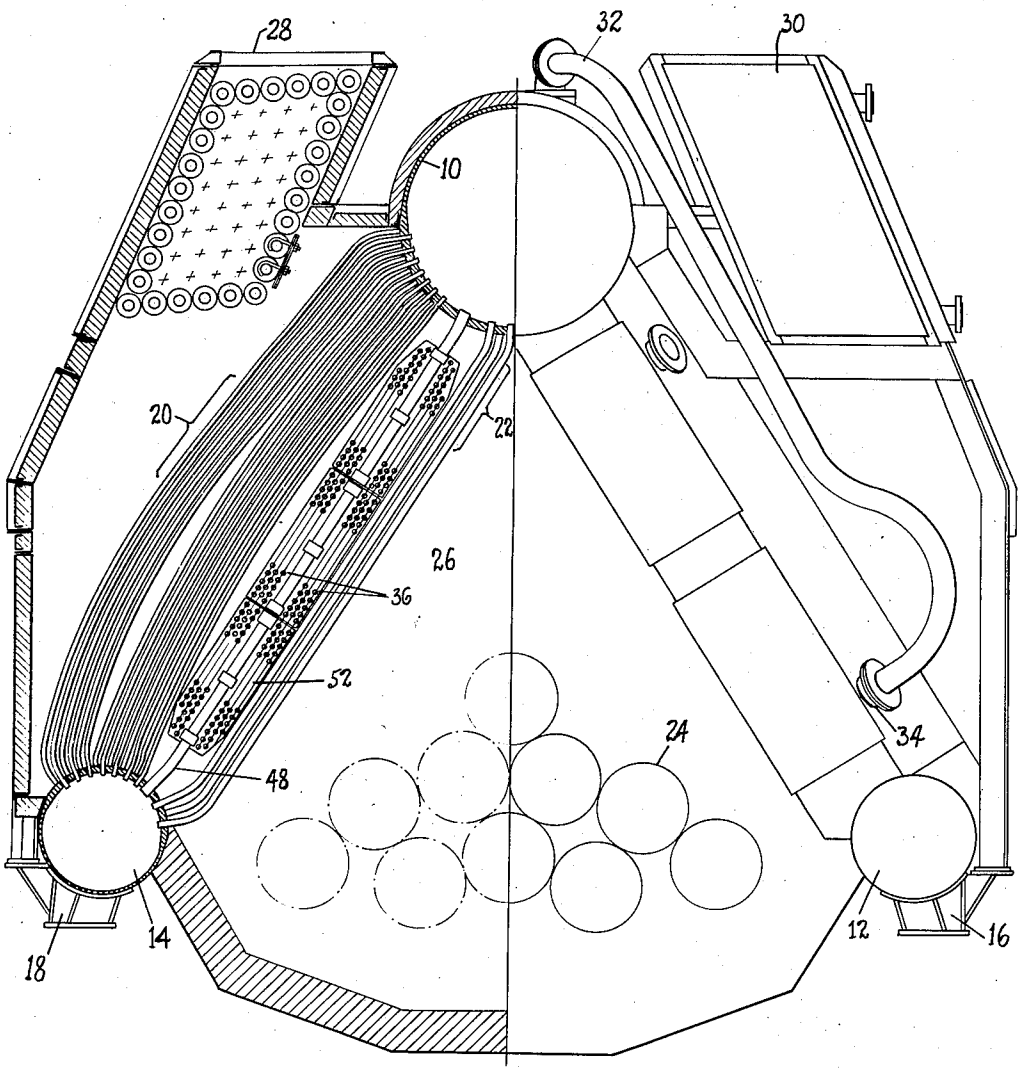
July 11, 1939. R. M. HARDGROVE 2,165,258

