Nov. 18, 1924. 1,516,341

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METHOD OF AND APPARATUS FOR PROTECTING BOILER ECONOMIZERS FROM EXTERIOR CORROSION

Original Filed July 13, 1918 2 Sheets-Sheet 1

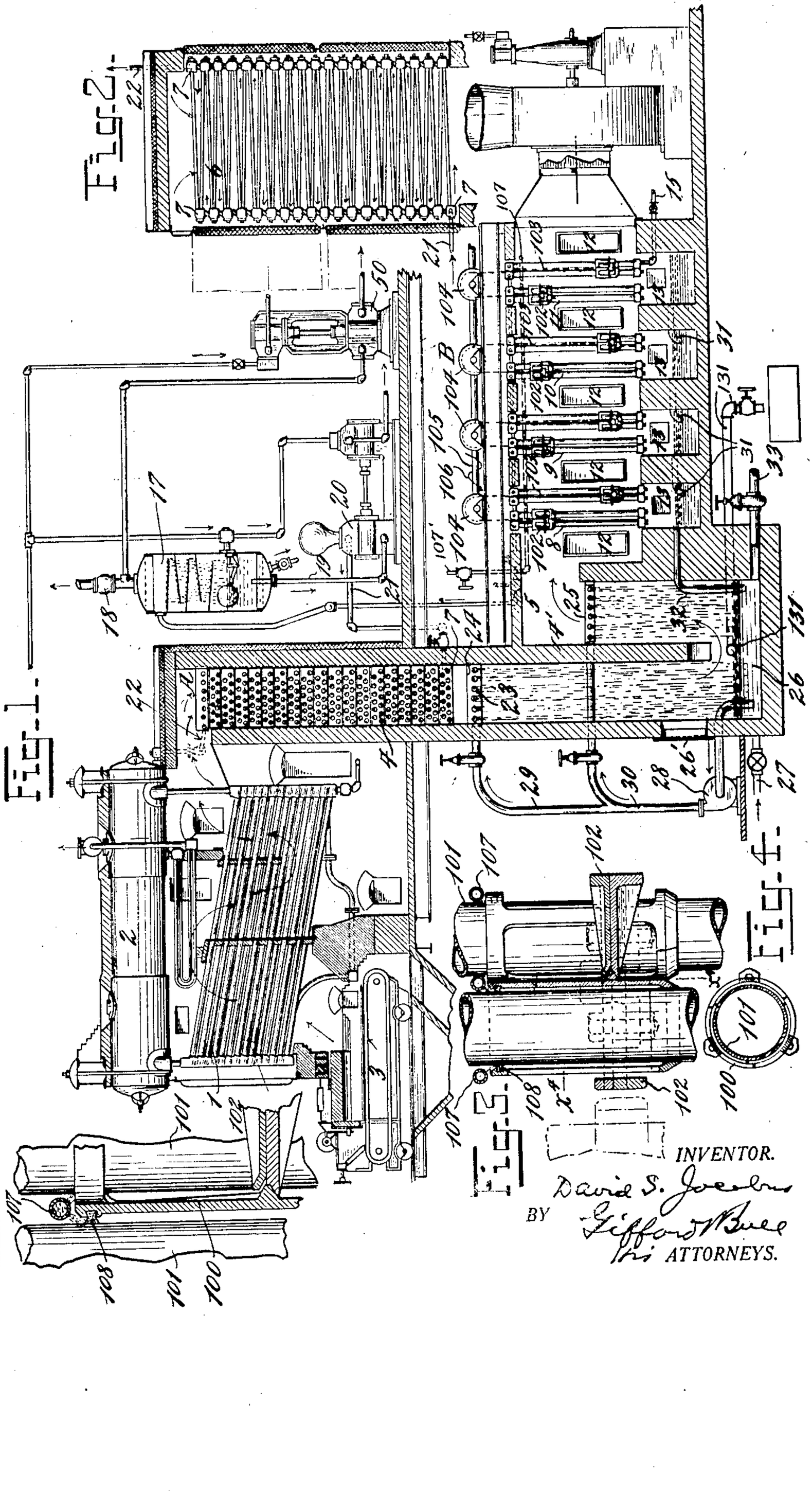

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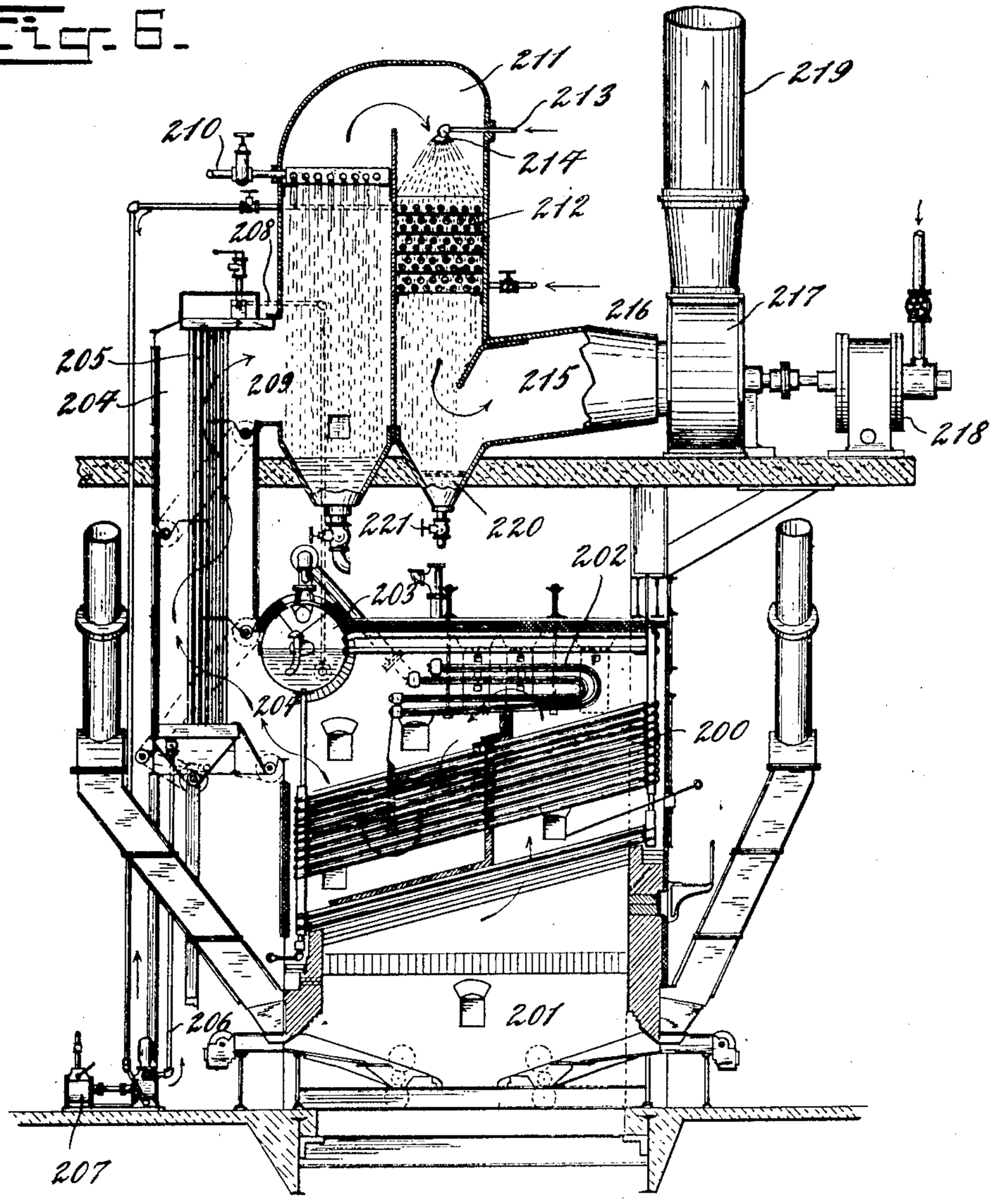
Fig. 6.



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His ATTORNEYS.

Patented Nov. 18, 1924. 1,516,341

UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR PROTECTING BOILER ECONOMIZERS FROM EXTERIOR CORROSION.

Application filed July 13, 1918, Serial No. 244,635. Renewed April 12, 1924.

To all whom it may concern:

Be it known that I, DAVID S. JACOBUS, a citizen of the United States, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Methods of and Apparatus for Protecting Boiler Economizers from Exterior Corrosion, of which the following is a specification.

The purpose of the present invention is to prevent corrosion on the exterior surfaces of economizers for boilers in cases where there is sweating on the exterior surfaces of the tubes ordinarily employed in the construction of such economizer, but I contemplate the use of my improvements in any field for which they are adapted by their nature.

An important object of my invention is to provide for the application of oil, asphaltum, pitch or the like material for preventing corrosion, to the tubes subjected to the sweating action, the protective material being fed at intervals or continuously along with the gases so as to cause it to spread over the surfaces, this method being particularly applicable where the gases are washed with water before they are passed to the section of the economizer which is to be treated with the protective material.

