

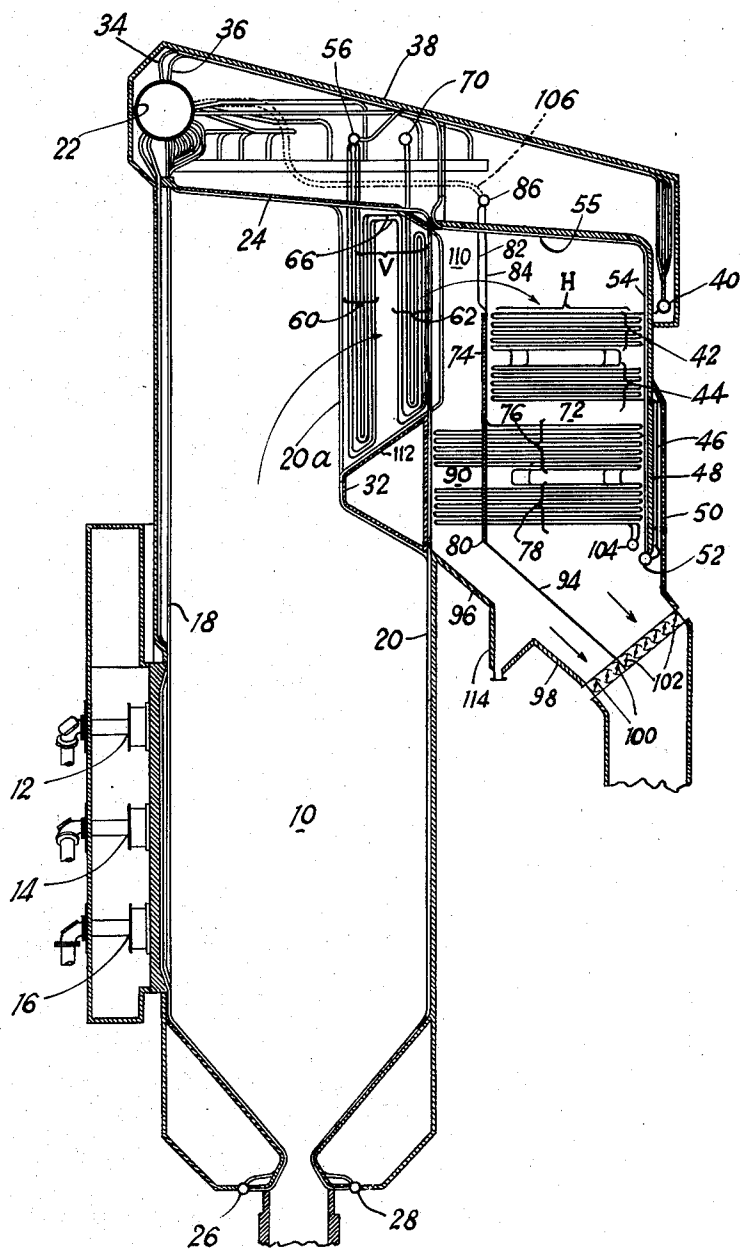
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FLUID HEAT EXCHANGE INSTALLATION

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FLUID HEAT EXCHANGE INSTALLATION

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This invention relates to fluid heaters, and is particularly concerned with apparatus for maintaining relatively constant the temperature of a fluid heated by a tubular heater.

The invention is particularly concerned with a fluid heater which is adapted for association with apparatus using the heated fluid in such a way that it is of great importance that the temperature of that fluid be maintained at a relatively constant value, within close limits.

As an example of the application of the invention a high temperature steam generator is referred to. Experience in the field of steam generation, and particularly with large boilers of the type used in stationary practice to supply steam for turbo-electric generators, has demonstrated that certain conditions are necessary in order that the maximum of practical efficiency may be attained. Many of these conditions are difficult to fulfill, and this is particularly true of the maintenance of constant superheat, or the final temperature of steam. Relatively high steam pressures must be used in such boilers, in the interest of efficiency. For the turbine use of such high pressure steam, the steam must not only be superheated to higher temperatures as steam pressures increase, but it is of considerable importance that the total steam temperature shall remain substantially constant over a wide range of boiler loads. This is particularly important in the operation of large central power stations which are subject to daily peak load demands.

It is also important that a superheater for effecting the above indicated result shall be screened to a considerable extent from furnace radiation. One reason for this is the importance of preventing the superheat from being too high. Such high temperatures may damage turbines or permit the metal of the superheater tube to be overheated to a damaging degree. This is particularly apt to occur when steam flow is deficient or absent, as for example, when a boiler is being started up.

