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D. S. JACOBUS

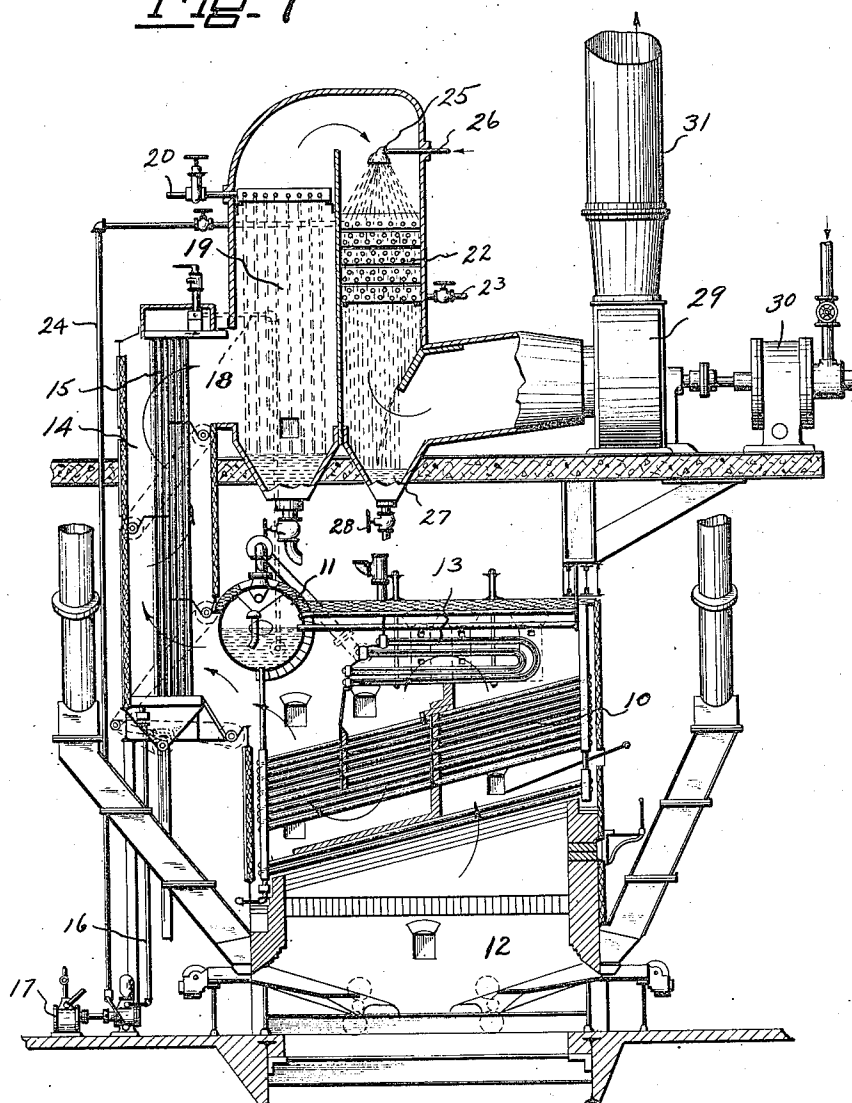
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METHOD AND APPARATUS FOR APPLYING A FLUID TO HEAT TRANSFER SURFACES

