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STEAM BOILER AND ECONOMIZER AND METHOD OF OPERATING THE SAME

Filed March 25, 1922

3 Sheets-Sheet 1

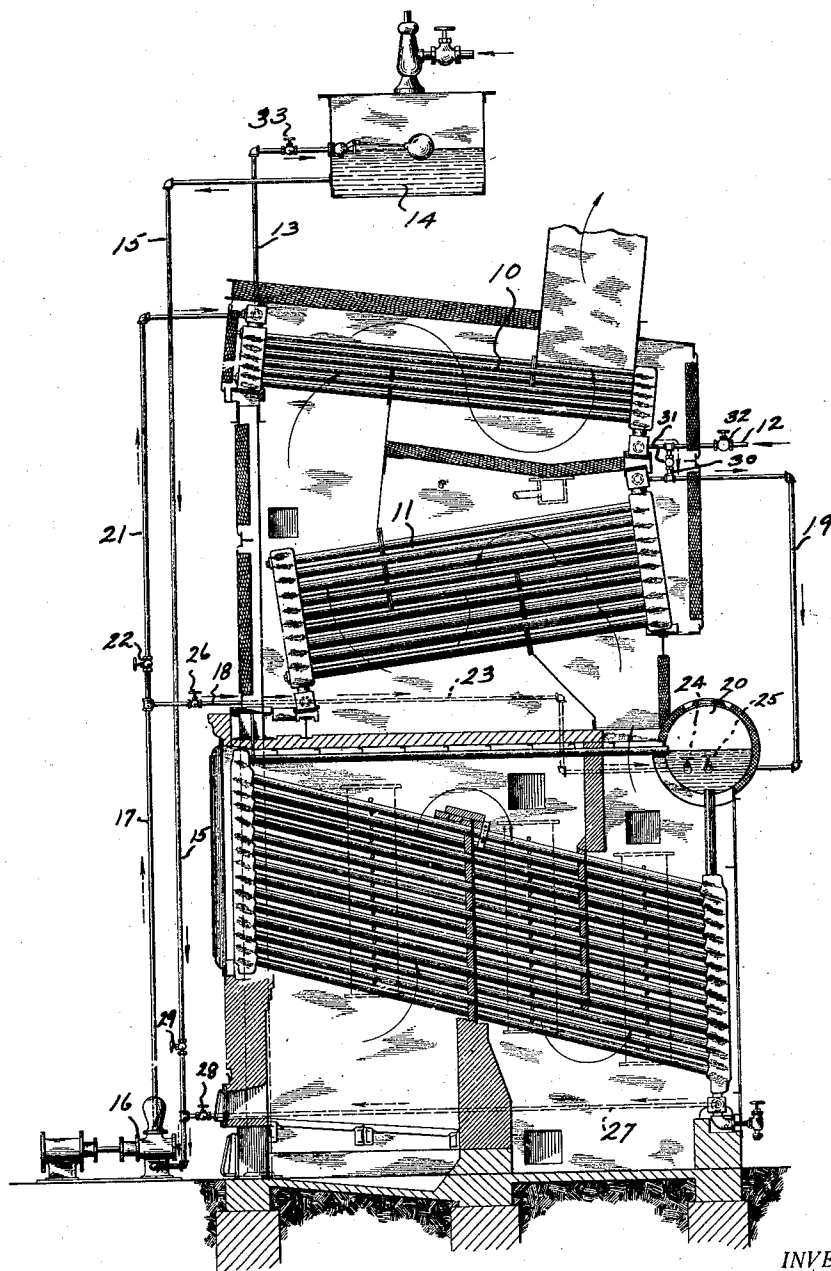


FIG. 1

