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SUPERHEAT TEMPERATURE CONTROL BY OVERFIRE AIR

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Fig. 1.

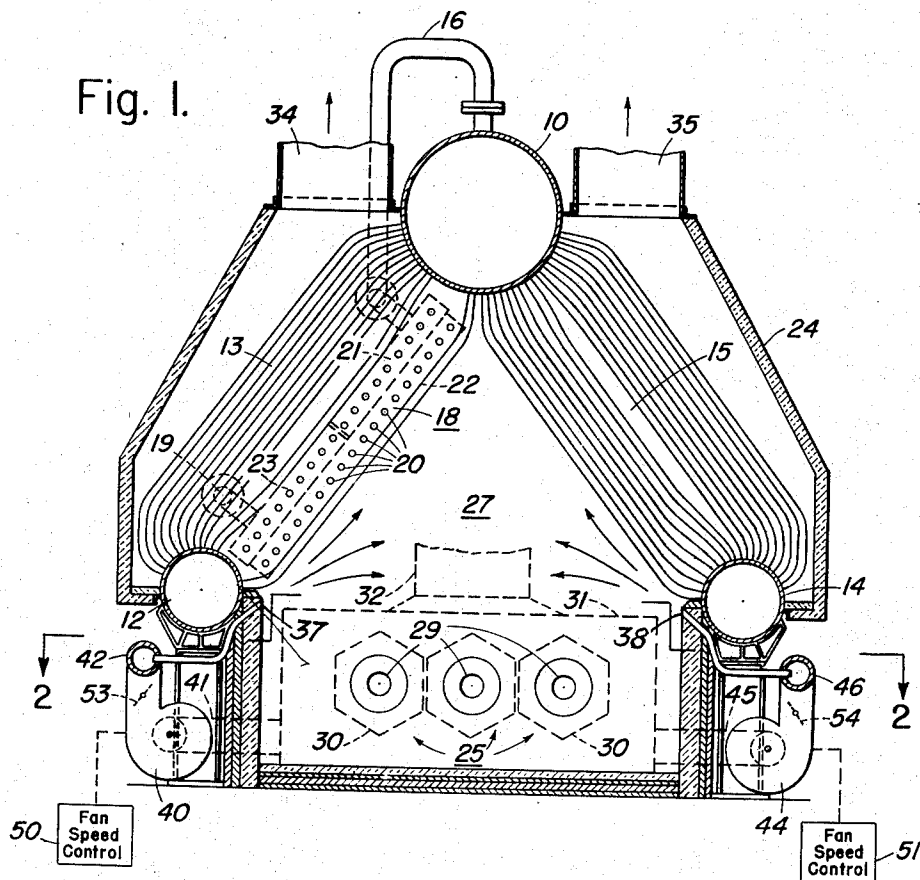
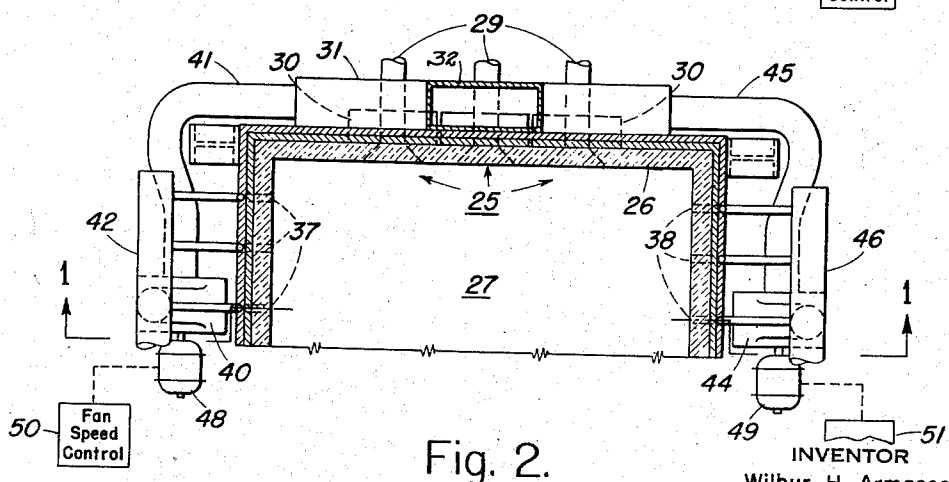


Fig. 2.

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SUPERHEAT TEMPERATURE CONTROL BY OVERFIRE AIR

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8 Claims. (Cl. 122-479)

This invention relates to the control of superheat temperature in vapor generating units and it has special reference to an accomplishment of such control through a novel use of overfire air in the fuel combustion chamber of the unit.