Another important object of my invention is to provide means for applying uniformly in the desired quantities the protective material, such means serving also to remove any excess of the material or other accretions from the economizer tubes and I provide also for reclaiming any excess of the protective material fed to the economizer.

The invention will be understood by reference to the accompanying drawings in which Figure 1 is a diagrammatic side elevation partly in section of a steam boiler plant embodying my invention; Fig. 2 a rear view of the high pressure stage of the economizer of Fig. 1; Fig. 3 is a fragmentary view in side elevation partly in section, upon an enlarged scale, of a portion of one group of the economizer tubes provided with oil-fed wipers; Fig. 4 is a view in transverse, horizontal section of one of the economizer tubes and wipers taken on the line x^4—x^4 in Fig. 3; Fig. 5 is a fragmentary, detailed view upon a still larger scale of a portion of the wiper shown in Fig. 3; Fig. 6 is a diagrammatic view in elevation, partly in section of a modified form of boiler plant illustrating a modification of my invention. Similar reference numerals indicate similar parts in the several views.

My method may be carried out in connection with any suitable boiler plant, such as that illustrated and described in my application Serial No. 876,012, of which a description follows.

Referring to Figs. 1, 2 and 3, the numeral 1 designates a boiler of standard design having a longitudinal steam and water drum 2, and fired with a chain grate stoker 3, the waste gases from the boiler escaping through a flue in which the economizer and spraying devices are located. For the purpose of describing one method of practising the invention I have shown a two-stage economizer with means for eliminating the air from the water before it is delivered to the high pressure stage. The latter is designated generally by the letter A and is shown as located in a vertical flue 4, and as subjected to the hottest gases. The low pressure stage is designated generally by the letter B and is shown as located in a horizontal flue 5, and as subjected to the coldest gases. The gases are made to flow in a downward direction over the tubes of the high pressure stage, and the flow of water through said stage is, in general, in the reverse direction of the flow of the gases. The high pressure stage of the economizer is shown in Fig. 2 as consisting of a series of rows of tubes 6 expanded into horizontal boxes or headers 7, said tubes having a slight inclination upward in the direction of the flow of the water. The tubes and boxes are preferably of wrought iron or wrought steel to withstand the high boiler pressure to which this stage of the economizer is subjected.

The low pressure stage is shown as consisting of four separated banks or groups 8, 9, 10 and 11, each of four sections, preferably of cast iron tubes fitted into cast iron horizontal boxes or headers. The spaces between the banks provide for access to the tubes through doors 12. Beneath each of these banks is a pit 13 for collecting steam condensed from the gases, or the oil which may be used for coating the outside of the tubes. Wipers 102 are shown on the tubes

of the low pressure stage of the economizer for applying the protective coating thereto. The banks of the low pressure stage are so connected that the feed water entering through pipe 15 is distributed through the lower connected headers of bank 11 and escapes from said bank through the upper headers thereof to the upper header of the right hand section or row of tubes of bank 10; thence down said section to the lower header thereof from which it is distributed through the remaining lower headers of bank 10, thence upward through the other sections of bank 10 to the corresponding upper headers, and thence in a similar manner through the sections of banks 9 and 8, finally leaving the low pressure stage through the pipe 16 leading to the tank 17. It is to be understood of course that I do not limit myself to this exact connection of the several banks of the low pressure stage. In tank 17 are preferably perforated plates over which the water is made to flow, and by which it is broken up, to facilitate the disengagement and escape of air and gases from the water, such disengagement being assisted by heating the water in the low pressure stage of the economizer, and, if desired, by maintaining a partial vacuum in the tank by any suitable means; such as the dry vacuum pump 50; or the air and gases are permitted to escape through a relief valve 18. From the tank 17 the water is conducted by a pipe 19, to a feed pump 20 which forces it through a pipe 21 to the lower part of the high pressure stage of the economizer. The water enters the lowermost header 7 and flows from side to side, through successive rows of tubes as indicated by the arrows in Fig. 2, and is delivered from the high pressure stage, through pipe 22, into the steam and water drum 2. This flow of the water through the high pressure stage of the economizer provides for a positive circulation, and the passage through tubes all of which are inclined upward with reference to the direction of flow of the water, and, in general in the reverse direction of the flow of the gases.