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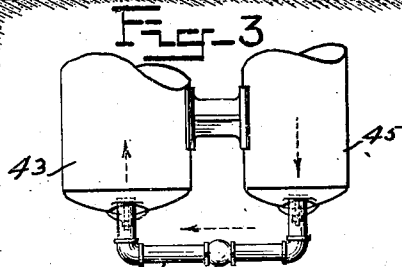
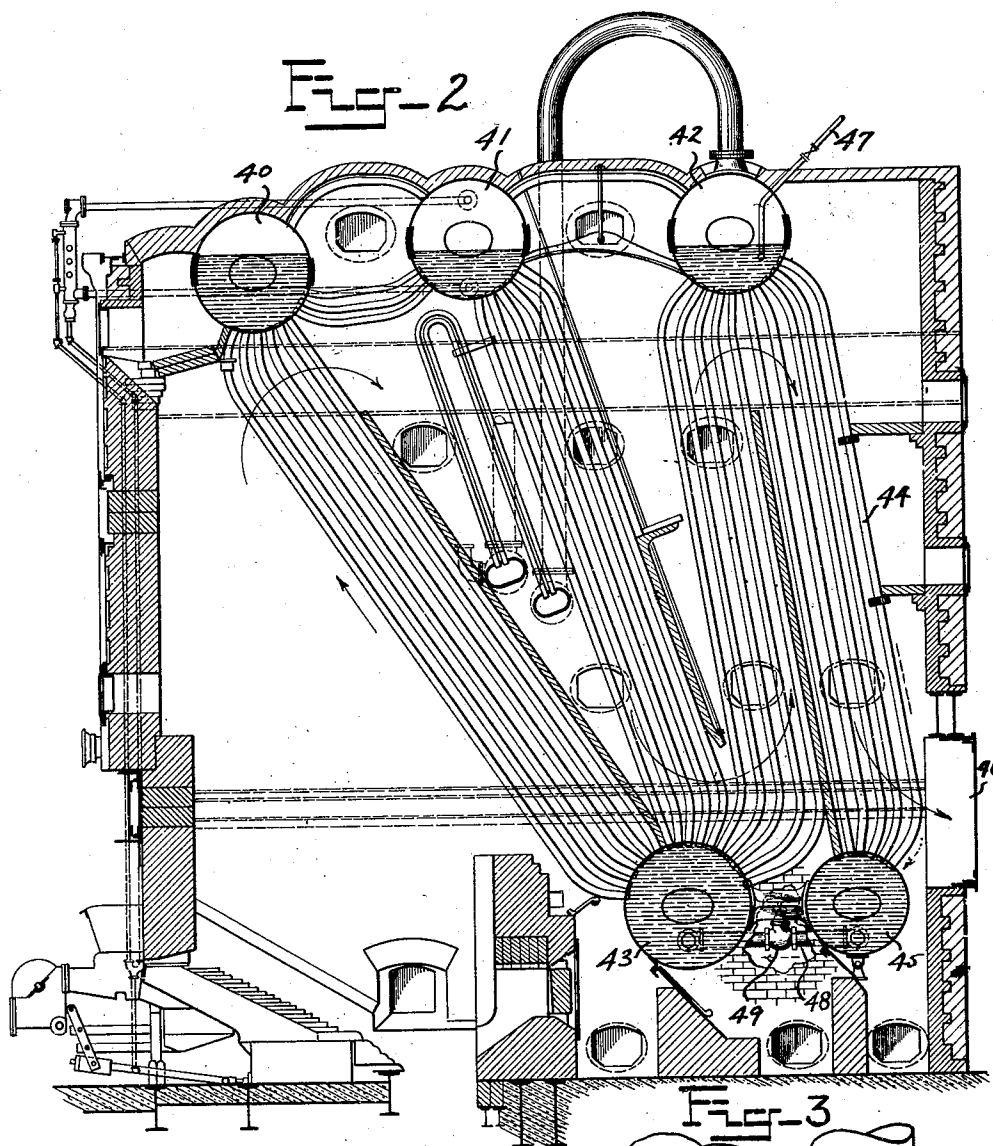
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STEAM BOILER AND ECONOMIZER AND METHOD OF OPERATING THE SAME