Filed July 5, 1923

2 Sheets-Sheet 1

Fig. 1



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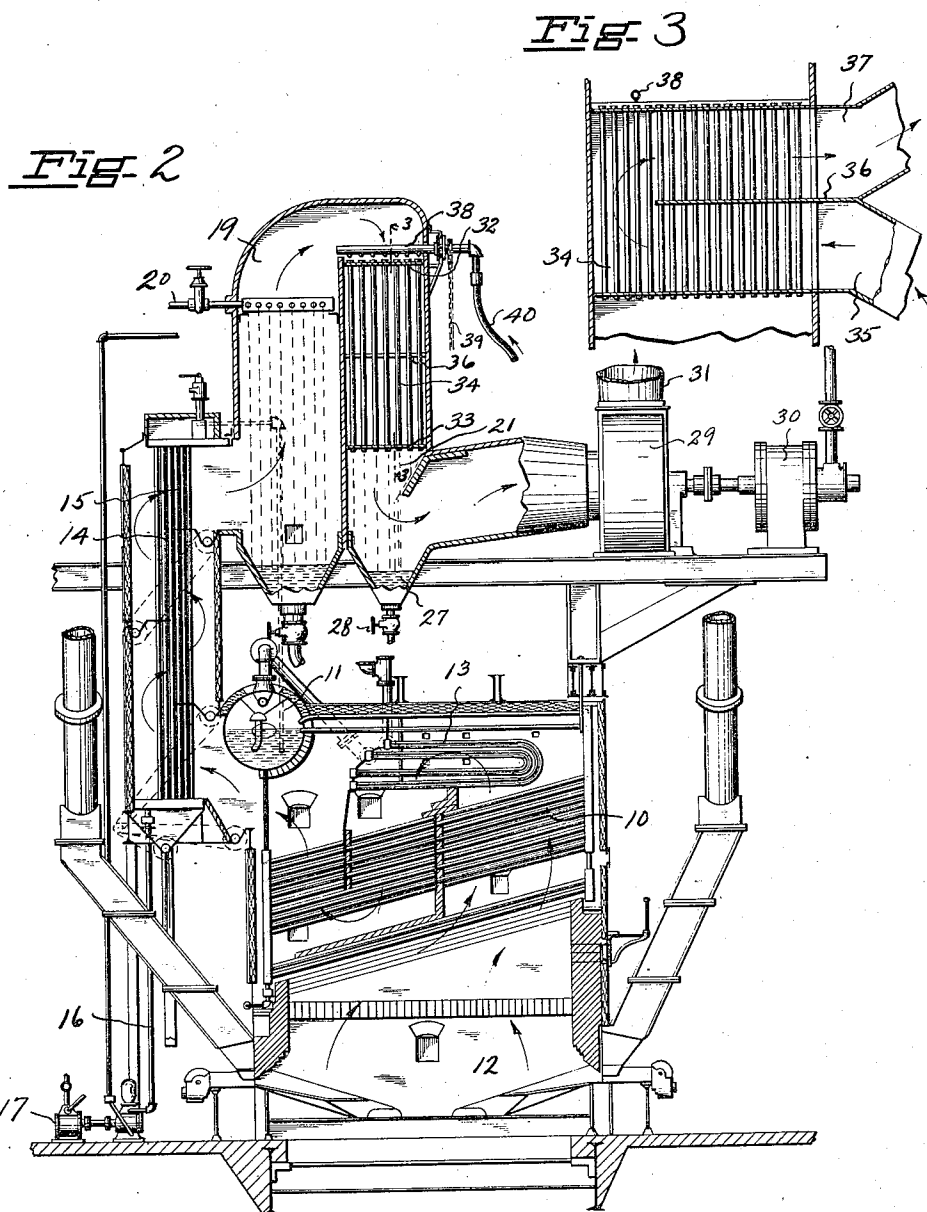
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METHOD AND APPARATUS FOR APPLYING A FLUID TO HEAT-TRANSFER SURFACES

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In the operation of heat-transfer devices in which a metallic surface is contacted on opposite sides by two fluids, such as a gas and a liquid, or two gases, particularly when such heat-transfer devices or heat exchangers are operated in connection with flue gases of steam boilers, there is liable to be a deposition of moisture from the gases on the metallic surfaces, and such moisture may also contain very dilute acid. This moisture, particularly if any acid is present, will eventually destroy the metallic surfaces. Furthermore, there is a liability for tar, soot and cinders to collect on the surfaces of the heat exchanger which are contacted by the flue gases, particularly on the cooler portions of the heat-exchanger surfaces.

By my present invention I propose to provide an apparatus and a method by which the difficulties arising from the above-named conditions can be readily remedied or prevented.

My present application is a continuation in part of my prior application Serial Number 336,419, filed November 17, 1919, which was in turn a division of my application Serial No. 244,685, filed July 13, 1918.

My invention will be best understood from the following description and the annexed drawing of illustrative forms of apparatus embodying my invention and by which my method may be carried out.

In the drawings, Fig. 1 is a longitudinal section, partly in side elevation, of an illustrative steam boiler plant embodying my invention; Fig. 2 is similar to Fig. 1, but showing a modification, and Fig. 3 is a vertical section on the line 3—3 of Fig. 2, looking in the direction of the arrows.

Like reference characters indicate like parts in the several views.

In the arrangement shown in Fig. 1, the boiler is of a well-known type in which the horizontally inclined water tubes 10 are connected to uptake and downtake headers which, in turn, are connected to a transverse steam and water drum 11, the boiler having a furnace 12 and a superheater 13.