Broadly stated, the object of this invention is to control the superheated steam temperature by utilizing secondary air streams to direct either more or less of the fuel combustion gases either over or away from the superheater heating surface.

A more specific object is to adapt the foregoing novel form of control to A type boilers wherein a superheater is included in one of two main boiler tube banks that incline downwardly and outwardly from a central upper drum and wherein the fuel is fired in a combustion chamber beneath and between said boiler tube banks.

Another object is to apply the superheat control means of this invention to the foregoing and other boilers when fired by fuels such as natural gas or coal which require overfire air to enhance the efficiency of the combustion process.

Additional objects and advantages will become apparent from the following description of an illustrative embodiment when taken in conjunction with the accompanying drawing wherein:

Fig. 1 represents an elevational cross section of an A type steam generating unit taken on line 1-1 of Fig. 2 and illustrating one preferred manner in which the invention may be practiced; and

Fig. 2 is a plan section showing a portion of the apparatus of Fig. 1 as viewed on line 2-2 of that figure.

Referring to the drawing, the A type steam generating unit there represented comprises an upper drum 10 positioned centrally above two horizontally spaced lower drums 12 and 14 and respectively interconnected therewith through the medium of left and right tube banks 13 and 15. Steam generated in these banks passes from drum 10 through conduit 16 to a superheater 18 and leaves the superheater by way of outlet 19.

In the illustrative form shown, this superheater 18 is positioned in the left bank 13 of boiler tubes; it is made up of hairpin-shaped tube elements 20 disposed transversely of the boiler tubes in said bank 13; and steam from conduit 16 enters inlet header 21, thence passes through tube elements 20 into intermediate header 22 and from this intermediate header passes through other tube elements 20 to outlet header 23 and thence to outlet 19.

This steam generator of Figs. 1-2 may be fired in any suitable manner such as by means of burners 25 mounted in an end wall 26 of the combustion chamber 27 formed beneath and between the left and right tube banks 13 and 15 by the represented setting structure and the conventional casing structure 24 which surrounds the boiler banks.

In the illustrative form shown each of these burners 25 consists of a centrally located fuel nozzle 29 through which natural gas or other suitable fuel is admitted into the combustion chamber.

Air for supporting combustion also enters the combustion chamber 27 in surrounding relation to the incoming fuel under the direction of outer casing members 30. In the burner arrangement shown this air is made available to the burners by means of a wind box 31 fed in any suitable manner as through a supply duct 32. This air may be under a small pressure created by a forced draft fan

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(not shown) or it may be brought into the furnace under the action of either natural draft or an induced draft fan (not shown) connected with flue outlets 34-35.

The combustion gases resulting from the burning of fuel in chamber 27 pass upwardly through boiler tube banks 13 and 15 and thence out of the boiler casing 24 by way of said flue outlets 34-35. The heat carried by these combustion gases is given up to boiler heating surface 13-15 as well as to the superheater surface 20; but only the gases passing through boiler bank 13 are instrumental in imparting to the superheater 18 heat for superheating the steam generated in the boiler.

It is well known that certain fuels such as natural gas require considerable excess air for efficient combustion, and I have therefore found it desirable to provide such excess air through the medium of overfire jets. In the illustrative apparatus shown such jets are represented at 37 and 38.

Air under pressure is discharged through said jets 37-38 to provide penetration through the gas mass in the combustion chamber and to set up turbulence which will bring the air into more intimate contact with the fuel and thereby speed up the combustion process and make same more complete.

In accordance with the invention air under the required pressure is supplied to the left set of jets 37 by a fan 40 whose inlet is connected with wind box 31 via conduit 41 and whose outlet leads to header 42 in communication with the jets 37; and similarly air under the required pressure is supplied to the right set of jets 38 by a fan 44 whose inlet is connected with wind box 31 via conduit 45 and whose outlet leads to header 46 in communication with the jets 38. Motors 48 and 49 respectively drive left and right fans 40 and 44 and these two motors are provided with conventional speed control means diagrammatically represented at 50 and 51.

Modern steam generating practice requires that a constant superheat temperature be provided for most efficient operation of supplied turbines and certain other steam-consuming apparatus. It is also known that varying load conditions on an A type steam generator such as here shown will result in undesirable variation in the temperature of the superheated steam obtained at outlet 19.