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3 Sheets-Sheet 2



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STEAM BOILER AND ECONOMIZER AND METHOD OF OPERATING THE SAME

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3 Sheets-Sheet 3

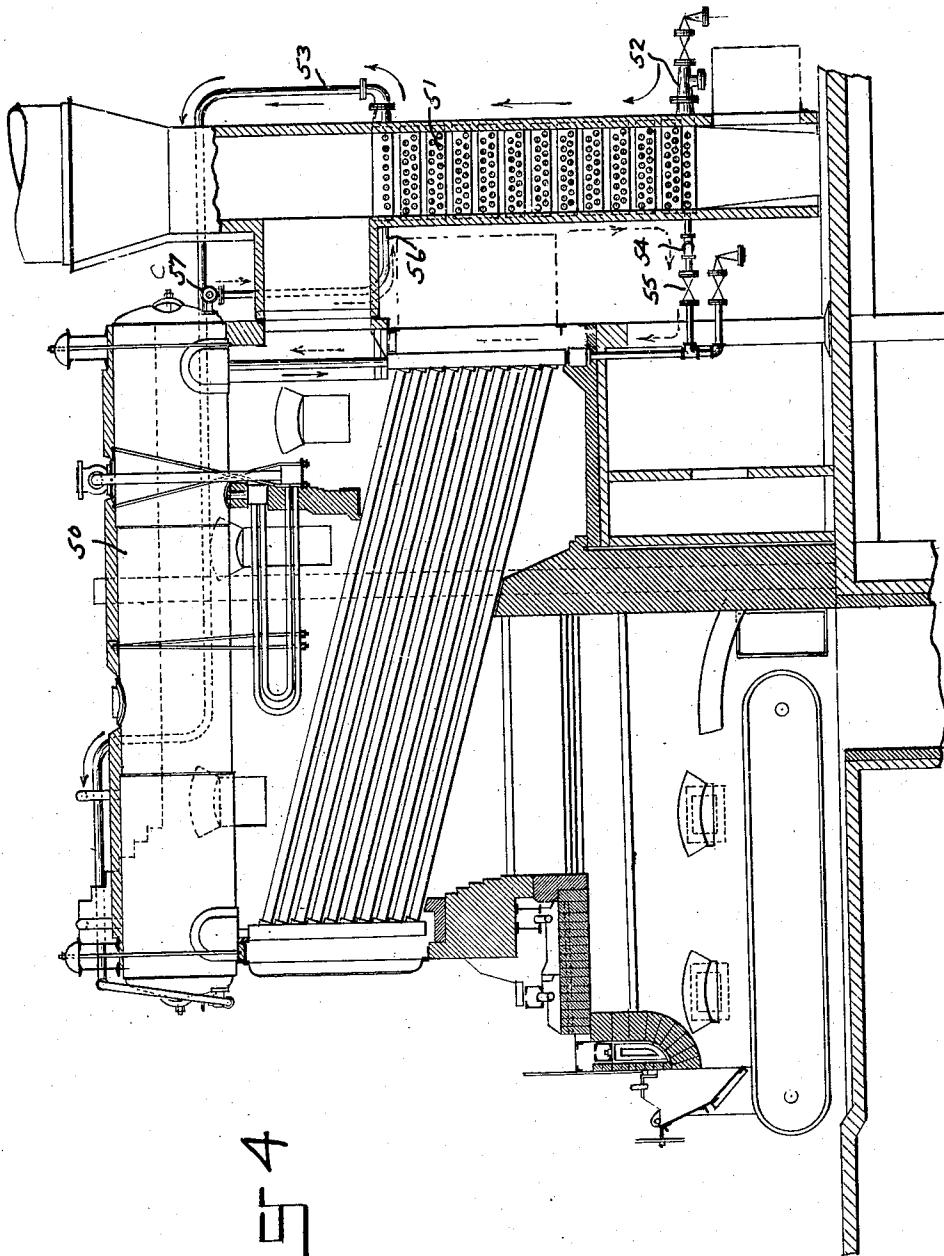


Fig. 4

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STEAM BOILER AND ECONOMIZER AND METHOD OF OPERATING THE SAME

Application filed March 25, 1922. Serial No. 546,671.

In the operation of steam boilers, it is sometimes necessary to suspend the operation of a boiler temporarily and yet hold it in readiness for being thrown into service 5 quickly. In such cases, the water in the boiler remains hot, since under such conditions, the fires are still lighted though banked, and such water maintains a slow circulation through the boiler, so that the boiler remains 10 substantially at a uniform temperature throughout. When such a boiler is provided with an economizer, however, the economizer does not form a part of the circulating system of the boiler, so that the economizer itself 15 may become cool enough during a lay-over period to cause a condensation of moisture on the exterior of the tubes. In the normal operation of a steam boiler furnace, acid-forming gases and dust may be thrown off, 20 and such dust may accumulate on the exterior of the tubes of the economizer. So long, however, as the hot gases from the furnace are passing in sufficient volume across the economizer to prevent the deposition of moisture 25 on the tubes, this dust has little or no harmful effect. If, however, moisture be added to this dust, acids may be produced which will cause corrosion of the exterior of the tubes.

