Dec. 24, 1940. C. S. SMITH 2,226,445

FLUID HEAT EXCHANGE APPARATUS

Filed May 5, 1937 3 Sheets-Sheet 1

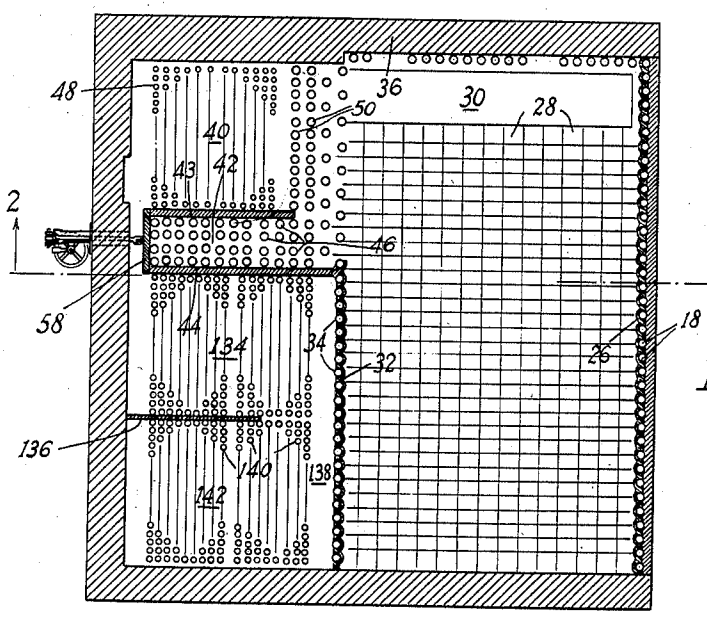

Fig. 1

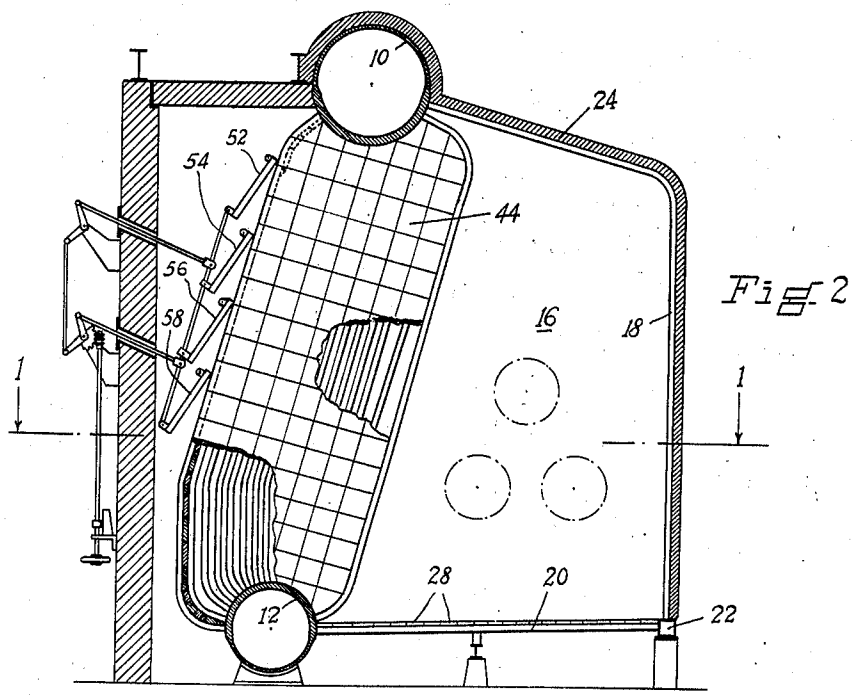

Fig. 2

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Dec. 24, 1940. C. S. SMITH 2,226,445

