drum has been of the order of 180 tons. It is therefore clear that the drum cost of a unit of such capacity is a substantial part of the total cost of the unit, and any substantial reduction in drum costs results in a substantial reduction in the original cost of the entire unit, and a consequent reduction in the cost of electrical power supplied by the station of which the unit is a part.

The above indicated arrangement of a steam water drum relative to the other components of the unit also minimizes drum bending stresses in operation, because it permits of increased freedom or latitude with respect to the location of the drum straps. These drum straps, or drum supports, may be located at distributed positions along the length of the drum and the number of such permissible locations is substantially increased by the pertinent arrangement.

With the above indicated arrangement, and when the division wall extends through or divides the convection sections, as well as the furnace chambers, the furnace width is reduced by reason of the pertinent twin design, and therefore soot blower elements of shorter lengths may be used, resulting in a substantial increase in life of the soot blowers, and a consequent reduction in the cost of electric power produced by the station of which the unit is a part.

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 indepndent 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 head 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, re-

course should be had to the following description which refers to the accompanying drawings in which a preferred embodiment of the invention is shown.

In 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 steam generating tubes are bent out of the plane of the division wall 14 to define an opening 14' connecting the chambers 10 and 12. 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, 59 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 gas separately flows from the separate secondary furnace chambers 10 and 12 and 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 are 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 of 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 the 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 tem-

perature and a predetermined reheat temperature may be maintained over a wide load range, the invention inlcudes 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 convection 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 intertube 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** communicating 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 drum **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 as 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 drums **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 use of such downcomers intermediate the length of the drum, in combination with end downcomers, materially reduces the drum space requirement for flow of water longitudinally of the drum to the downcomers, and thereby reduces drum diameter, drum weight and cost. The drum length for the illustrative unit is also reduced because of the unit's characteristic high ratio of heat absorptive surfaces to furnace volume. This attribute, resulting in a substantial reduction in drum cost may be recognized as of substantial importance when it is considered that the drums of some steam generating and superheating units of similar high capacity have had lengths of 30 to 50 feet, and weights of the order of 180 tons. The cost of such drums, when they are made of alloy steel, may be well recognized as being a substantial part of the entire cost of the steam generating and superheating unit.

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**, **58** 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 dum **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 of a scope commensurate with the scope of the subjoined claims.

What is claimed is:

1. In a high capacity steam generating and superheating unit operating at high steam pressures, a first component including a vertically elongated unitary construction for upright flow of high temperature gases, said component having upright walls including steam generating tubes arranged to form a furnace space toward the lower part of the component and a gas flow space for a convection section above the furnace space, an upright division wall dividing the first component into separate secondary furnace chambers and separate gas passes there-above leading upwardly from the secondary furnace chamber, the division wall including steam generating tubes extending from the lower part of the unit toward the upper part thereof and past the gas passes for the convection section, a row of cyclone coal burners at the lower part and at one side of said unit, means including some of said steam generating tubes defining a primary furnace chamber common to the outlets for said cyclones and disposed between the cyclones and the gas entrance through one of the secondary furnace chambers, a row of cyclone burners in the opposite side of the component and firing oppositely from the first row of cyclone burners, a second primary furnace chamber common to the second row of cyclones and interposed relative thereto and the other secondary furnace chamber, some of said steam generating tubes forming separate tubular screens each leading across gas flow from said primary furnace chambers to their associated secondary furnace chambers, a convection steam reheater disposed at one side of the division wall and in the gas pass leading from one of the secondary furnace chambers, a steam superheater of a convection type disposed in the gas pass leading from the other of the secondary furnace chambers, separately operable gas flow control means for independently controlling the gas flow through said separate gas passes, a recycled combustion gas system including a fan and inlet ductwork leading to the inlet of the fan from a position in the gas flow path downstream of a superheater or reheater, outlet ductwork connected with the outlet of the fan and communicating separately with said secondary furnace chamber near the upper portion thereof and adjacent steam heating surfaces of the convection section, a spray attemperator disposed intermediate the steam flow path through the superheater, means for controlling the flow of recycled gases into the secondary furnace chamber as tempering gases so that the flow of said gases decreases as the load on the unit decreases from maximum, the attemperator being operated to decrease the amount of attemperation as the load decreases, said recycled gas system including outlet ducts or chambers in dampered communication with the primary furnace chambers for the increasing flow of recirculated gases into the primary furnace chambers as the load decreases, toward the minimum load over a lower part of the load range, a steam and water drum, means connecting the outlet ends to the steam generating tube to said drum, and means connecting the steam space of said drum to the inlets of the superheater tubes.

