Sept. 26, 1933. W. A. JONES 1,927,892

SUPERHEATER STEAM BOILER

Filed July 12, 1932 3 Sheets-Sheet 1

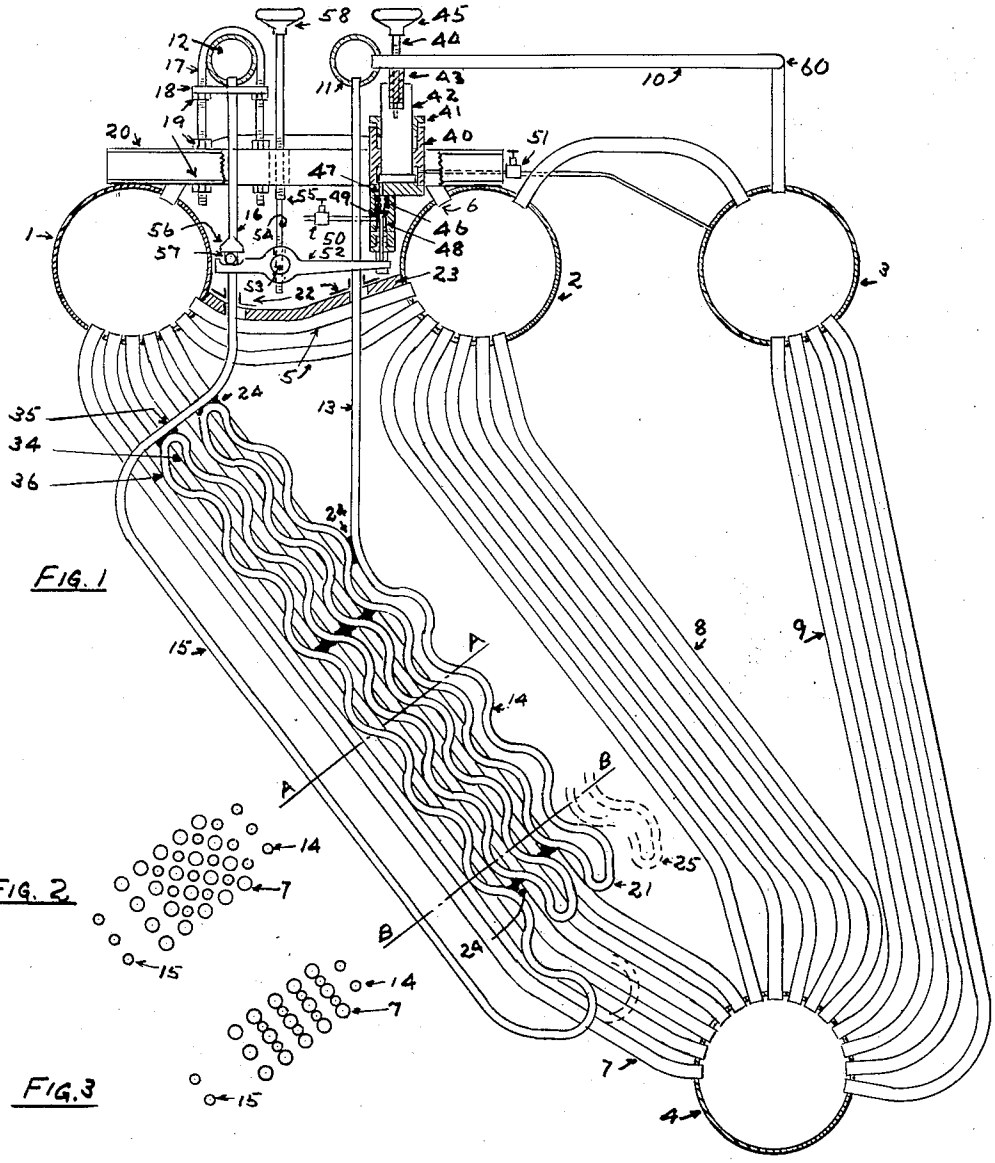


FIG. 1

FIG. 2

FIG. 3

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Filed July 12, 1932 3 Sheets-Sheet 2