FLUID HEAT EXCHANGE APPARATUS

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Fig. 1



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Fig. 2

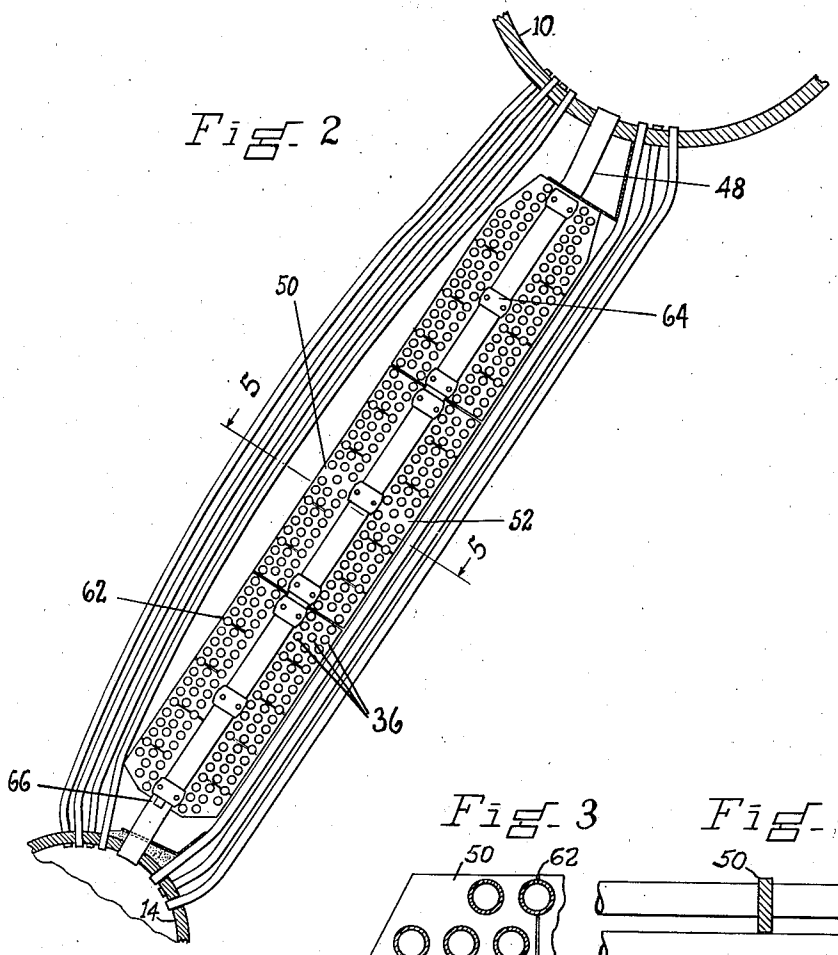


Fig. 3

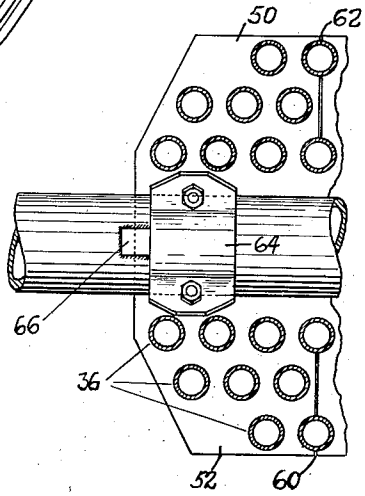
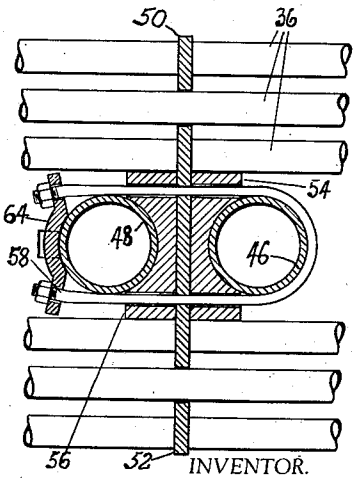