The superheater of this invention is heated mainly by convection from furnace gases. Such a superheater, when designed for safe metal temperature and desired superheat at the full boiler load, is apt to be deficient of superheating capacity at frictional loads. The factors which require the predetermined superheat at full load are still effective at fractional loads. It is one object of this invention to overcome this difficulty in a reliable manner.

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Further objects of the invention will appear as the following description proceeds.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawing which illustrates a preferred form of apparatus for attaining the desired results.

The drawing is a somewhat diagrammatic view in the nature of a vertical section, showing a modern high pressure steam generator in which a superheater is incorporated in a manner to attain the desired results.

The drawing discloses a large combustion chamber 10 of rectangular cross section fired by burners such as 12, 14, and 16. The walls of this combustion chamber are delineated by steam generating tubes such as 18 and 20 receiving heat from combustion taking place in the combustion chamber 10 and transmitting that heat to water supplied to the tubes from the steam and water drum 22. The wall tubes are connected to this drum at their upper ends in the manner indicated in the drawing, the wall tubes 20 also extending along the roof 24 of the combustion chamber to the drum. At the base of the combustion chamber the steam generating tubes are connected to headers such as 26 and 28 which are supplied with water from the drum 22 by appropriate downcomers. Some of the tubes along the right-hand wall of the combustion chamber 10 are bent inwardly from that wall and around a refractory construction 32 at the base of the superheater. Of these tubes the tubes 20A form a radiant screen disposed forwardly of the superheater.

The drawing shows the superheater surface divided into two sections. Section V consists of upright tube lengths disposed immediately rearward of the radiant screen tubes 20A.

The other superheater section H consists of banks of horizontally disposed tube lengths disposed transversely of the downwardly extending gas pass rearward of the superheater section V.

Steam to be passed to the superheater flows from the steam space of the drum 22 through tubes such as 34 and 36, along the roof 38 of the installation, and to the superheater inlet header 40. From this header the steam flows through the two banks of horizontally extending tubes 42 and 44 constituting the section H of the superheater. These banks of tubes are formed by return bend coils, vertically disposed and spaced apart across the gas pass. They are series connected as to steam flow, and the steam superheated by the superheater section H flows

through the tubes 46 and downwardly between the installation walls 48 and 50 to an intermediate superheater header 52.

From the header 52 steam flows through the wall tubes 54 along the wall 48 and then to the left along the roof section 55. It then continues to a second intermediate superheater header 56 disposed above the superheater section V. This section comprises flat coils and return bend tubes forming the separated banks 60 and 62. The forward tubes of the bank 60 have their upper ends directly connected to the header 56 so that steam flows downwardly through the first several rows of the bank 60, then upward directly to the cross-over tubes such as 66, and then through the tubes of the rear bank 62. From the outlet tubes of this bank the steam flows to the superheater outlet header 70, and thence to a point of use.

The gas pass 72 in which the superheater section H is disposed is spaced rearwardly of an upward projection of the right-hand wall of the combustion chamber, the left-hand side of this gas pass being formed by the wall 74, extending downwardly through the banks 76 and 78 of economizer tubes to the position 80. The upper part of this wall is supported by the economizer outlet tubes such as 82 and 84, which extend downwardly from the economizer outlet header 86.

The banks 76 and 78 of economizer tubes are similar to the banks 42 and 44 of superheater tubes but they are longer and their left-hand portions extend across the bypass 90. This bypass is formed between the wall 74 and the rearward wall of the refractory construction 32. The bypass is also continued downwardly by the walls 94, 96, and 98 to a series of dampers 100 which, by controlling the amount of gases flowing through the bypass 90 relative to the amount of gas passing through the gas pass 72, correct changes in the superheat from a desired optimum value and bring the superheat back to the latter.

The dampers 100 may also be associated with a series of dampers 102 extending across the outlet of the gas pass 72.

As to the fluid flow in the banks of economizer tubes 76-78, water is supplied to the economizer inlet header 104, and from that position it flows upwardly through the banks 76 and 78 of economizer tubes, through the outlet tubes 82 and 84 to the header 86, and then through tubular connections such as 106 to the drum 22.

The banks of tubes 60 and 62 of the superheater section V are disposed in a gas passage between the inclined wall 112 and an extension of the roof of the furnace 24 so that effective heat exchange conditions are maintained as the gases have their temperature decreased in passing over these tubes. As the temperature of the gases decrease, their volume decreases, and the structure of the gas pass compensates for this changing factor.

The illustrative structure minimizes draft loss by providing for a substantially straight line flow of furnace gases from the top of the furnace across the banks of tubes 60 and 62 of the superheater V and across the space or chamber 110 between the tubular sections 82 and 84 and the superheater section V, to the inlet space indicated below the roof section 55 and just above the superheater section H. Thus, in the gas flow from the furnace over the superheater

sections, there is but a single turn and that turn is limited to 90°.