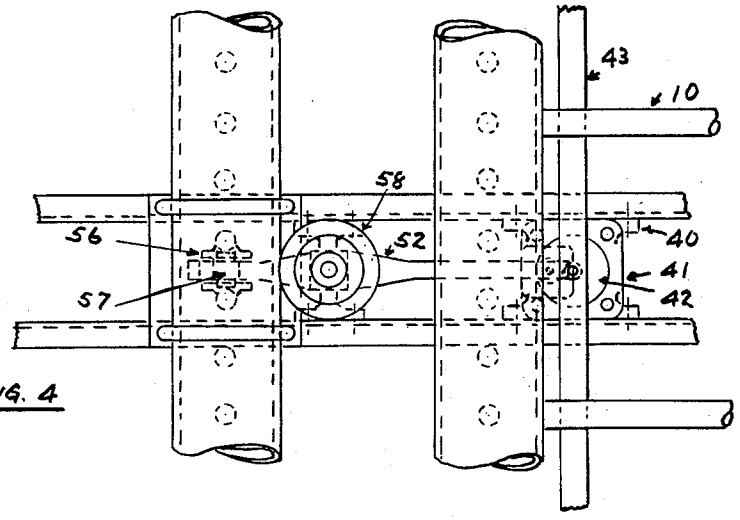


FIG. 4

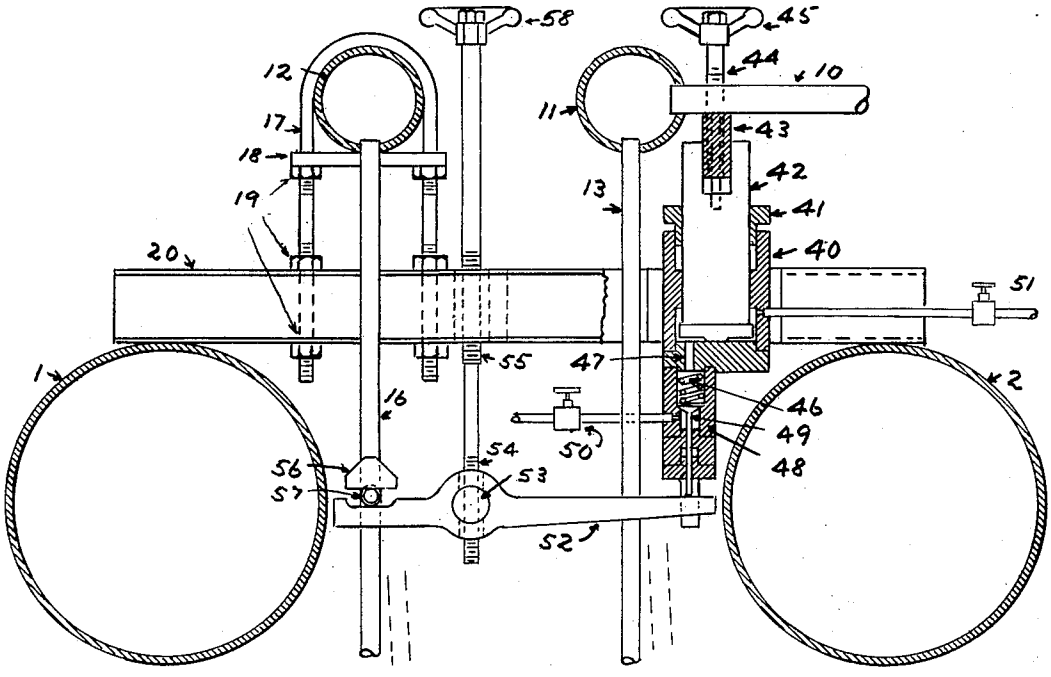


FIG. 5

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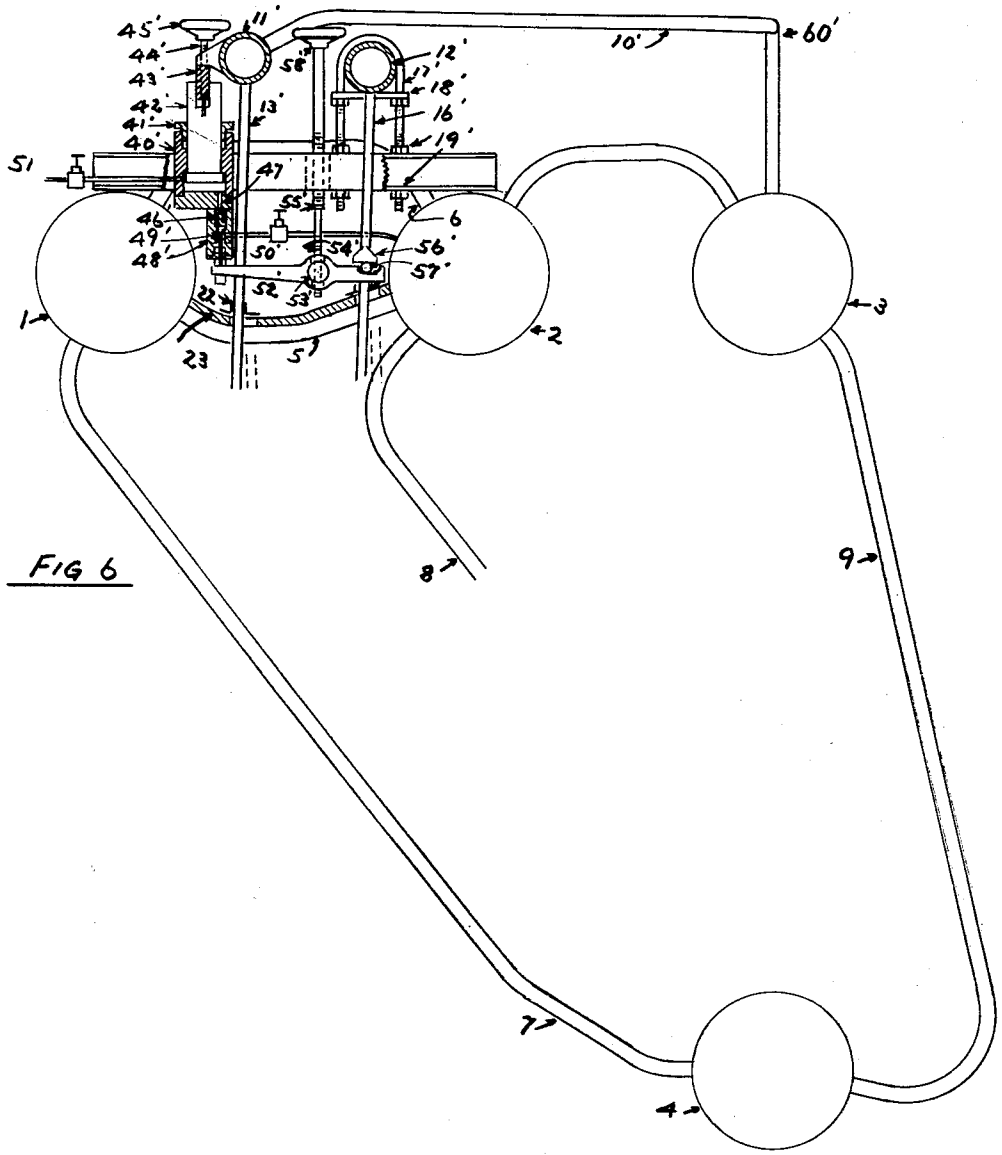


FIG 6

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UNITED STATES PATENT OFFICE

1,927,892

SUPERHEATER STEAM BOILER

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Application July 12, 1932. Serial No. 622,070

3 Claims. (Cl. 122—479)

My invention utilizes change in temperature for controlling a motive power for 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.

This invention differs from that described in United States Patent No. 1,855,915, issued to me April 26, 1932, in that it uses a separate motive power to move the plates of corrugated superheater tubes, supplementing the motion due to the expansion of the superheater tubes themselves, and doing away with the limitations in dimensions which are imposed when the expansion of the superheater outlet tube itself does all of the work. In some cases the added complication of a separate motive power will be justified by space conditions and the like.