FLUID HEAT EXCHANGE APPARATUS

Filed May 5, 1937 3 Sheets-Sheet 2

Fig. 3

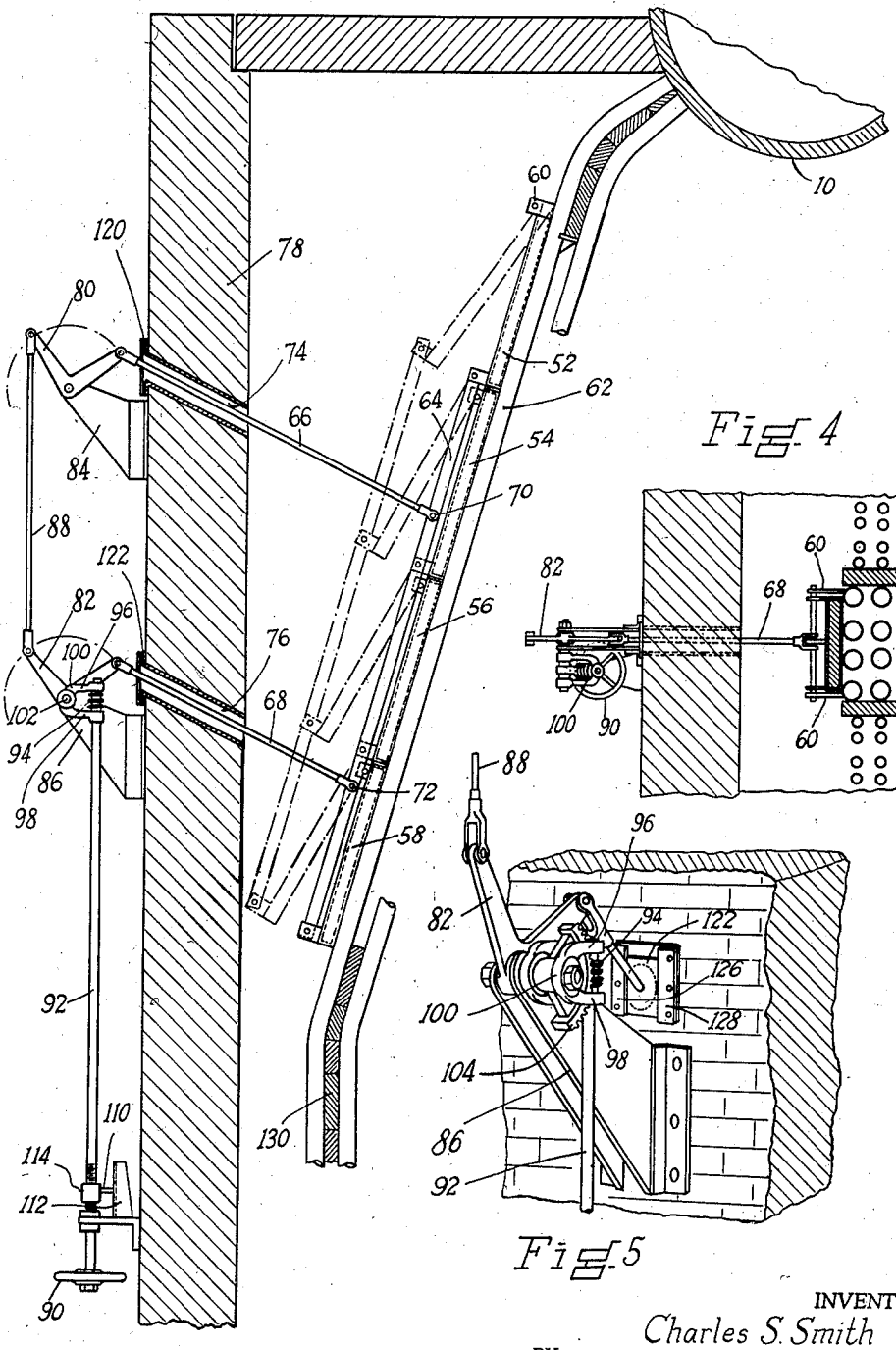

Fig. 4

Fig. 5

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Filed May 5, 1937 3 Sheets-Sheet 3

