April 26, 1932. W. A. JONES 1,855,915

SUPERHEATER BOILER

Filed May 1, 1931

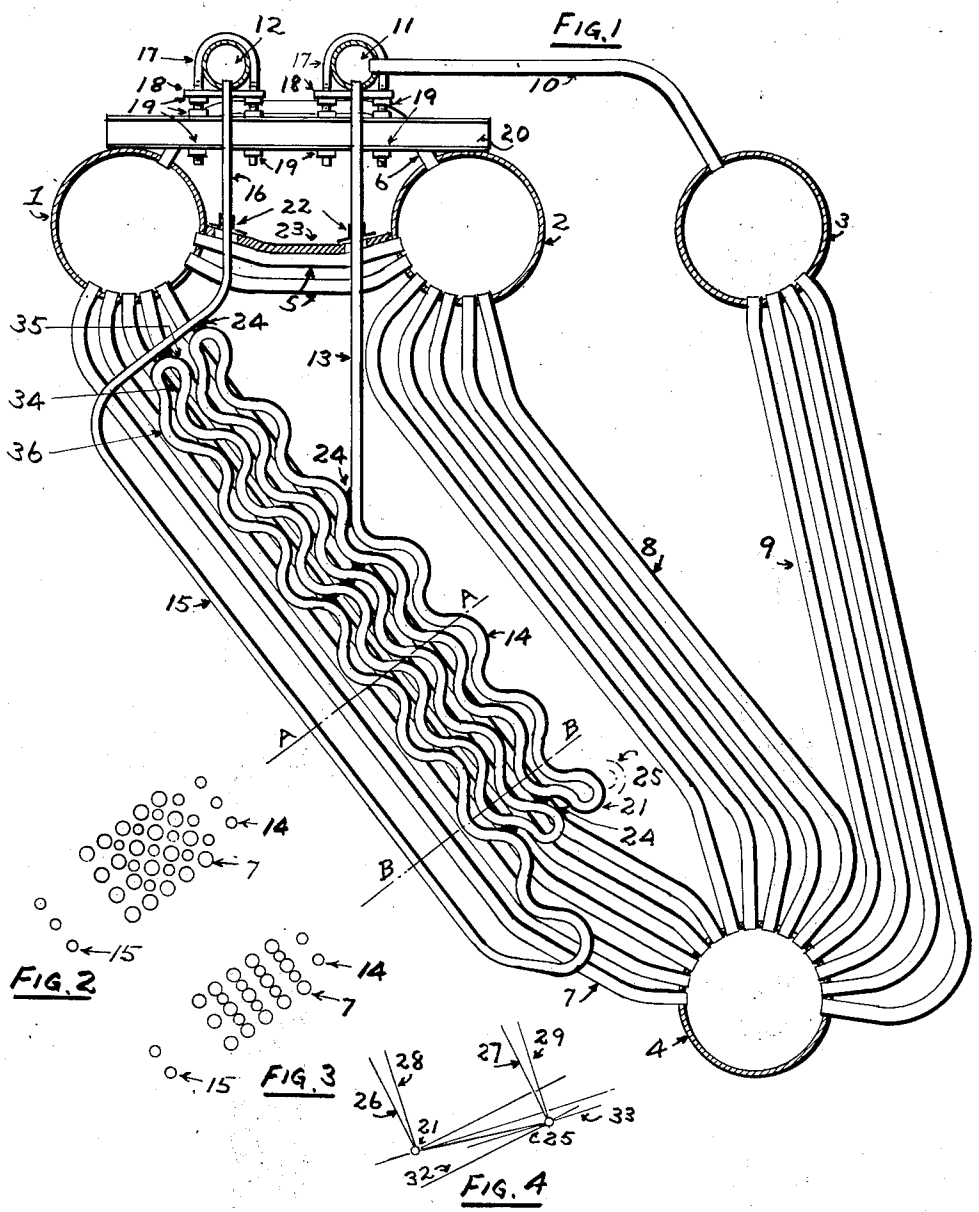

FIG. 1

FIG. 2

FIG. 3

FIG. 4

INVENTOR

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Patented Apr. 26, 1932 1,855,915

UNITED STATES PATENT OFFICE

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SUPERHEATER BOILER

Application filed May 1, 1931. Serial No. 534,288.

My invention utilizes the expansion of the superheater tube due to heat as a means of moving plates of superheater tubes between plates of boiler tubes into hotter or cooler gases to automatically maintain a nearly constant outlet temperature of superheated steam for momentary variations in boiler ratings.