Thus, in the absence of superheat control means low steam loadings on the generator will be accompanied by low superheat temperatures; intermediate loadings on the generator will be accompanied by intermediate superheat temperatures; and high steam loadings on the generator will be accompanied by high superheat temperature.

In accordance with this invention it becomes possible simply, readily and reliably to keep the temperature of superheated steam leaving outlet 19 constant through the entire range of loadings on the represented steam generator merely by adjusting the relative velocities of the overfire air issuing from left jets 37 and from right jets 38. In the illustrative arrangement shown such adjustment is accomplished through control of the operating speeds of left and right fans 40 and 44.

With these two fans operating at substantially the same speed the total combustion gases liberated in the furnace chamber 27 will divide substantially equally in flowing through left boiler tube bank 13 and discharge outlets 34 and in flowing through right boiler tube bank 15 and discharge outlet 35. Under this condition substantially half of said total gases will be instrumental in imparting heat to the superheater 18.

When however by reason of reduction in steam load or other cause the temperature of the steam leaving superheater outlet 19 falls below the desired value, same may be correctively raised either by increasing the speed of right fan 44 or decreasing the speed of left fan 40. The effect in either instance will be to flow a greater proportion of the total combustion gases through left boiler tube bank 13 and over superheater 18. In this way the superheated steam temperature will be correctively raised.

Likewise if by reason of increase in steam load or for other cause the superheated steam temperature rises above the desired value, same may be correctively lowered either by increasing the speed of left fan 40 or by cutting down the speed of right fan 44. In either in-

stance the effect will be to cause a greater proportion of the total combustion gases to flow through right boiler tube bank 15 with consequent reduction in the rate at which heat is imparted to the superheater, 18. In this way the superheated steam temperature will be correctively lowered.

Obviously the required adjustment of speed control means 50—51 may be accomplished either manually or automatically. In the event of automatic control there can be used a conventional hookup which is actuated by the temperature of the steam leaving superheater outlet 19. Inasmuch as such automatic control facilities are well known no attempt to represent same is here made.

Moreover, adjustment in the velocity of the air streams issuing from jets 37 and 38 may be effected by running the fans 40 and 44 at constant speed and interposing a damper device in the outlet of each fan. In Fig. 1 such damper devices are indicated at 53 and 54.

From the foregoing it will be seen that this invention has provided novel means for effecting superheat control through the use of overfire air in vapor generators typified by the A type steam generating unit here shown and described. It will be understood however that the apparatus represented for practicing the invention is illustrative rather than restrictive and that other equivalent means for accomplishing the same or a similar purpose may be substituted without departing from the spirit and scope of the invention as claimed.

This application is a substitution of application Serial No. 121,239 filed October 14, 1949.

What I claim is:

1. In a boiler furnace, the combination of an upper drum, first and second banks of boiler tubes extending generally downwardly and divergently outwardly from said drum, a superheater in said first boiler tube bank for raising the temperature of steam received from the drum, enclosure means surrounding combustion space beneath and between the aforesaid two banks of boiler tubes, a burner for introducing into said space fuel which in burning generates hot combustion gases that divide and pass upwardly and outwardly through said first and second tube banks, jet means along the second-bank side of said combustion space and spaced from said first boiler tube bank by substantially the full width of said combustion space, said jet means being positioned to direct a stream of air generally towards said first bank of boiler tubes opposite the jet means and through the combustion gases flowing toward said second bank of boiler tubes thereby agitating the combustion gases in a way tending to urge an additional portion of same through said first tube bank and over said superheater in that bank, and means for adjusting the velocity of said air stream whereby to control the proportion of the total combustion gases from said burning fuel which pass through said first bank over said superheater and which determine the temperature of the steam leaving the superheater.

2. In a boiler furnace, the combination of an upper drum, first and second banks of boiler tubes extending generally downwardly and divergently outwardly from said drum, a superheater in said first boiler tube bank for raising the temperature of steam received from the drum, enclosure means surrounding combustion space beneath and between the aforesaid two banks of boiler tubes, a burner for introducing into said space fuel which in burning generates hot combustion gases that divide and pass upwardly and outwardly through said first and second tube banks, jet means along the first-bank side of said combustion space and spaced from said second boiler tube bank by substantially the full width of said combustion space, said jet means being positioned to direct a stream of combustion supporting air generally over said combustion space and towards said second bank of boiler tubes opposite the jet means thereby agitating the combustion gases in a way tending to urge an additional portion of same through said second tube bank and away from said superheater in the first tube bank, and means for adjusting the velocity of said air stream whereby to control the proportion of the total combustion gases from said burning fuel which pass through said first bank over said superheater and which determine the temperature of the steam leaving the superheater.