Fig. 6

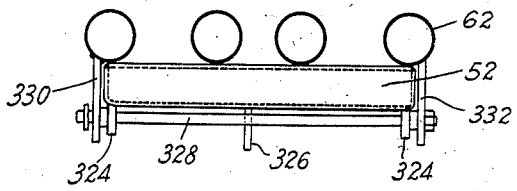


Fig. 7

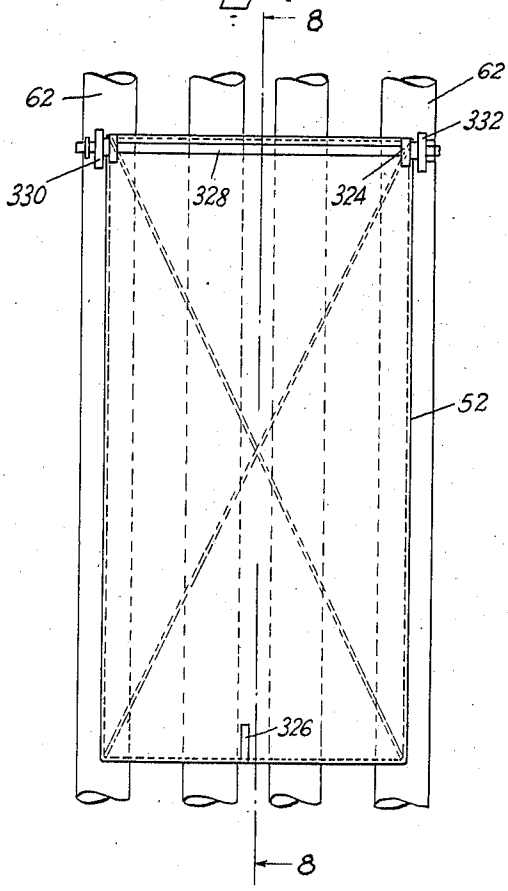
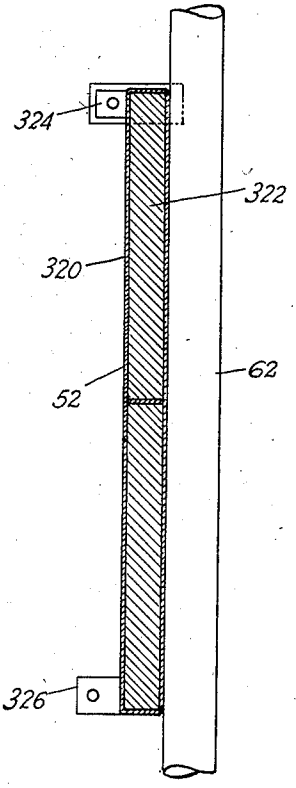


Fig. 8



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Patented Dec. 24, 1940 2,226,445

UNITED STATES PATENT OFFICE

2,226,445

FLUID HEAT EXCHANGE APPARATUS

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Application May 5, 1937, Serial No. 140,812

3 Claims. (Cl. 122—480)

This invention relates to steam boilers and it is particularly concerned with a steam boiler associated with a superheater in such a manner that the final temperature of the superheated steam may be maintained at a substantially uniform value over a wide range of boiler capacities.

It is an object of the invention to provide a boiler in the operation of which gas mass flow over the superheater may be regulated so as to maintain a desired superheat even though boiler capacity and gas flow varies over a wide range.

Another object of the invention is to provide a boiler having upright steam generating tubes subjected to horizontal gas flow and associated with a superheater in the manner above indicated.

It is also an object of the invention to provide an effective control of the flow of heating gases over a superheater associated with a boiler of the type having vertically extending tubes connected to and arranged longitudinally of a lower drum and one or more upper drums, and characterized by a generally horizontal multiple pass gas flow over the tubes.

Other objects of the invention will appear as the accompanying description proceeds.

The invention will be described with reference to certain embodiments thereof which are shown in the accompanying drawings.

In the drawings:

Fig. 1 is a horizontal section of an illustrative embodiment indicating the relationship of the furnace to the steam generating tubes and the superheater. This view is taken on the line 1—1 of Fig. 2.

Fig. 2 is a view in the nature of a vertical section taken on the line 2—2 of Fig. 1 and looking in the direction of the arrows.

Fig. 3 is a view in the nature of a vertical section of the damper operating mechanism indicated in Fig. 2 of the drawings.

Fig. 4 is a detailed view in horizontal section showing a part of the damper and operating mechanism on an enlarged scale.

Fig. 5 is a view in the nature of a perspective view showing a part of the operating mechanism by which the dampers for the superheater bypass are controlled.

Fig. 6 is a detailed view, substantially in horizontal section, showing the relation of the damper 52 to the tubes 62, and the manner in which the damper is supported by the tubes.

Fig. 7 is an elevation of the structure indicated in Fig. 6 of the drawings.

Fig. 8 is partly a vertical sectional view on the line 8—8 of Fig. 7.