Fig. 4



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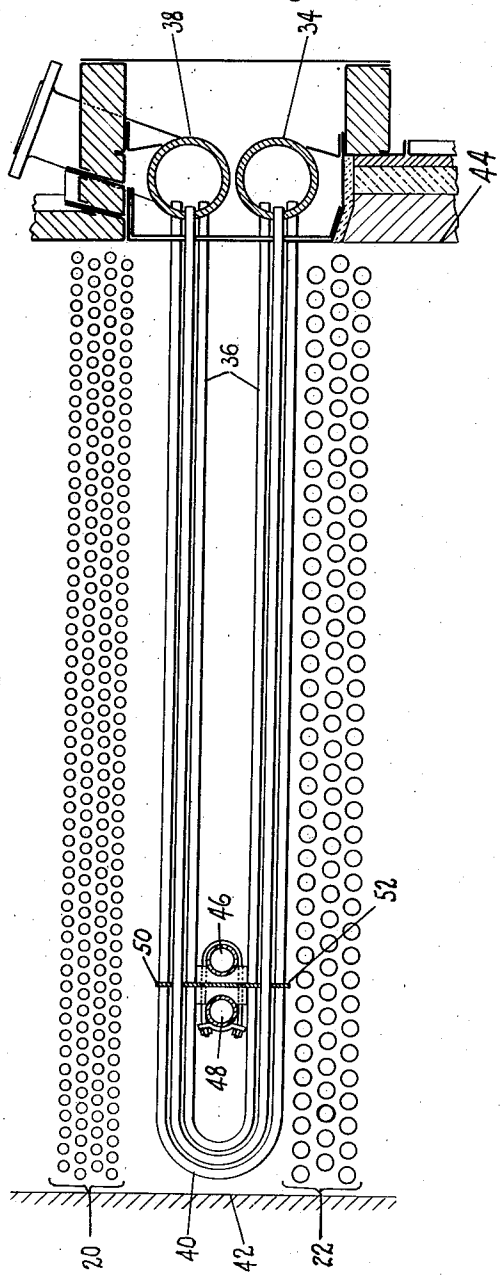


Fig. 5

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FLUID HEAT EXCHANGE APPARATUS

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Application August 29, 1935, Serial No. 38,345

9 Claims. (Cl. 122—473)

This invention relates to improvements in fluid heat exchange apparatus, and it is exemplified herein by a steam superheater operating on convection principles.

In general, it is a desideratum that superheaters for high temperature steam be located as near the furnace as practicable in order that the contacting gases shall be of sufficiently high temperature, yet the gas temperature must not be so high as to damage the superheater metal, and in many cases the superheater is protected from such excessive temperatures by screening it from radiant heat of the furnace. It is also desirable that superheater tubes be relatively small in diameter, and that they extend across a gas pass of considerable width. Consequently the relation of their length to their diameter is such that they are not stiff enough to be self-supporting at the metal temperatures, prevailing. Interposed supports are subjected to gases at such high temperatures that they would quickly burn out unless adequately protected, and for efficiency reasons, such supports must effect a minimum of resistance to gas flow. It is an object of the invention to provide a superheater which will operate effectively under these conditions.

It is also an object of the invention to provide a superheater in which the superheater tubes are in the form of loops presented substantially edgewise to oncoming furnace gases which are not moving vertically, the loops being therefore superposed relative to other loops and supported in a novel manner described below.

A further object of the invention is to provide a superheater boiler having balanced and fluid cooled supports for the superheater tube loops, so constructed that there shall be a minimum of "outage" resulting from damage to the superheater by high temperature furnace gases.

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

The invention will be described with reference to the accompanying drawings, in which:

Fig. 1 is a view partly in elevation and partly in vertical section, of a marine boiler including a superheater constructed in accordance with the teachings of this invention.

Fig. 2 is a partial view of the boiler in the nature of a vertical section, showing parts of the superheater construction.

Fig. 3 is a detail view showing the relations of some of the superheater supports to a boiler tube to which they are secured.

Fig. 4 is a vertical section of Fig. 3.

Fig. 5 is a view in the nature of an oblique section taken on the line 5—5 of Fig. 2.

Fig. 1 of the drawings illustrates a marine boiler installation in which a steam and water drum 10 is connected with lower drums 12 and 14 by banks of steam generating tubes preferably communicating with the drum 10 below its water level. The drums 12 and 14 are bottom supported upon pedestals 16 and 18, and the drum 10 is, at least to some extent, supported from the drums 12 and 14 through the steam generating tubes. Banks of these tubes are shown at 20 and 22.

The furnace is located between the upwardly converging banks of steam generating tubes, and its burners 24 are preferably located in a wall which is normal to the longitudinal axes of the drums 12 and 14. When a comparatively large number of burners are supplied for use with a high grade fuel, such as oil, high rates of combustion may be maintained. The furnace gases pass from the combustion chamber 26 across the steam generating tubes to outlet flues 28 and 30. Such auxiliary devices as economizers and air heaters may be disposed in these flues, and the operation of the apparatus may be controlled by the provision of dampers, positioned in the flues.