Particles of incombustible material separated from the furnace gases in passing through the chamber 110 or separated from the gases proceeding through the bypass 90 separate from the gases and are collected in a dust hopper 114 disposed between the walls 96 and 98.

What is claimed is:

1. In a vapor generating and superheating installation, a vertically elongated furnace, upright steam generating tubes constituting at least parts of the walls of the furnace and a lateral furnace gas outlet at the upper part thereof, the predominant part of the vapor generated by the installation being generated in said wall tubes, a liquid and vapor drum to which the upper ends of the steam generating tubes are connected, a first convection superheater including a bank of upright tubes disposed across the path of furnace gas flow through said outlet, said superheater tubes being subjected to high temperature gases from the furnace and constituting the only bank of tubes at their zone transversely of gas flow, wall means including parts of some of said steam generating furnace wall tubes forming an upright gas by-pass having its inlet communicating with the gas space immediately to the rear of said superheater, means forming an upright main gas pass arranged in parallel with the by-pass and extending from a gas turning space at the top of the installation and rearwardly of said outlet, a second superheater including a bank of horizontally extending and vertically spaced tubes extending across gas flow in the main gas pass, means conducting steam from the steam and water drum to the inlet of the second superheater, means conducting superheated steam from the outlet of the second superheater to the first superheater, the last mentioned means including a plurality of tubes having portions extending along a wall of the main pass, an economizer including a bank of vertically spaced tube sections extending across the vertical flow of gases in said main gas pass and also in the gas by-pass, and gas flow control means for variably proportioning the gas flow between the gas by-pass and the main gas pass to control superheat.

2. In a vapor generating and superheating installation, a vertically elongated furnace, upright steam generating tubes constituting at least parts of the walls of the furnace and a lateral furnace gas outlet at the upper part thereof, a liquid and vapor drum to which the upper ends of the steam generating tubes are connected, a first convection superheater including a bank of upright tubes disposed across the path of furnace gas flow through said outlet, said superheater tubes being subjected to high temperature gases from the furnace and constituting the only bank of tubes in their zone transversely of gas flow, wall means including parts of some of said steam generating furnace wall tubes forming an upright gas by-pass having its inlet communicating with the gas space immediately to the rear of said superheater, means forming an upright main gas pass arranged in parallel with the by-pass and extending from a gas turning space at the top of the installation and rearwardly of said outlet, a second superheater including a bank of horizontally extending and vertically spaced tubes extending across gas flow in the

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main gas pass, means conducting steam from the steam and water drum to the inlet of the second superheater, means conducting superheated steam from the outlet of the second superheater to the first superheater, the last mentioned means including a plurality of tubes having portions extending along a wall of the main pass, an economizer including a bank of vertically spaced tube sections extending across the vertical flow of gases in said main gas pass and also in the gas by-pass, the by-pass and the main gas pass being separated by a common wall including parts of tubes connecting the outlet of the economizer to the drum, and gas flow control means for variably proportioning the gas flow between the gas by-pass and the main gas pass to control superheat.

3. In a vapor generating and superheating installation, a vertically elongated furnace, upright steam generating tubes constituting at least parts of the walls of the furnace and a lateral furnace gas outlet at the upper part thereof, a liquid and vapor drum to which the upper ends of the steam generating tubes are connected, a first superheater including a bank of tubes, wall means including parts of some of said steam generating furnace wall tubes forming an upright gas by-pass having its inlet beyond the superheater relative to gas flow, means forming an upright main gas pass arranged in parallel with the by-pass and extending from a gas turning space at the top of the installation and rearwardly of said furnace outlet, a second superheater including a bank of horizontally extending and vertically spaced tubes extending across gas flow in the main gas pass, means conducting steam from the steam and water drum to the inlet of the second superheater, means including outlet tubes

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conducting superheated steam from the outlet of the second superheater to the inlet of the first superheater, an economizer including a bank of vertically spaced tube sections extending across the vertical flow of gases in said main gas pass and also in the gas by-pass, said outlet tubes conducting steam from the second superheater extending along a wall of the main gas pass from an elevation below that of the upper edge of the economizer, the by-pass and the main gas pass being separated by a common wall including parts of tubes connecting the outlet of the economizer to the drum, and gas flow control means for variably proportioning the gas flow between the gas by-pass and the main gas pass to control superheat, the bank of tubes of the second superheater extending across the main gas pass between the wall including said outlet tubes and the wall associated with the economizer outlet tubes.

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