From the boiler the gases pass upward through a bank of tubes 15 constituting a vertical economizer to which water is introduced

through the pipe 16 by means of a pump 17 and passes to the steam and water drum 11 through the pipe 18.

The gases on passing from the vertical economizer enter a chamber 19 through which water is sprayed, this water being introduced thereto through a pipe 20 and from this washing chamber, the water may flow to a settling tank and means for re-pumping the same, this tank and re-pumping means not being shown. When the water is circulated over and over again, a re-agent to neutralize the acid fumes absorbed by water may be added. From the chamber 19 the gases flow to a chamber 21, in which is installed a low-pressure stage 22 of the economizer, this low-pressure stage having horizontally extending tubes connected by headers in a well-known manner. The water for the low-pressure stage enters through the pipe 23 and flows back and forth through the tubes of the economizer to the upper header, from which it flows through the pipe 24 to the pump 17. Above the economizer 22 I provide a spraying device 25 supplied by a pipe 26, this spraying device being arranged so that all of the tubes of the economizer 22 will be contacted with the sprayed liquid from the spraying device 25. Any of the sprayed liquid falling to the bottom of the compartment 21 will be caught in a funnel-shaped receptacle 27, from which it may be drawn through a valve 28. A forced-draft fan 29 operated by a motor 30 serves to draw the gases into the flue 31.

The spraying device may be arranged to supply water for washing purposes only, the minute streams of water being arranged to strike the exterior surfaces of the economizer tubes to wash off any accumulation of soot or tar, and this may be done without stopping the operation of the boiler and while the gases are flowing through the flue and water through the economizer. The spraying device 25 may be also used for supplying a fluid-protective material, such as oil, asphaltum, pitch or the like, which, by its adherence to the exterior surfaces of the economizer tubes, will provide a protective coating to prevent the corrosion of the tubes from the moisture and acids which may be contained in the

gases. The protective material may be so finely sprayed that it will be carried by the gases which are flowing in the same direction as that in which the spray is applied, so that a complete coating will be provided for all of the surfaces of the economizer tubes. The oil or other coating material used will spread over the surfaces of the tubes and form a coating impervious to the corrosive gases in the flue. Ordinarily such coating material will not harden, but will run slowly down the tubes and will drop off or be slowly removed by the sweeping of the gases over the tubes. By providing a continuous or a frequently renewed supply, however, the tubes are kept continually coated.

The excess of oil or other coating material may be drawn off through the valve 28.

By spraying the gases in the chamber 19, I not only preliminarily wash the gases but secure a better heat transfer rate to the economizer, because it is well known that the rate of heat transfer from steam or liquids to a cooler surface, such as a tube wall, is much higher than the rate of transfer from gases at the same temperature to the same cooler surfaces. The rate of heat transfer from the gases to the tubes, due to the introduction of water vapors in the gases more than compensates for any slight reduction in temperature that may take place. This preliminary washing, however, loads the gases with water and without some protective arrangement, such as I have provided, the deterioration of the economizer surfaces might be more rapid than if no spraying in the chamber 19 took place.

In Figs. 2 and 3 I have shown an arrangement in which my invention is applied to a boiler having an air heater, the heated air from which may be utilized in any suitable manner, preferably by being returned to the combustion chamber, so that the heat of the flue gases is returned to the boiler system.

The arrangement heretofore described is precisely the same except that in the chamber 21, I have provided an air heater formed of an upper and a lower head 32, 33 between which extends a plurality of tubes 34, so that the flue gases from the chamber 19 will pass downward through the tubes 34 into the gas outlet and the stack. The air to be heated enters at the side of the air heater through the duct 35 and passes around the end of the baffle 36 and through the outlet duct 37, this air thereby flowing in a generally upward direction through the air heater, whereas the hot flue gases pass downwardly through the tubes 34.

Above the head 32 I provide a spraying means by which the interior surfaces of the tubes 34, which are the surfaces contacted by the hot flue gases, may be washed and also sprayed with protective coating material. In the illustrative embodiment, such a spraying

arrangement is illustrated by a tube 38 extending horizontally across the chamber 21, the tube 38 being provided with nipples each over one of the tubes 34. The spray tube 38 is mounted in a carriage 39 so that it may be moved laterally across the chamber 21 by means of a rack and pinion operated by the chain 39, the tube 38 having a hose connection 40. Since the tubes 34 are arranged in rows, it is obvious that by moving the tube 38 laterally and bringing it to rest over successive rows, the nipples on the tube 38 may be brought over all of the tubes 34, one row at a time.