Saturated steam passes from the drum 10 through an offtake tube 32 to a superheater inlet header 34 preferably disposed alongside the boiler setting and in parallelism with the tubes of the bank 22.

As indicated in Fig. 5 of the drawings, the header 34 is connected by relatively small diameter superheater tubes 36 to an outlet header 38 which is shown adjacent the header 34 and arranged in parallelism therewith. From this point superheated steam passes to a point of use.

As further indicated in Fig. 5, the superheater tubes are in the form of loops, each tube presenting a loop 40 near the wall 42 of the boiler. At the opposite wall 44, the superheater tubes are supported by the headers 34 and 38 and the looped ends of the superheater tubes are supported by the relatively large diameter water tubes 46 and 48 which are in communication with the upper and lower drums. These tubes are arranged transversely of the rows of superheater tubes as shown, and between them there are clamped metallic plates 50 arranged transversely of the rows of superheater tubes. These water tubes, in combination with the opposite plates 50 and 52, and together with the metallic saddles 54 and 56 held together by the clamping devices

58 form, in effect, water cooled beams or girders independent as to the size and location of the other water tubes of the boiler, and disposed across the gas pass as heat absorbers. The superheater tubes are passed or "threaded" through openings in the plates 50, in assembling the superheater.

The plate members 50 and 52 are parallel to the water tube beam and are protected against overheating by the good thermal connection made by the clamping members and the interposed saddles 54 and 56. The circulation of boiler water through the beam keeps the metal temperature of its parts at properly low values. Excessive distortion of the plates 50 and 52 due to differences in temperatures at the edges of the plates are prevented by the formation of slots 60 and 62 extending inwardly from the edges of the plates remote from the tubes 46 and 48.

The clamp members 64 and their associated parts are maintained at desired elevations along the tubes 48 by lugs 66 which are welded to those tubes. Thus, the vertical load of the superheater is taken by the tubes 46 and 48 at a plurality of positions along those tubes, dependent upon the positioning of the lugs 66.

The bank of tubes 22 operates as a radiant heat screen, preventing overheating of the superheater tubes when furnace temperatures are high.

What is claimed is:

1. In combination, a furnace, a steam boiler including upper and lower water chambers, the upper chamber presenting a steam space and a water space, a plurality of steam generating tubes connected to said chambers and disposed across a gas pass leading from the furnace, some of said water tubes being disposed in spaced banks, a superheater including tubes extending transversely of the water tubes and positioned in the space between said banks, relatively large diameter water tubes directly connecting said chambers and included in a balanced water cooled support construction between said superheater tubes, metallic plates disposed between said last mentioned water tubes and extending across the superheater tubes at an intersecting plane location with the superheater tubes threaded through openings in the plates, clamping devices including metallic saddle members disposed on opposite sides of the plates and held in good thermal relation with the plates and the large diameter tubes to maintain low metal temperatures in the plates, and means for connecting the superheater tubes with the steam space of said upper chamber.

2. In combination, a furnace, a steam boiler including upper and lower water chambers, the upper chamber presenting a steam space and a water space, a plurality of steam generating tubes connected to said chambers and disposed across a gas pass leading from the furnace, some of said water tubes being disposed in spaced banks, a superheater positioned in the space between said banks, relatively large diameter water tubes connected into boiler circulation and included in a balanced water cooled superheater supporting construction between said superheater tubes, metallic plates disposed between said last mentioned water tubes and extending across the superheater tubes at an intersecting plane location with the superheater tubes threaded through openings in the plates, clamping devices disposed in said construction and including metallic saddle members disposed on opposite sides of the plates and held in good thermal relation with the plates and the large diameter tubes to maintain low metal temperatures in the plates, and means for connecting the superheater tubes with the steam space of said upper chamber.