The use of a separate motive power also permits the cooler inlet steam to be in the tubes which are surrounded by the hottest gases instead of requiring that the hotter outlet steam be in the tubes surrounded by the hottest gases and this results in somewhat less maximum temperature of metal of the tube, doing away with the necessity of using expensive special alloy steel in some cases.

Evidently the separate motive power, for moving the plates of superheater tubes, may be a reversible electric motor controlled by the temperature of the outlet steam.

The separate motive power may also be a hydraulic cylinder or a corrugated sheet metal bag, actuated by pressure of water in a closed vessel in contact with the superheated steam, but for high temperatures the resulting water pressure would be very high and such an arrangement does not permit of easy adjustment. Any leakage would be fatal.

Because feed water at a pressure higher than the boiler steam pressure is always available it seems most convenient to use a hydraulic cylinder actuated by feed water pressure and discharging spent water into the boiler and the particular illustration shown in the accompanying drawings contemplates this arrangement.

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.

Fig. 2 is a part cross section through boiler tubes and superheater tubes on line AA of Figure 1.

Fig. 3 is a part cross section through boiler tubes and superheater tubes on line BB of Figure 1.

Fig. 4 and Fig. 5 are enlarged part plan and sectional side views respectively of the hydraulic operating cylinder and operating valve shown in Fig. 1.

Fig. 6 is similar to Fig. 1 but arranged for the inlet steam to be in the tube which is surrounded by the hottest gases.

Like reference characters indicate like parts in the several views.

Fig. 1 shows 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 in United States Patent, 1,855,915, without materially changing the gas flow areas and it shows a hydraulic cylinder for imparting a motion to the plates of superheater tubes in addition to the motion which the expansion of the superheater tube itself imparts, all arranged for the hottest steam to be in the tube surrounded by the hottest gases.

In this case, at the temperature for which it is adjusted, the heat operated valve admits feed water to the hydraulic cylinder, thus moving the superheater tubes into cooler gases.

Fig. 6 shows a superheater with the hydraulic operating cylinder and valve arranged for the cooler inlet steam to be in the superheater tubes that are surrounded by the hottest gases. In this case the heat operated valve discharges water from the hydraulic cylinder to the boiler thus lowering the forward box and moving the superheater tubes into cooler gases.

In the boiler shown, which I have chosen for purposes of illustration, the 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 boiler tubes, 7, 8, and 9, with or without baffles.

Saturated steam is supplied by drum, 3, through tube, 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 the 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 upflow tube, 16, for conducting superheated steam to the outlet box, 12.

Outlet box, 12, is 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, 12, to be raised or lowered and adjustment of screw, 44, permits box, 11, 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 tube, 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.

Fig. 2 and Fig. 3, show maximum and minimum gas flow areas between boiler tubes and plates of 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.

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

Fig. 4, and Fig. 5, show the hydraulic operating cylinder, 40, packing gland, 41, piston, 42, slotted to receive transverse beam, 43, which supports superheater inlet box, 11. Screw, 44, operated by hand wheel, 45, determines the height of the inlet box, 11, above the piston, 42, and affords a convenient means of manually raising and lowering this box thus causing the superheater tubes to move into cooler or hotter gases, independent of their automatic motion.

Expansion of tubes, 16, by the heat lowers lugs, 56, and through roller, 57, lowers the short end of lever, 52, raising its long end.

Hand wheel, 58, operates differential screw, 54, 55, engaging trunnion nut, 53, whereby the long end of lever, 52, may be brought as near to the stem of valve, 49, as is necessary to open this valve for a given height of lugs, 56, as determined by the desired temperature. Increasing the clearance between lever, 52, and valve stem, 49, causes the valve to open at a higher temperature of steam causing a greater expansion of tube, 16.

As shown in Fig. 4 and Fig. 5, valve, 49, when open admits feed water through throttle valve, 50, and pasasge way, 47, to cylinder, 40, raising the superheater inlet box, 11, and causing the superheater tubes to move into cooler gases, giving less superheat to the steam.