My invention also permits of adjustment of position of plates of superheater tubes with respect to boiler tubes, while apparatus is in service, to give any desired degree of superheat within limits.

My invention permits a superheater to give the desired degree of superheat to a small amount of steam for a power plant when first installed in a new territory and later the same superheater to be adjusted to give the required degree of superheat to several times as much steam which is later needed from each unit after the demand for power has been developed in that territory.

These results are made possible by so shaping the superheater tubes that the gas flow area, between the superheater tubes and the boiler tubes, is nearly constant for different positions of the superheater tubes.

In the past superheaters have had their heating surface in each individual case in a fixed relation to the boiler heating surface and if the resulting degree of superheat was not what was required it was necessary to permanently add to or deduct from the superheater surface to give the desired superheat to the particular amount of steam that was being generated and the particular conditions which obtained.

If later the amount of steam changed or the conditions or the requirements changed it was necessary for men to cut out or add to the superheater surface or the boiler surface at the hot side of the superheater to give the required superheat to the particular amount of steam being generated under the new conditions.

The expense of making these permanent changes, the disadvantage of their inflexibility and the necessary interruption of the service are obvious.

In the past superheaters have been designed to receive heat by convection from hot gases after such gases had given up some heat to some of the boiler surface and the amount of heat which the superheater surface received depended upon the temperature of the steam within the tubes and the temperature of the surrounding gases, with the result that the total heat received and the final temperature of the steam increased with the rating up to a certain point.

In the past superheaters have also been designed to receive radiant heat from the furnace and the amount of heat received in this way resulted in less heat being given to steam per pound as the rating of the particular furnace increased, because in general the amount of steam increases faster with increase of rating than the amount of radiant heat does.

In an effort to obtain a constant degree of superheat for different ratings, a convection superheater and a radiant superheater have been used in series, with the steam flowing first through one and then through the other, so that the increase of superheat in the convection superheater with increase of rating would be offset by the decrease of superheat in the radiant superheater with increase of rating.

The complication of this construction, the high steam pressure drop due to resistance of steam flow and the high cost of this construction leave much to be desired and the combination does not do away with the necessity of changing surface to get the desired superheat if after trial the resulting superheat is not what is required. It simply attempts to give a constant superheat with changing ratings.

My invention contemplates plates of superheater tubes placed partly or altogether between boiler tubes and with the superheater tubes corrugated or out of parallel to the boiler tubes so that the resulting gas passage between the boiler tubes and the superheater tubes is practically constant without regard to the position of the superheater tubes, together with means for moving the plate of superheater tubes towards the furnace for increasing the degree of superheat or away

from the furnace for decreasing the superheat.

My invention is applicable to superheaters with or without tubes for receiving radiant heat.

Referring to the accompanying drawings;

Fig. 1 is a part side view of a water tube boiler with a superheater having plates of tubes with a tube for receiving radiant heat in series with tubes for receiving heat by convection, the latter corrugated where they occur between boiler tubes so that they can move with respect to the boiler tubes as described without materially changing gas flow areas.

Fig. 2 is a part cross section through boiler tubes and superheater tubes on line AA.

Fig. 3 is a part cross section through boiler tubes and superheater tubes on line BB.

Fig. 4 is a diagram showing how when the outlet tube increases in length due to increase in temperature it results in the plate of superheater tubes being moved away from the furnace so that, with proper proportions, the degree of superheat for which the superheater has been set will be automatically maintained for different ratings.

Like reference characters indicate like parts in the several views.

In the boiler shown, which I have chosen for purposes of illustration, steam drums, 1, 2 and 3 are connected to mud drum, 4, by banks of tubes, 7, 8 and 9.

Steam drums, 1 and 2, are connected by tubes, 5, below the water line and by tubes, 6, above the water line.

The furnace or source of heat is in front of the boiler tubes, 7, and gases flow in succession between tubes, 7, 8 and 9, with or without baffles.

Saturated steam is supplied by drum, 3, through tubes, 10, to superheater inlet box, 11.

Superheated steam is discharged from superheater outlet box, 12.

Plates of superheater tubes connect the inlet box, 11, to the outlet box, 12, and occupy spaces between boiler tubes, 5, 6 and 7.

As shown each plate of superheater tubes includes, in series, a down flow tube, 13, supplying saturated steam, several lengths of corrugated tubes, 14, 34 and 36, for receiving heat by convection, a length of tube, 15, for receiving radiant heat, and an up flow tube, 16, for conducting superheated steam to the outlet box, 12.