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 surface, and this principle is utilized by me in the operation of a steam boiler economizer. In the arrangement shown in Fig. 1 I introduce water, or steam, or both, into the gases between the high and low pressure stages of the economizer, one means for such purpose being a series of perforated pipes 23 connected to boxes 24 located in the flue 4 below the high pressure stage A of the economizer. As shown, the wall 4′ of the flue 4 stops short of the bottom of the flue so that the gases will flow through the passage below the wall 4′, and upward to the opening into flue 5, and, if desired, a second series of perforated pipes 25 may be placed at the opening into flue 5. The water or steam is delivered to the pipes 23 and 25 by any suitable means. The water may be supplied to the well 26 at the bottom of the flue 4 by a pipe 27 and pumped from the well by a pump 28, through valved pipes 29 and 30 to the perforated pipes 23 and 25 from which it escapes in fine streams or spray. Any suitable means other than perforated pipes may be used for spraying the water. The water in the well 26 is maintained at a lower lever than that in the pits 13 under banks of tubes of the low pressure stage of the economizer, and the water which collects in the pits 13 flows from one to the other through pipe connections 31, passing through the partition walls. These connections are water-sealed to prevent the flue gases being drawn through them. The water which collects in the pit beneath the bank 8 of the low pressure stage flows through a pipe 32 to the well 26, the lower end of pipe 32 being water-sealed as shown. When the water becomes too impure for use it may be drawn off through a pipe 33 and fresh water supplied to the well 26. When the water is circulated over and over again, a reagent to neutralize the acid fumes absorbed by the water may be added. Instead of circulating the water, the plant may be operated by having a continuous supply of fresh water through pipes 29 and 30, and a continuous withdrawal through pipe 33 with a sufficient supply in the well 26 to maintain a water seal for the pipe 32.

Doors 26′ may be provided in the wall of flue 4 through which access may be had to the well 26 for the purpose of washing out the sediment through pipe 33, or the sediment may be shoveled out through the doors.

When the water is sprayed into the gases, as above described, the water will be partly evaporated and will reduce the temperature of the gases, as a limit, to approximately 212° F., and this will produce a considerable volume of steam which will be condensed as the gases pass over the low pressure stage of the economizer. This cooler stage of the economizer will be more active in absorbing the heat from the steam and moist gases than the same stage would be in absorbing heat from relatively dry gases.

As above stated, steam alone, or steam and water, may be used for moistening and washing the gases. In plants where the main steam motors are run non-condensing, there is a surplus of exhaust steam, and this exhaust steam could be used in place of water. Steam would give additional heat to the economizer and would serve to throw down the cinders.

In addition to the advantage of an increased rate of heat transfer due to the addition of moisture to the gases, there is a further advantage in that the means described provide for the removal of soot, cinders and tar from the gases. In certain plants there is much trouble with the deposition of tar from the furnace gases on the coolest tubes of the economizer. This tar carries with it soot from the gases, the whole forming a pasty mass which cannot be effectively scraped from the tubes and which collects at the lower ends of the tubes and above the lowermost headers. By using a water spray or steam, in the manner described, the greater part of the tar and the soot will be carried down and deposited in the well 26.

Any suitable means may be utilized to carry out my process for the application of protective material to the exterior of the economizer tubes of the banks 8, 9, 10 and 11, and as one convenient form of device for this purpose I have shown each bank of tubes as having spreading devices somewhat similar in arrangement and operation to the scrapers illustrated in my application, Serial No. 876,012, these spreaders being preferably made in three parts in the same way as the scrapers used in commercial forms of cast iron economizers. The part designated by the reference numeral 100 consists of a skeleton frame or sleeve of which one may be provided for each of the economizer tubes 101 to be provided with protective material, these sleeves being operated by any suitable means, such as a carriage 102 for each bank of tubes, the carriages on adjacent banks being connected preferably in balanced relation by flexible devices 103 such as chains passing upward over pulleys 104 which may be utilized to operate the carriages 102, an actuating shaft 105, actuated by suitable means, not shown, being illustrated as the main actuating member. When the shaft 105 is operated in the direction of the arrow 106, all the pulleys 104 are turned to lift one of the pairs of carriages, allowing the other member of each pair to descend, and reversal of the shaft raises the last mentioned members of each pair, and permits the others to descend, the oil, pitch or other protective material being supplied through pipes 107 mounted above the frames 100 and having perforations through which the protective material is delivered, and each frame preferably having means such as the leather insets 108 to spread the protective material over the surface of its pipe 101. All of the pipes 107 may be fed from a common source as by a pipe 107′ having a valve and connecting the ends of all of the pipes 107 with a supply of protective material, such as a tank or the like.