By supplying water through the hose 40 and the spray tube 38, the interiors of the tubes 34 may be washed so as to remove any tar or soot which may have collected in them. Furthermore, by supplying a protective coating fluid through the hose 40 and the tube 38, the interiors of the tubes 34 may be coated with a protective material in a manner similar to that described for the arrangement shown in Fig. 1.

The apparatus shown in Fig. 2 will be operated in a manner similar to that described for Fig. 1 and when carrying out my method will have the same advantages, the washing of the surfaces of the tubes and the spraying of the protective coating being carried on while the boiler is in operation. In the arrangement shown in Fig. 2, as well as that shown in Fig. 1, it will be understood that the application of the protective coating to the surfaces of the heat exchanger is effected not only by the direct application of the spray to such surfaces, but also by the fact that the spray is directed in the same direction as the gas flow through the heat exchanger, so that the gases pick up and carry the protective material to all parts of the surfaces contacted by the gases.

I claim:

1. In a boiler, a flue adapted to conduct hot gases, a heat exchanger in the flue having tubes each contacted by the hot gases on one of its surfaces while a fluid is flowing in contact with the other surface, means within the flue to spray a fluid-protective material downwardly on the surfaces of the tubes, and means for causing the hot gases to flow downwardly over surfaces of the tubes exposed to said gases and while fluid is flowing through said heat exchanger, in order to protect the tubes of said heat exchanger from the corrosive tendencies of said gases.

2. In a steam boiler, an economizer having tubes and connections whereby water may be passed through the interior of said tubes, a flue surrounding the tubes and adapted to conduct hot gases over the exterior thereof, means within the flue to spray a fluid-protective material downwardly on the exterior of the tubes, and means for causing the hot gases to flow downwardly over surfaces of

the tubes exposed to said gases and while fluid is flowing through said heat exchanger, in order to protect the tubes of said heat exchanger from the corrosive tendencies of said gases.

the protective material being introduced in the direction of flow of said gases.

8. The improvement in that method of operating a steam boiler in which a heat exchanger is disposed in the path of the heated gases, which consists in successively introducing a spray of a heat transferring liquid and a protective material to the gases during their passage to said heat exchanger, the protective material being introduced downwardly into the gases in the form of a spray, and the gases flowing downwardly over said heat exchanger.

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3. In a steam boiler, a heat exchanger disposed in the path of the heated gases from the furnace, and means for introducing to said gases in succession during their passage to said heat exchanger, a heat transferring liquid and a material for producing a protective coating on the surfaces of the heat exchanger contacted by said gases to protect said heat exchanger from the corrosive tendencies of said gases.

4. In a steam boiler, a chamber having separate compartments in one of which is located liquid-spraying means and in the other of which is located a heat exchanger, means to lead the gases from said spraying compartment to said heat exchanger compartment, means for spraying a fluid-protective material downwardly over the exterior of the tubes of said heat exchanger, and means for causing the hot gases to flow downwardly over surfaces of the tubes exposed to said gases and while fluid is flowing through said heat exchanger, in order to protect the tubes of said heat exchanger from the corrosive tendencies of said gases.

5. The method of operating a heat exchanger in the gas flue of a steam boiler, which consists in passing gases downwardly over one contact surface of the heat exchanger and a fluid over the other contact surface of the heat exchanger, and spraying a fluid-protective material downwardly on the surface contacted by the gases while the gases and such fluid are flowing, to protect said surface from the corrosive tendencies of said gases, said material being supplied in quantities and at a rate sufficient to maintain a coating on the surface exposed to the boiler flue gases.

6. The method of protecting the exterior of a boiler economizer from corrosion, which consists in passing hot gases downwardly over the exterior of the economizer and water through the interior thereof and spraying a fluid-protective material downwardly on the exterior of the economizer while the gases and water are flowing, to protect said economizer from the corrosive tendencies of said gases, said material being supplied in quantities and at a rate sufficient to maintain a coating on the economizer.

7. In a steam boiler, an economizer disposed in the path of the heated gases, and means for introducing to said gases in succession during their passage to said economizer a heat transferring liquid and a material for producing a protective coating on said economizer to protect said economizer from the corrosive tendencies of said gases,

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