3. In a three drum marine boiler, a furnace, submerged lower drums positioned at opposite sides of the furnace, an upper steam and water drum, upwardly converging banks of steam generating tubes connecting the submerged drums with the steam and water drum, a superheater positioned between spaced groups of the tubes of one of said banks and including small diameter tubes extending transversely of the steam generating tubes, an upright tube of larger diameter than the generating tubes positioned adjacent the superheater tubes at one side of the boiler and communicating directly with the upper drum and one of the submerged drums, said larger diameter tubes being positioned between said spaced groups of tubes and acting as a water cooled beam or girder supporting the superheater, an upright superheater header positioned at the opposite side of the boiler, and metallic plates secured in good thermal relation to the large diameter tube and engaging the superheater tubes to maintain them in their spaced operative relationships.

4. In a three drum marine boiler, a furnace, submerged lower drums positioned at opposite sides of the furnace, an upper steam and water drum, upwardly converging banks of steam generating tubes connecting the submerged drums with the steam and water drum and acting as supports for the latter, a superheater positioned between two spaced parts of one of said banks at one side of the furnace and including small diameter tubes extending transversely of the steam generating tubes, an upright tube of larger diameter than the generating tubes separate from said banks of tubes and positioned adjacent the superheater tubes at one side of the boiler and communicating directly with the upper drum and one of the submerged drums, said large diameter tube acting as a column support for the steam and water drum, an upright superheater header positioned at the opposite side of the boiler, the superheater tubes being in communication with the header and metallic plates secured in good thermal relation to the large diameter tube and engaging the superheater tubes to maintain them in their spaced operative relationships.

5. In a three drum marine boiler, a furnace, submerged lower drums positioned at opposite sides of the furnace, an upper steam and water drum, upwardly converging banks of steam generating tubes connecting the submerged drums with the steam and water drum, a superheater positioned between spaced groups of the tubes of one of said banks and including tubes extending transversely of the steam generating tubes, an upright tube of larger diameter than the generating tubes positioned adjacent the superheater tubes at one side of the boiler and communicating directly with the upper drum and one of the submerged drums, said large diameter tube acting as a column support for the steam and water drum, an upright superheater header positioned at the opposite side of the boiler, and metallic plates secured in good thermal relation to the large diameter tube and engaging the superheater tubes to maintain them in their spaced operative relationships, said superheater tubes being formed as loops straddling the large diameter tube.

6. In a fluid heater, a series of superposed tubes in the form of loops extending into a gas pass, means forming walls defining the gas pass, means

for supporting the tubes at the ends of the loops and along one of said walls, a fluid cooled tubular member in the nature of a column extending through the loops, means in good heat exchange relationship with said member for fixing the tubes to said member so that the latter acts as a support for the loops, and means for connecting said member into a fluid circulation.

7. In a water tube steam boiler, an upper steam and water drum, a lower submerged drum, vertically inclined steam generating tubes directly connecting said drums and extending across the path of furnace gases, a superheater having small diameter tubes extending transversely of the steam generating tubes at a position rearwardly of the steam generating tubes so that the latter act as a radiant heat screen for the superheater, upwardly extending superheater supporting tubes being of larger diameter than the steam generating tubes and directly connecting said drums and located adjacent the superheater tubes, and apertured metallic plates secured to said supporting tubes in good heat transfer relationship therewith, the superheater tubes extending through the apertures of said plates.

8. In a steam boiler, an upper steam and water drum, a submerged drum, upwardly extending banks of tubes connecting said drums, a furnace laterally adjacent one of said tube banks, a heating gas outlet from the outside of the other tube bank, a superheater positioned between said tube banks including small diameter U-loop tubes extending horizontally transversely of said boiler tubes, and a superheater support tube extending between said drums and embraced by complementary legs of said superheater tube loops, said superheater support tube being of larger diameter than the tubes of the said banks.

9. In a steam power installation, a furnace, upper and lower drums, banks of steam generating tubes extending across the path of the furnace gases and connecting said drums, a superheater arranged between the banks of tubes connecting the drums, said superheater having U-loop tubes of relatively small diameter contacted by the furnace gases subsequent to their contact with the generating tubes, and means apart from the said banks of tubes connecting said drums and acting to support the superheater tubes and relieve said banks of tubes of any superheater supporting function, said means including an upright tube of a diameter and wall thickness much greater than the superheater tubes and greater than the tubes of said banks, said upright tube being disposed between the U-loops.

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