MEANS FOR CONTROLLING SUPERHEAT

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3 Sheets-Sheet 1
The present invention relates to boilers equipped with superheaters and has for its object the provision of improved means for regulating the degree of superheat. More specifically the invention relates to boilers in which so-called "tangential firing" is employed and in which the superheater receives all or a very substantial part of its heat by convection from gases after they have left the furnace, the furnace itself having its walls lined with water-cooled tubes.

The invention will be described with reference to the accompanying drawings in which it is shown by way of illustration as applied to a water tube boiler, Fig. 1 showing such boiler in vertical longitudinal section and Figs. 2 and 2a being sectional views on line 2-2 of Fig. 1. Figs. 3, 4 and 5 are detail sectional views illustrating two forms of pulverized fuel burners adapted to be used in the practice of my invention.

The setting I encloses the furnace 2, all of the walls of which are lined with water tubes 8-9 which are tied into a circulation system with the upper drum 5 and lower drum 7. The particular system of connections for supplying these tubes with water and to take off from them the steam generated together with the unevaporated water is immaterial and it is therefore believed unnecessary to describe it. The firing is "tangential," this term being used herein with the usual well understood meaning which will be more fully stated below in connection with descriptions of Figs. 2 and 2a.

The gases generated in the furnace are directed by baffles 11 over the convactor boiler surface 13 and superheater 15 and so ultimately to the stack.

The tangential firing spoken of above implies the use of pulverized fuel or liquid or gaseous fuel and the invention is applicable no matter which of these three fuels is used. The fuel is injected into the furnace by means of burners arranged preferably adjacent to each corner as illustrated at 16 in the horizontal sections in Figs. 2 and 2a and in general in a direction tangent to an imaginary horizontal circle whose center lies in the central vertical axis of the furnace. This circle is in Fig. 2 shown at 17. The burning fuel and products of combustion describe a circular or spiral path as they move upward in the furnace roughly tangent to this circle 17.

I have discovered that the degree of superheat can be materially affected by altering the angle at which the fuel and air are injected relatively to the adjacent water-cooled walls while keeping other conditions constant. The amount by which the heat imparted to the superheater can be altered in this manner is sufficient to answer the degree of regulation ordinarily required with a correctly proportioned superheater.

In Fig. 2 the direction of injection of fuel is indicated by the arrows 19-19 and it will be noted that each arrow is roughly parallel to the adjacent wall or at any rate forms a rather acute angle with it. In Fig. 2a the arrows 19a-19a indicate the direction at which the fuel and air are injected into the furnace to effect a change in the degree of superheat and it will be seen that these lines 19a form a larger angle with the adjacent walls than do the arrows 19-19 of Fig. 2. The result of this alteration in the direction of injection is that the circle 17a about which the gases in the furnace now gyrate as they move upward is smaller than the circle 17 of Fig. 2. A concomitant result is that the gas currents do not sweep as closely along the walls or, in other words, do not scrub the walls as effectively as they do under the conditions indicated in Fig. 2. While the greatest part of the heat absorbed by the water walls in the furnace is radiant heat, yet a not inconsiderable amount is absorbed by convection. The heat absorbed by radiation under the two conditions shown in Figs. 2 and 2a may be substantially the same but the heat absorbed by convection is reduced in the case of Fig. 2a as compared with that of Fig. 2.

As a result the gases leaving the furnace and entering the superheater 15 are of higher temperature under such conditions as those of Fig. 2a than they are under conditions such as indicated in Fig. 2. They are therefore able to deliver more heat to the superheater and the degree of superheat attained by the steam while flowing through the superheater will be higher.

I have found that the amount of variation possible to obtain by these means is sufficient for the amount of regulation usually required. With a correctly proportioned superheater it is possible under ordinary conditions to remain within 15 or 20 degrees either way of a predetermined final superheat temperature. This, however, may not be quite satisfactory for turbine operation or other uses and by means of my invention the additional regulation required is easily obtained.

The particular means employed for making the motion about the vertical axis required in the burners possible may be any desired by the designer. The maximum angle through which the
burners have to swing is not of any considerable size. Figs. 3 to 5 illustrate two forms of pulverized fuel burners for this purpose.

In the form of Fig. 5, the whole burner housing can be swung about a vertical axis, whereas in the form of Figs. 3 and 4 the housing remains fixed and the change of direction of the fuel jet is accomplished by other means. These means comprise vertical plates 37—37, which are for this purpose pivotally mounted at 39—39. The fuel is delivered, together with the air conveying it, through nozzle 41, additional air from box 43 being delivered in a stream surrounding the nozzle. This additional air is delivered through duct 40, controlled by dampers 42. The angle with respect to the adjacent wall, at which this combined fuel and air stream enters the furnace can be altered by swinging the plates 37—37 about the centers 39—39. The plates are connected by one or more links 45 so they will move in unison. A shaft 41, rotatably mounted and connected to one of the plates 37 by link 49 effects the swinging of the plates. As indicated in Fig. 4, there may be a plurality of nozzles mounted vertically one above the other at each corner, in the case shown three such nozzles being used.

The shafts 41 are worked in unison by means of the rod 48 and links 50. Preferably the burners at all four corners are adjusted simultaneously by suitable linkage, not shown, connecting the rods 48.

In Fig. 5 the entire housing 31 can be swung about vertical axis 25. The two plates 27—27 of the casing have, for this purpose, cylindrical outer surfaces whose axis is at 28, and engage complementary cylindrical surfaces of fixed plates 23—25 of the furnace setting. Fuel is delivered by fuel delivery pipe 33, and air, in addition to that bringing in the fuel, by damper controlled duct 35. The fuel and air lines must of course be connected flexibly to their supplies to permit the swinging of the burner housing about the axis 25.

I realize that when the gases are delivered to the superheater at a somewhat higher temper-