One of the objects of my invention is to 30 provide a system and a method of operating the same by which this exterior corrosion may be minimized or entirely eliminated.

My invention will best be understood from the accompanying description and the annexed drawings, in which Fig. 1 is a sectional 35 elevation of a steam boiler of the horizontally inclined tube type provided with an economizer having a high and a low pressure section; Fig. 2 is a vertical section of a Stirling 40 boiler having an economizer connected therewith; Fig. 3 is a bottom view of a portion of the drums shown in Fig. 2, and Fig. 4 is a vertical section of a horizontally inclined water tube boiler with an economizer of another 45 type connected therewith.

Like reference characters indicate like parts in the several views.

In Fig. 1, I have illustrated the type of boiler shown in Fig. 3 of my prior Patent 50 No. 1,219,320, with my present invention in

connection therewith, and it will, therefore, be unnecessary to describe in detail more of the boiler than relates to my present invention. As described in my said prior patent, the boiler is provided with the economizer 55 sections 10 and 11, the feed water normally entering the section 10 through the inlet 12 and flowing from thence through the pipe 13 to the tank 14, from which it passes through the pipe 15 to the pump 16, from 60 which it is carried through the pipes 17 and 18 to the left-hand end of the economizer section 11, from which it flows through the pipe 19 to the boiler steam and water drum 20. For purposes to be hereinafter more specifically 65 pointed out, a pipe 21 connects the left-hand end of the section 10 with the pipe 17 and is provided with a valve 22. Similarly, the pipe 18 is continued as pipe 23 past its connection with the lower left-hand 70 end of the section 11 to the drum 20, being provided with a valve 24. The pipe 19 is also provided with a valve 25 adjacent the drum 20, and the pipe 18 with a valve 26. 75 A pipe 27 connects the mud drum of the boiler with the pipe 15, and is provided with a valve 28, the pipe 15 being provided with a valve 29. Between the lower right-hand end of the section 10 and the pipe 19 is a connection 30 having a valve 31, the inlet pipe 80 12 being provided with a valve 32. Pipe 13 has a valve 33.

In the normal operation of the boiler, the valves 22, 24, 28 and 31 are closed and the remaining valves referred to are open, and 85 the water flows as above indicated and as pointed out more specifically in my said prior patent.

Now, if a lay-over period is reached, so that the gases passing over the economizer 90 sections may not be sufficiently hot to prevent the condensation of moisture on the economizer tubes, the valves 25, 26, 29, 32 and 33 are closed and the valves 22, 24, 28 and 31 are open. The water from the boiler is now 95 permitted to pass through the pipe 27 to the pump 16 and up the pipes 17 and 21 to the left-hand end of the section 10, from the right-hand end of which it will flow through the connection 30 and valve 31 to the upper 100

right-end portion of the section 11. From thence it will flow through the section 11 and out of the pipe 23 into the drum 20, and thus pass back to the water in the boiler. In order to cause this flow in the arrangement illustrated, the pump 16 will be kept in operation and it will be obvious that by the connections described, the economizer sections are made a part of the boiler circulating system, so that the hot water of the boiler will keep the tubes correspondingly hot and thus prevent the deposit of moisture. Providing a circulation through the economizer during the layover period, also prevents or tends to prevent leakage. With the ordinary arrangement of economizer in which there is no circulation during the layover period, there are differences in temperature in the economizer boxes and in the economizer tubes set up in the layover periods, and further differences in temperature on starting to feed through the economizer, such differences in temperature producing strains during the expansion and contraction in the economizer. By circulating water through the economizer during the layover periods, such leakage is avoided or at least minimized.

In Fig. 2 I have illustrated my invention in connection with a boiler of the usual Stirling type having three upper steam and water drums 40, 41 and 42 connected to a lower drum 43, the economizer being formed of a bank of tubes 44 connected to the upper drum 42 and to a lower drum 45. Baffles cause the hot gases to flow along the several banks of tubes and finally along the economizer tubes 44 to the gas outlet 46.