3. In a boiler furnace, the combination of an upper drum, first and second banks of boiler tubes extending generally downwardly and divergently outwardly from

said drum superheater in said first boiler tube bank for raising the temperature of steam received from the drum, enclosure means surrounding combustion space beneath and between the aforesaid two banks of boiler tubes, a burner for introducing into said space fuel which in burning generates hot combustion gases that divide and pass upwardly and outwardly through said first and second tube banks, first jet means along the second-bank side of said combustion space for injecting into the aforesaid combustion gases a first stream of hot air directed towards said first bank of boiler tubes opposite the first jet means and tending to urge an additional portion of those gases through said first tube bank and over said superheater, second jet means along the first-bank side of said combustion space for injecting into said combustion gases a second stream of hot air directed towards said second bank of boiler tubes opposite the second jet means and tending to urge an additional portion of those gases through said second tube bank and away from said superheater, and means for adjusting the velocities of said first and second air streams whereby to control the proportion of the total combustion gases from said burning fuel which pass through said first bank over said superheater and which determine the temperature of the steam leaving the superheater.

4. In a boiler furnace comprising an upper drum, first and second banks of boiler tubes extending generally downwardly and divergently outwardly from said drum, a superheater in one of said two tube banks for raising the temperature of steam received from the drum, casing means surrounding said boiler tube banks and superheater and enclosing a combustion chamber beneath and between those banks, and burner means for introducing into said chamber fuel which in burning generates hot combustion gases that divide and pass upwardly and outwardly through said first and second banks, the combination of first and second jet means respectively disposed along the two tube-bank sides of said combustion chamber and respectively directed over said burner means towards the boiler tube bank on the opposing chamber side, air supply means causing each of said first and second jet means to blow into the aforesaid combustion gases a stream of hot air which agitates those gases and tends to urge same through the boiler tube bank on the opposing chamber side, and means for varying the velocity of the air streams issuing from one of said first and second jet means whereby to adjust the proportion of the total combustion gases from said burning fuel which pass through the tube bank wherein said superheater is included and which thereby determine the temperature of the steam leaving said superheater.

5. In a boiler furnace comprising an upper drum, first and second banks of boiler tubes extending generally downwardly and divergently outwardly from said upper drum to first and second lower drums horizontally spaced one from the other, a superheater in one of said two tube banks connected with said upper drum and disposed to raise the temperature of generated steam discharged therefrom, casing means surrounding said boiler tube banks and superheater and having an upper portion that is open for gas discharge and a lower portion that encloses a combustion chamber beneath and between said first and second banks, and burner means for introducing into said combustion chamber fuel which in burning generates hot combustion gases that divide and pass upwardly through said first and second banks, the combination of first and second sets of jets respectively disposed beneath said lower drums along the two tube-bank sides of said combustion chamber and respectively directed over said burner means toward the boiler tube bank on the opposing chamber side, hot gaseous fluid combustion supporting supply means causing each of said first and second sets of jets to blow into the aforesaid combustion gases streams of gaseous fluid which agitate those gases and tend to urge same through the boiler tube bank on the opposing chamber side, and means for varying the relative velocities of the gaseous fluid issuing from said first and second sets of jets whereby to adjust the proportion of the total combustion gases from said burning fuel which pass through the tube bank wherein said superheater is included and which thereby determine the temperature of the generated steam leaving said superheater.

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6. In a boiler furnace having a lower portion and an upper portion formed with adjoining passes, the combination of two tube banks arranged in the adjoining passes in the furnace's upper portion and adapted for parallel upwardly directed flow of combustion gases therethrough, a superheater in one of said two tube banks for raising the temperature of steam from those banks, a burner in the furnace chamber's lower portion for there introducing fuel which in burning generates combustion gases that divide and pass upwardly from the chamber through said two tube banks, and means positioned along each of said tube-bank sides of the combustion chamber's lower portion for directing streams of gas into the furnace, said means being so located and directed that the streams of gas projected from each side pass generally over the location of the burning fuel toward the bank of tubes at the opposite side, and means effective to vary the relative entering velocity of the projected gas at said two sides within limits determining the proportion of the total combustion gases from said burning fuel which passed through the tube bank wherein said superheater is included.

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7. A boiler organization as defined in claim 6 wherein the gas projected from each side of the combustion chamber's lower portion is air.

8. A boiler organization as defined in claim 6 wherein the boiler is of the marine A type.

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