2. In a high capacity steam generating and superheating unit operating at high steam pressures, a first component including a vertically elongated unitary construction for upward flow of high temperature gases, said component having upright walls including steam generating tubes arranged to form a furnace space toward the lower part of the component and a gas flow space for a convection section above the furnace space, an upright division wall dividing the first component into separate secondary furnace chambers and separate gas passes there-above leading upwardly from the secondary furnace chamber, the division wall including steam generating tubes extending from the lower part of the unit toward the upper part thereof and past the gas passes for the convection section, a row of cyclone coal burners at the lower part and at one side of said unit, means including some of said steam generating tubes defining a primary furnace chamber common to the outlets for said cyclones and disposed between the cyclones and the gas entrance through one of the secondary furnace chambers, a row of cyclone burners in the opposite side of the component and firing oppositely from the first row of cyclone burners, a second primary furnace chamber common to the second row of cyclones and interposed relative thereto and the other secondary furnace chamber, some of said steam generating tubes forming separate tubular screens each leading across gas flow from said primary furnace chambers to their asociated secondary furnace chambers, convection steam heaters disposed on both sides of the division wall and in the gas pass leading from the secondary furnace chambers, separately operable gas flow control means for independently controlling the gas flow through said separate gas passes, a recycled combustion gas system including a fan and inlet ductwork leading to the inlet of the fan from a position in the gas flow path downstream of said steam heaters, outlet ductwork connected with the outlet of the fan and communicating separately with said secondary furnace chambers near the upper portion thereof and adjacent steam heating surfaces of the convection section, a spray attemperator disposed intermediate the steam flow path through the steam heaters, means for controlling the flow of recycled gases into the secondary furnace chamber as tempering gases so that the flow of said gases decrease as the load on the unit decreases from maximum, said recycled gas system including outlet ducts or chambers in dampered communication with the primary furnace chambers for the increasing flow of recirculated gases into the primary furnace chambers as the load decreases, toward the minimum load over a lower part of the load range, a steam and water drum, means connecting the outlet ends of the steam generating tubes to said drum, and means connecting the steam space of said drum to the inlets of the steam heater tubes.

3. In a high capacity steam generating and superheating unit operating at high steam pressures, a first component including a vertically elongated unitary construction for upward flow of high temperature gases, said component having upright walls including steam generating tubes arranged to form a furnace space toward the lower part of the component and a gas flow space for a convection section above the furnace space, an upright division wall dividing the first component into separate secondary

furnace chambers and separate gas passes there-above leading upwardly from the secondary furnace chambers, the division wall including steam generating tubes extending from the lower part of the unit toward the upper part thereof and past the gas passes for the convection section, a row of cyclone coal burners at the lower part and at one side of said unit, means including some of said steam generating tubes defining a primary furnace chamber common to the outlets for said cyclones and disposed between the cyclones and the gas entrance through one of the secondary furnace chambers, a row of cyclone burners in the opposite side of the component and firing oppositely from the first row of cyclone burners, a second primary furnace chamber common to the second row of cyclones and interposed relative thereto and the other secondary furnace chamber, some of said steam generating tubes forming separate tubular screens each leading across gas flow from said primary furnace chambers to their associated secondary furnace chambers, means defining an opening in the lower portion of said division wall, a convection steam reheater disposed at one side of the division wall and in the gas pass leading from one of the secondary furnace chambers, a steam superheater of a convection type disposed in the gas pass leading from the other of the secondary furnace chambers, separately operable gas flow control means for independently controlling the gas flow through said separate gas passes, a recycled combustion gas system including a fan and inlet ductwork leading to the inlet of the fan from a position in the gas flow path downstream of a superheater or reheater, outlet ductwork connected with the outlet of the fan and communicating separately with said secondary furnace chambers near the upper portion thereof and adjacent steam heating surfaces of the convection section, a spray attemperator disposed intermediate the steam flow path through the superheater, means for controlling the flow of recycled gases into the secondary furnace chamber as tempering gases so that the flow of said gases decreases as the load on the unit decreases from maximum, the attemperator being operated to decrease the amount of attemperation as the load decreases, said recycled gas system including outlet ducts or chambers in dampered communication with the primary furnace chambers for the increasing flow of recirculated gases into the primary furnace chambers as the load decreases, toward the minimum load over a lower part of the load range, a steam and water drum, means connecting the outlet ends to the steam generating tube to said drum, and means connecting the steam space of said drum to the inlets of the superheater tubes.

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