Normally the feed water enters through the inlet 47 and circulates locally through the tubes 44 and finally passes into the boiler system.

During a lay-over period, the tubes 44 are out of the circulating system of the boiler, and therefore tend to become chilled when the gases passing over them are not hot enough to keep them warm. To obviate this for the reasons indicated above, I provide a connection 48 having a valve 49 between the drums 43 and 45 either at one or both ends thereof, and during the lay-over period, the valve 49 will be open. It will now be obvious that the tubes 44 are connected into the circulating system of the boiler so that, because of the difference in specific gravity of the hot water in the boiler tubes and the cooler water in the economizer tubes 44, a circulation will be established between the hot water in the boiler and the economizer to maintain the tubes of the latter as hot as the tubes of the boiler. When the boiler is started up again, the valve 49 is closed and the economizer then functions as usual.

In Fig. 4, I have illustrated my invention in connection with the type of economizer

illustrated more in detail in my prior Patent No. 1,289,182. The boiler is of the horizontally inclined water tube type, having one or more upper drums 50, the economizer 51 being made up of tubes extending across the gas outlet from headers located in the side walls thereof. Normally, the water enters through the inlet 52 and flows upwardly through the economizer to the pipe 53, from which it passes into the boiler system at the left-hand end of one of the drums 50. In order to carry out my invention in connection with this type of boiler and economizer, I provide a connection 54 having a valve 55 and leading to the mud drum of the boiler. The upper end of the economizer is connected to a drum 50 by a pipe 56 having a valve 57. In the normal operation of the boiler, the valves 57 and 55 are closed, but during a lay-over period, these valves will be open, and then the cooler and denser water in the economizer will cause the water in the economizer to flow downward which will draw the hot water from the drums 50 into the economizer and cause it to mingle with the water in the economizer and to flow down through the economizer sections and through the connection 54 back to the boiler. It will be understood that the connections between the economizer and the boiler are made to the latter beneath the normal water level therein. Under certain conditions of operation during the lay-over period, the economizer may become hot and produce steam. It will be apparent that under these conditions the use of the special connections allows either for the circulation of water through the economizer in the manner set forth above or it allows any steam generated in the economizer or steam and water to pass upward through the connection into the boiler. It is also apparent that any steam generated in the economizer illustrated in Fig. 2 will pass upwardly into the boiler.

The water in the economizer during a lay-over period is cool as compared with the water in the circulation system of the boiler. By connecting the top of the economizer, therefore, to a point in the circulation system near the top thereof, and connecting the bottom of the economizer to the circulation system near the bottom thereof, a positive circulation is produced through the economizer and a portion of the circulation system of the boiler, and this circulation is particularly pronounced where the economizer is located below the upper steam and water drum to which the economizer is connected.

In each of the forms of my invention illustrated in Figs. 1 and 3, I have indicated by full-line arrows the path which the water normally follows through the economizer into the boiler, and in each of Figs. 1, 2, and 3 I have indicated by broken-line arrows the path which the boiler water follows in circulating

through the economizer during a lay-over period.

Where the economizer sections are located above the boiler, it will usually be necessary to provide a pump to keep the water circulating through the economizer sections during the lay-over period, but where the economizer is located so as to be either at or below the level of the boiler, the water will circulate by gravity through the economizer sections. This is true of the forms shown in Figs. 2 and 4.

While I have shown my invention applied to certain types of boilers and economizers, it will be understood that its application may be widely varied both as to arrangement and as to the boilers and economizers to which it is applied.

I claim:—

1. The method of operating a steam boiler and its economizer connected thereto, which consists in normally feeding water forwardly through the economizer to the boiler without circulation, and in circulating the water by gravity between the boiler and economizer in the direction opposite to that in which it normally flows during a layover period when the temperature of the gases passing over the economizer is subnormal and while the water in the boiler is hot.

2. In combination, a steam boiler, an economizer, a feed-water inlet connected to the economizer and a connection between the boiler and the economizer arranged to permit water from the feed-water inlet to pass through the economizer into the boiler in the normal operation of the boiler, and valved connections between the boiler and the economizer, said connections operating when the valved connections are open, to permit hot water from the boiler to flow from the boiler to and through the economizer and back to the boiler in a direction the reverse of the flow of water in the normal operation of the system, the connections between the economizer and the boiler being made to the boiler below the normal water level therein.