Any excess of oil will descend into the pits 13 and pass over through pipes 31 and 32 into the well 26 from which means to reclaim the oil may be provided, a convenient form of such means being shown at 131 which designates a drain pipe located at a height suitable to receive the oil without the water therebeneath. The pipe 131 may conveniently be provided with a valve by which the oil may be drawn off from time to time into a suitable tank as it accumulates in the well 26.

In the design shown in Fig. 6, I have illustrated modified apparatus for carrying out my protective process in connection with a boiler plant comprising a bank of generating tubes 200, which with the furnace 201, superheater 202 and steam and water drum 203, may be, and are shown as being, of well-known structure and arrangement, so that detailed description thereof is not necessary.

From this boiler, the gases pass upward through a flue 204 in which I have shown a bank of tubes 205 constituting a vertical economizer to which the water is introduced through pipe 206 by means of pump 207 and passes to the steam and water drum 203 through pipe 208.

The gases on passing from the vertical economizer enter a chamber 209 through which water is sprayed, being introduced thereto through a pipe 210, and from this washing chamber the water may flow to a settling tank and means for re-pumping, not shown. From the chamber 209 the washed gases pass over to an extension chamber 211 in which are installed the horizontally extending tubes of an economizer 212, this economizer being preferably of substantially the same type and structure as that illustrated and described with reference to Figure 2.

In accordance with my invention, I provide for the application to the outer surfaces of the tubes in economizer 212 of a protective material, which may consist of oil introduced through a pipe 213 at high pressure through a spray nozzle 214 which applies it in atomized condition, the oil being preferably heated to secure a better atomization.

The gases after passing through the economizer 212 flow through an upwardly inclined conduit 215 of approximately the full width of economizer 212 which brings them together through a funnel-shaped connection 216 into a fan 217 driven by a motor 218 to create a forced draft in the stack 219.

The excess of oil may be collected as indicated at 220 at the base of the extension containing economizer 212, and suitable means, such as the pet-cock 221 may be provided for drawing off the oil.

What I claim and desire to secure by Letters Patent of the United States is:—

1. The method of protecting the exterior of a boiler economizer from corrosion, which consists in passing hot gases over the exterior of the economizer and water through the interior thereof and applying a fluid-protective material to the exterior of the economizer while the gases and water are flowing.

2. The method of protecting the exterior of a boiler economizer from corrosion, which consists in passing hot gases over the exterior of the economizer and water through the interior thereof and applying substantially continuously a fluid-protective material to the exterior of the economizer while the gases and water are flowing.

3. In a boiler, an economizer having tubes, a flue surrounding said tubes and adapted to conduct hot gases over the exterior thereof, and means within the flue to apply a protective coating to the exterior of the tubes while the hot gases are flowing over the tubes.

4. In a boiler, an economizer having tubes, a flue surrounding said tubes and adapted to conduct hot gases over the exterior thereof, and means within the flue to spread fluid-protective material upon the exterior surfaces of the tubes while the hot gases are flowing over the tubes.

5. In a boiler, an economizer having vertical tubes arranged in banks or stacks, a flue to conduct hot gases over the exterior of the tubes, spreader devices to apply protective material at a single operation to the tubes of one of said stacks, and means exterior of the flue to operate said devices.

6. In a boiler, an economizer having vertical tubes arranged in banks or stacks, a flue to conduct hot gases over the exterior of the tubes, spreader devices to apply protective material at a single operation to the tubes of one of said stack, means to connect in balanced relation the spreader devices upon adjacent stacks, and means exterior of the flue to operate said devices.

7. A spreader device for applying protective material to tubes in boilers of the class described, said device comprising a frame having spreading means, a supply pipe for the delivery of protective material to said spreading device, a carriage to operate a plurality of said frames, and means exterior of the boiler setting to operate said carriages.

8. The combination with a boiler having an economizer, of means to apply protective material to the tubes thereof, and means to collect the excess of protective material and reclaim it.

9. The combination in a boiler having an economizer and means to spray the gases passing through said economizer, of means to apply protective material to the tubes of a portion of said economizer, and means to collect and reclaim separately the fluids used in spraying and protection, respectively.

10. The combination in a boiler having an economizer and means to spray the gases passing through said economizer, of means to apply protective material to the tubes of a portion of said economizer, a tank and connections thereto, adapted to collect in said tank the surplus spraying and protective fluids, and means to collect and reclaim separately the fluids in said tank.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

DAVID S. JACOBUS.

Witnesses:

EDITH CAMP,

JOHN A. W. DIXON.