Inlet box, 11, and outlet box, 12, are held by inverted U bolts, 17, cross pieces, 18, and nuts, 19, above supporting beams, 20, represented as resting above drums, 1 and 2.

As represented, adjustment of nuts, 19, permits box, 11, or box, 12, to be lowered or raised causing plates of superheater tubes to swing towards or away from the fire. Point, 21, may move to point, 25.

Seals, 22, form gas closures where tubes, 13 and 16, pass through gas closure, 23, above tubes, 5.

Tubes of each plate will ordinarily be tied together by welding at points, 24, to give structural strength to the plate of tubes as a whole.

Cross sections, Fig. 2 and Fig. 3, show maximum and minimum gas flow areas between boiler tubes and plates of corrugated superheater tubes. Evidently as plates of superheater tubes move with respect to the boiler tubes, the gas passage areas shown in Fig. 2 and Fig. 3 will occur at different planes along the length of the tubes, maintaining a nearly constant total gas passage area.

The location of any point of the plate of tubes is determined by its distance from the two supporting boxes, 11 and 12.

Fig. 4 shows how when due to expansion of the plate of tubes the distance 26, of point 21 from box 12, increases to distance 27 and 28 of point 21 from box 11, increases to distance 29, then point 21 moves to point 25 as determined where arc 32 perpendicular to 27 and arc 33 perpendicular to 29 cross.

This shows how points of the superheater move away from the furnace when outlet tube 16 and forward part of the plate of tubes grow longer with increase of temperature, while saturated steam tubes remain at nearly the same temperature and length, all tending to maintain a constant outlet temperature for any given setting.

Raising or lowering box 11 or lowering or raising box 12 by adjusting nuts 19, evidently superimposes a definite motion to the plate of superheater tubes, away from or towards the furnace, over the motion which it automatically receives from the change in length of tubes due to temperature change as described.

Evidently tube 15 and tube 36 could be eliminated and tube 16 connected to tube 34 at point 35 doing away with radiant superheater tube if desired.

Indeed this will be the usual construction doing away with the necessity of special expensive material which radiant tubes require to be made of and doing away with the necessity of very high steam flow velocity and consequent high pressure drop which radiant tubes require in order that they may live.

In general where radiant tubes are used they will be smaller in diameter than the convection tubes resulting in higher velocity described and also allowing tube thickness to be less, saving material and resulting in less temperature strain in the material of the tube due to the outside being hotter than the inside.

Less pressure drop permits less saturated steam pressure and thinner drums and tubes for a given outlet pressure from the superheater.

Radiant tube 15 need not be corrugated because it does not come between boiler tubes.

The apparatus described may be varied without departing from my invention. One or both boxes may be placed below the superheater instead of above the superheater and still function as described.

The superheater may be used with a boiler having curved tubes or straight tubes. Only a very slight adjustment of one of the boxes will ordinarly be required and the connecting tubes will readily spring enough to permit this without being over strained and without flexible joints.

I claim:

1. In a superheater watertube boiler a superheater having plates of corrugated tubes adjustable so that they can be moved between boiler tubes into hotter or cooler gases to give higher or lower superheat to steam.

2. In a superheater watertube boiler a superheater having tubes adjustable so that they can be moved into hotter or cooler gases to give higher or lower superheat to steam and arranged so that the expansion, due to temperature, of the superheater tube then automatically moves the superheater surface into hotter or cooler gases to maintain a nearly constant degree of superheat for different ratings for any one adjustment.

3. In a superheater watertube boiler a superheater having plates of corrugated tubes adjustable so that they can be moved between boiler tubes into hotter or cooler gases to give higher or lower superheat to steam and arranged so that the change in expansion due to change in temperature then automatically moves the superheater surface into hotter or cooler gases to maintain a nearly constant degree of superheat for different ratings for any one adjustment.

4. In a superheater watertube boiler a superheater having plates of corrugated convection tubes in series with tubes for receiving radiant heat with the plates of tubes adjustable so that they can be moved into hotter or cooler gases to give higher or lower superheat to steam and arranged so that changes in the resulting temperature then automatically moves the superheater surface into hotter or cooler gases to maintain a nearly constant degree of superheat for different ratings for any one adjustment.

5. In a superheater watertube boiler a superheater having plates of single continuous tubes corrugated where they occur between boiler tubes for receiving heat by convection and each tube having a portion of its length in front of the boiler tubes for receiving heat by radiation and with the tubes adjustable so that they can be moved into hotter or cooler gases to give higher or lower superheat to steam.

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