Valve, 51, at all times, slowly discharges water from the hydraulic cylinder to the boiler drum, so that when ever valve, 49, is closed the weight of the superheater causes the superheater box, 11, to lower slowly returning the superheater tubes to the hotter gases.

Valves, 50, and 49, permit a greater flow of water than valve, 51, does so that when ever valve, 49, is open, pressure builds up slowly in the cylinder to nearly that in the feed line, causing the piston and the superheater box, 11, to rise, at a speed determined by the opening of valve, 50, as compared with the opening of valve, 51.

The use of the differential screw permits a very fine adjustment of the height of the trunnion nut, 53, and thereby of the long end of the lever, 52. For instance if the upper screw, 55, has eleven threads per inch and the lower screw, 54, has ten threads per inch, both right hand threads, then the effective pitch is the same as one hundred and ten threads per inch right hand.

A spring, 46, is shown for closing valve, 49, against the pressure in this case.

Fig. 6, shows the same arrangement of hydraulic cylinder and thermostatic valve adapted for use where the coolest steam enters the superheater tube which is surrounded by the hottest gases.

In this case valve, 51', permits a limited flow of feed water to cylinder, 40', at all times, and valve, 50', permits a free flow from the hydraulic cylinder, 40', to the boiler drum, 2, when valve, 49', is opened by the expansion of the superheater outlet tube, 16', thus lowering the superheater inlet box, which is the forward box in this case, and this in turn causes the superheater tubes to move into cooler gases.

When valve, 49', closes, the pressure slowly rises in the cylinder, 40', causing the superheater tubes to again move into hotter gases.

In operation all valves will permit a slight flow of feed water to the boiler and the action will be independent of slight leaks. Valves should be of small size to permit of proper adjustment.

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. Attachment may be made to move the superheater tubes independent of the boxes if desired without departing from my invention.

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

The superheater should be in the mean position when saturated tubes, 10, are connected so that maximum stress due to distortion will be that due to one half of the total motion.

Saturated tubes, 10, may be given a horizontal transverse offset at, 60, to increase their flexibility.

I claim;

1. In combination, a row of spaced steam generating tubes, a superheater comprising tubes extending substantially parallel with the generating tubes and between the spaces thereof, inlet and outlet headers for the superheater, a jack arranged with respect to one of the headers so as to move the header in a direction to cause a lateral movement of the superheater tubes with respect to the generating tubes, a lug attached to an outlet portion of one of the superheater tubes, a lever pivoted in fixed relation with the outlet header and having a portion contacting with said lug, a control device for controlling the position of the jack and arranged to be operated by said lever in a manner to cause the superheater tubes to be moved rearwardly of the generating tubes upon an increase in length of the outlet portion of the superheater tube.

2. In combination, a row of spaced steam gen-

erating tubes, a superheater comprising tubes extending between the spaces of the generating tubes, inlet and outlet headers for the superheater, a jack arranged with respect to one of the headers so as to move the header in a direction to cause a lateral movement of the superheater tubes with respect to the generating tubes, a lug attached to an outlet portion of one of the superheater tubes, a lever pivoted in adjustably fixed relation with the outlet header and having a portion contacting with said lug, a control device for controlling the position of the jack and arranged to be operated by said lever in a manner to cause the superheater tubes to be moved rearwardly of the generating tubes upon a definite increase in length of the outlet portion of the superheater tube.

3. In combination, a row of spaced steam generating tubes, a superheater comprising tubes extending between the spaces of the generating tubes, inlet and outlet headers for the superheater, a jack arranged with respect to one of the headers so as to move the header in a direction to cause a lateral movement of the superheater tubes with respect to the generating tubes, a lug attached to the outlet portion of one of the superheater tubes, a lever pivoted in adjustably fixed relation with the outlet header and having a portion contacting with said lug, a control device for controlling the motion of the jack and arranged to be operated by said lever in a manner to cause the superheater tubes to be moved rearwardly of the generating tubes upon a definite increase in length of the outlet portion of the superheater tube.

WILLIAM ANTHONY JONES.