The boiler indicated in Fig. 2 of the drawings includes a steam and water drum 10 connected to a submerged drum 12 by upright steam generating tubes 14. The furnace 16 associated with this boiler is defined by wall tubes 18 and floor tubes 20. The latter are connected to the drum 12 so as to supply water to the tubes 18 through the header 22. The tubes 18 have their upper portions bent to define the room 24, and at the upper end of the roof they are connected with the drum 10.

The furnace wall tubes 18 may be covered as indicated in Fig. 1, with ceramic refractory material 26, and the floor tubes are covered with smooth face metallic blocks 28. At the end of the furnace an ash pit 30 is located.

Referring to Fig. 1 of the drawings, the partition or baffle 32, of ceramic refractory material, is supported by the front row of tubes 34, and closes the spaces between them for a part of the distance across the boiler setting. Between the end of this baffle and the boiler wall 36 the furnace gases have their outlet from the furnace. The gases flow through this outlet and through two parallel gas passes 40 and 42 leading to the second and third convection passes of the boiler. These gas passes are defined by the outside setting wall 36 and the transverse baffles 43 and 44 extending from front to rear between upright tubular elements forming heating surfaces of the installation. As shown in Fig. 1, the gas pass 42 is a superheater bypass in which the steam generating tubes 46 are positioned. In the other of the parallel passes there is a superheater 48 having upright tubular elements extending across the path of the furnace gases. The superheater is screened by rows of steam generating tubes 50 interposed between the furnace and the superheater.

The draft loss through the bypass 42 due to the restriction of the steam generating tubes 46 is less than the draft loss due to the restriction in the main pass 40 resulting from the closely spaced superheater tubes 48. Opening the dampers 52—58 will accordingly divert flow of gases from the pass 40 to pass 42.

In order that superheat may be adequately controlled and a substantially uniform superheat maintained over a wide range of furnace gas flow, the flow of furnace gases is proportioned between the parallel gas passes 40 and 42. This is accomplished in the illustrative embodiment by dampers 52, 54, 56, and 58. The ar-

rangement of these dampers with reference to the steam generating tubes, and the mechanism for operating the dampers, is clearly indicated in Figs. 3, 4, and 5 of the drawings. Fig. 3 indicates the dampers as pivoted upon horizontal rods held in position by lugs 60 preferably welded to the rear tubes 62 of the bank of steam generating tubes. These dampers are moved from their positions indicated in full lines in Fig. 3 of the drawings to their dotted-line positions by operating mechanism including a link 64 and connecting rods 66 and 68 pivotally associated with the link at 70 and 72. The connecting rods extend through openings 74 and 76 formed in the rear boiler wall 78 and at their outer ends they are connected to bell-cranks 80 and 82 pivotally mounted on brackets 84 and 86 for corresponding movements. These brackets are fixed to the wall 78 so as to maintain the bell-cranks in their operative positions.

The bell-cranks 80 and 82 are connected by a rod 88 and are moved to their adjusted positions by the operation of a handwheel 90 fixed upon an upright shaft 92 which carries a worm 94 at its upper end. This worm is fixed upon the shaft 92 between the arms 96 and 98 of a bracket 100 through which the bell-crank trunnion 102 rotatably extends. As indicated in Fig. 5 of the drawings, the worm 94 meshes with a worm gear sector 104 which is fixed upon the trunnion 102. The latter is rotatable in bearings formed in arms of the bracket 86, and between these arms the bell-crank 82 is fixed to the trunnion 102. Thus, operation of the handwheel causes corresponding pivotal movements of the bell-cranks 80 and 82 and consequently moves the dampers 52—58 to desired positions. Various positions of the dampers are designated by an indicator 110 movable by the turning of the shaft 92 with respect to indicia which form a scale on the bracket 112. The pointer 110 is preferably carried by a sleeve 114 on the shaft 92.

The openings 74 and 76 are closed by movable seal plates 120 and 122 which are movable vertically with the connecting rods 66 and 68. As indicated in Figs. 3, 4, and 5 of the drawings, the connecting rods extend through openings in these plates, and the seal plates are slidable in guideways formed beneath parallel plates 126 and 128 fixed with reference to the boiler wall 78. The connecting rods 66 and 68 are freely slidable through the plates 120 so that the dampers may be moved to any desired position, and the plates 120 are always maintained in gas sealing relationship to the boiler wall.