3. In combination, a steam boiler having a water drum and a circulation system including said drum, an economizer located at a level lower than said drum, and valved connections from the top of said economizer to said boiler circulation system at a point near the top thereof but below the normal water level of said boiler, and from the bottom of said economizer to said circulation system at a point near the bottom thereof, said connections operating to permit hot water from the boiler to pass into and through the economizer and back to the boiler when the valved connections are open.

4. In combination, a steam boiler having a steam and water drum and a circulation system including said drum, an economizer located at a level lower than said drum,

valved connections from the top of said economizer to said circulation system at a point near the top thereof and from the bottom of said economizer to said circulation system at a point near the bottom thereof, said connections between the economizer and said drum being made below the normal water level of the latter, and said economizer and connections operating, when said connections are open, to permit hot water from the boiler to circulate by gravity from the drum through the economizer and back to the boiler.

5. In combination, a steam boiler, an economizer and a connection between the upper part of the economizer and the upper part of the boiler arranged to permit water to flow from the economizer to the boiler, and valved connections between the lower part of the boiler and the lower part of the economizer, said connections operating, when open, to permit hot water from the boiler to flow into the upper part of the economizer and from the lower part of the economizer back to the boiler, said valved connections being made to the boiler below the normal water level therein.

6. In combination, a steam boiler, an economizer and a connection between one end of the economizer and the boiler, arranged to permit water from the economizer to pass from the economizer to the boiler and a normally closed auxiliary connection from the other end of the economizer to another portion of the boiler, said economizer and said connections operating, when said connections are open, to permit hot water from the boiler to circulate by gravity through the economizer and back to the boiler in the reverse direction.

7. In combination, a steam boiler and economizer, connections between them arranged to permit water fed into the economizer to pass into the boiler in the normal operation of the system, and means for circulating water from the boiler through the economizer in the direction opposite to that of the feed water, said means comprising connections from each end of the economizer connected to the steam boiler below the normal water level therein.

8. In combination, a steam boiler and an economizer, connections between them arranged to permit water fed into the economizer to pass into the boiler in the normal operation of the system, and means to cause water to circulate through the boiler and economizer during a lay-over period when the boiler is hotter than the economizer in the direction of travel of water through the economizer during the lay-over period opposite that of the feed water through the economizer, said means comprising connections from each end of the economizer con-

ected to the steam boiler below the normal water level therein.

9. In combination, a steam boiler comprising water tubes and an economizer, said economizer being located on the other side of the boiler tubes from the fire box, connections between said boiler and economizer arranged to permit water fed into the economizer to pass into the boiler in the normal operation of the system, and means for circulating water from the boiler through the economizer in the direction opposite to that of the feed water, said connections between the boiler and economizer being made to the boiler below the normal water level therein.

10. In combination, a steam boiler, an economizer, connections between them arranged to permit water fed into the economizer to pass into the boiler in the normal operation of the system, and means for circulating water from the boiler through the economizer in the reverse direction, said means comprising connections from each end of the economizer connected to the steam boiler below the normal water level therein.

11. In a steam boiler, a steam and water drum, a boiler section and an economizer section each comprising tubes and a water compartment and each section being connected to said steam and water drum, said water compartments being physically distinct, means for directing heated gases over boiler tubes and then over economizer tubes, a connection between said boiler section and said economizer section below the normal water level, and means for controlling the flow of water through said connection.

12. In a steam boiler, a steam and water drum, a boiler section and an economizer section each comprising tubes and a water compartment and each section being connected to said steam and water drum, said water compartments being physically distinct, means for directing heated gases over boiler tubes and then over economizer tubes, and a valved connection between said boiler section and said economizer section below the normal water level.

13. In a steam boiler, a steam and water drum, a boiler section and an economizer section each comprising tubes and a water compartment and each section being connected to said steam and water drum, said water compartments being physically distinct, means for directing heated gases over boiler tubes and then over economizer tubes, and normally inoperative means adapted to cause a circulation of water from the boiler to and through the economizer.

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