The shaft 92 may also be automatically operated by devices which are responsive to changes in steam flow, or in response to changes in superheat from a desired value, or by other appropriate variables. With the use of such devices, the superheat may be maintained at a desired value, and compensatory adjustments are effected for the usual variations in gas flow which would otherwise make the superheat irregular.

As indicated particularly in Fig. 2 of the drawings the dampered outlet of the superheater bypass 42 extends over only a part of the vertical extent of the bypass. Below the outlet, the bypass is closed off by a baffle 130 which may be formed by refractory blocks held in position between two rows of the boiler tubes. A similar baffle extends from the top damper 52 to the drum 10.

From the outlets of the parallel gas passes 40 and 42 the furnace gases flow through a gas pass 134 defined by the baffle 44 and a parallel baffle 136. A furnace gas space 138 between the small diameter steam generating tubes 140 and the tubes 32 facilitates the turning of the gases from the gas pass 134 to the last gas pass 142. From the latter, the furnace gases may pass to an air heater, or directly to a stack or suitable draft inducing equipment.

The specific construction of the dampers indicated in Fig. 3 of the drawings may be such as that indicated in Figs. 6, 7, and 8. Here, each individual damper consists of an alloy shell 320, the metal of which has high heat resisting properties. This shell, for insulating purposes, and for lightness of construction, is filled with a non-combustible heat insulating material 322, and the shell is thereafter sealed in an appropriate manner, such as by welding. The shell has upper and lower lugs 324 and 326, the former of which receive the rod 328 upon which the damper is pivoted. This rod is supported in operative position by the brackets 330 and 332 which are welded to the tubes 62 in the positions shown. The lower lugs 326 are provided with openings to receive the pins by which the link 64 is pivotally related thereto.

I claim:

1. A steam boiler having an upper steam and water drum, a lower water drum, a vertically disposed convection heated bank of steam generating tubes extending between and connected to said drums along the length thereof, means forming a furnace chamber laterally of the space containing said tube bank and communicating therewith at only one end, baffle means extending transversely of said tube space and arranged to divide said tube space into a plurality of serially connected gas passes extending transversely of said tube bank, means for effecting a substantially horizontal flow of heating gases through said serially connected gas passes, an intermediate baffle dividing the first of said serially connected gas passes into two parallel gas passes, a superheater having its tubes disposed in one of said parallel gas passes while some of the steam generating tubes are disposed in the other, and a gas flow regulator disposed adjacent the outlet of one of the parallel passes to selectively control the proportioning of the furnace gas flow between the parallel passes and thereby control superheat.

2. A steam boiler having an upper steam and water drum, a lower water drum, a vertically disposed convection heated bank of steam generating tubes extending between and connected to said drums along the length thereof, means forming a furnace chamber laterally adjoining the space containing said tube bank and communicating therewith at only one end, boiler setting walls, baffle means extending transversely of said tube space and co-operating with said setting walls to divide said space into a plurality of serially connected gas passes extending transversely of said tube bank, means for burning fuel in said furnace chamber and effecting a substantially horizontal flow of heating gases longitudinally from said furnace chamber and reversely through said serially connected gas passes, an intermediate baffle dividing the first of said serially connected gas passes into two parallel gas passes from which gases unite to pass over some of the steam generating tubes, a superheater having its tubes disposed in one of said parallel gas passes while some of the steam generating tubes are disposed in the other, a gas flow regulator dis-

posed adjacent the outlet of one of the parallel gas passes and adjacent one of the boiler setting walls, and means extending through the last named wall to operate the regulator and thereby selectively control the proportioning of furnace gas flow between the parallel passes and thereby control superheat.

3. A steam boiler having an upper steam and water drum, a lower water drum, a vertically disposed convection heated bank of steam generating tubes extending between and connected to said drums along the length thereof, means forming a furnace chamber laterally of the space containing said tube bank and communicating therewith at only one end, baffle means extending transversely of said tube space and arranged to divide said tube space into a plurality of serially connected gas passes extending transversely of said tube bank, means for effecting a substantially horizontal flow of heating gases through said serially connected gas passes, an intermediate baffle dividing the first of said serially connected gas passes into two parallel gas passes, a superheater having its tubes disposed in one of said parallel gas passes, and a gas flow regulator disposed adjacent the outlet of one of the parallel passes and adjacent one of the boiler setting walls, and means extending through the last named wall to selectively control the proportioning of the furnace gas flow between the parallel passes and thereby control superheat.

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