

[54] **ELECTRODE BOILERS**

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[56] **References Cited**

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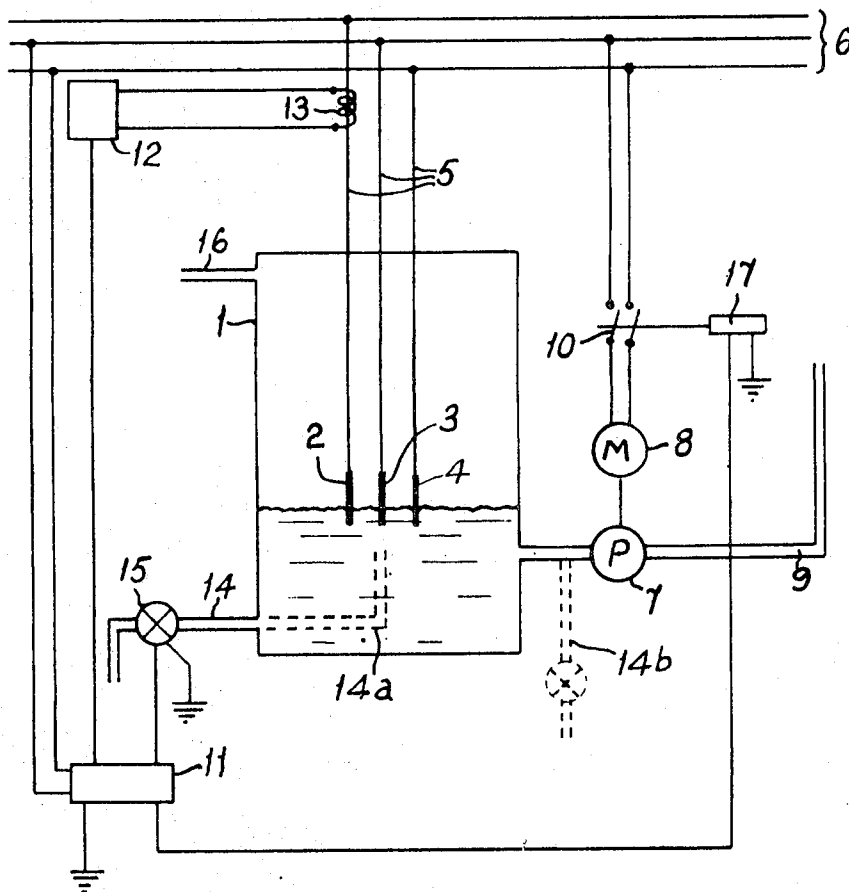
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[57] **ABSTRACT**

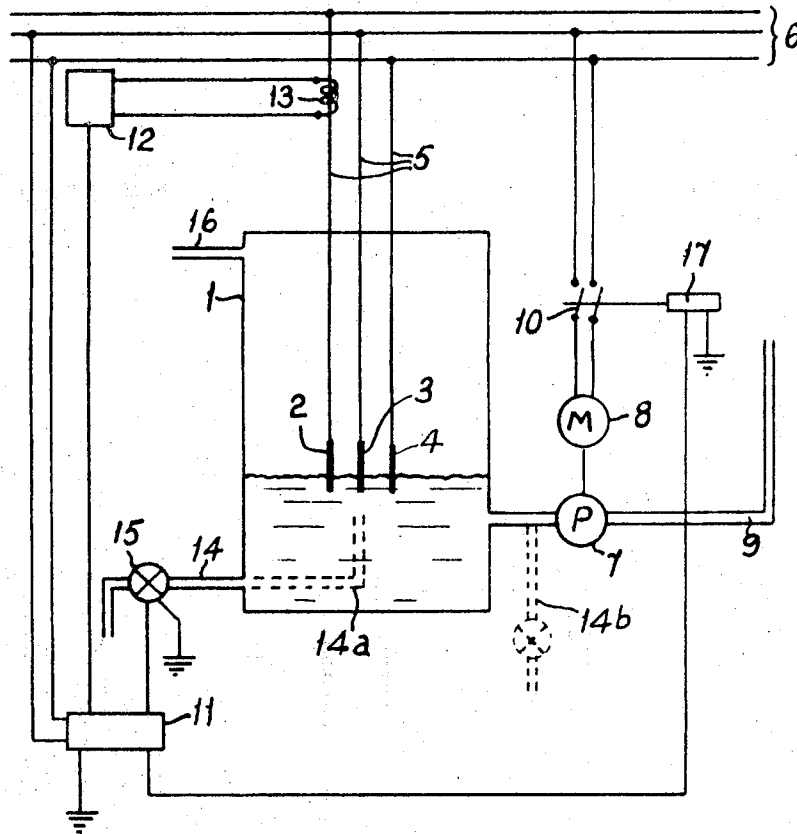
An electrode steam boiler comprises a water-receiving shell, water-heating electrodes supported in the shell, a pump for supplying feed water to the shell, means for causing intermittent operation of the pump, and means for withdrawing water from the shell just before and/or during and/or just after at least some of the periods of operation of the pump, so that water withdrawal occurs when the concentration of salts in the boiler water is highest.

15 Claims, 1 Drawing Figure



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ELECTRODE BOILERS

This invention relates to an electrode boiler for generating steam, hereinafter referred to as an electrode steam boiler, and to a method of operating such a boiler.

In electrode steam boilers it is usually necessary to control the concentration of salts contained in the feed water, particularly in the water surrounding the electrodes. A method of doing this is to remove water periodically from the boiler shell by means of a pipe which passes through the boiler shell and withdraws water from any desired region of the shell and advantageously from a region at or near the level of the lower end of the electrodes. The amount of water withdrawn by such a pipe must be controlled, and this is often done by providing it with an electrically-operated valve which can be operated by a timing device so that, at certain fixed intervals of time, water is withdrawn from the boiler shell and passed to waste. Alternatively, the operation of the valve can be controlled by some form of conductivity meter.

Operating the valve by means of a timing device has the disadvantage that the same amount of water is withdrawn irrespective of the load at which the boiler is operating or the concentration of salts in it. Operation of the valve by means of a conductivity meter is, for various technical reasons, very difficult to keep functioning all the time and is therefore very seldom used.

According to one aspect of the present invention in a method of operating an electrode steam boiler of the kind comprising electrodes supported in the boiler, means for withdrawing water from the boiler and means for supplying feed water to the boiler the feed water is supplied to the boiler intermittently and water is withdrawn intermittently from the boiler just before and/or during and/or just after at least some of the intervals of feed water supply.

Preferably, each period of water withdrawal from the boiler ends immediately before the commencement of an interval of feed water supply so that water withdrawal occurs when the concentration of salts in the boiler water is highest.

Preferably, the quantity of water withdrawn during each withdrawal period is set to a predetermined value, which value is adjustable.

In an electrode steam boiler in which no water is withdrawn and the feed water is supplied at intervals, the frequency of the feed water supply intervals will be proportional to the concentration of salts in the boiler water and to the amount of steam being generated. In an electrode steam boiler operating according to the method of the present invention, therefore, it will be appreciated that water is withdrawn from the boiler at a frequency which is proportional to the concentration of salts in the boiler.

According to a further aspect of the invention, an electrode steam boiler comprises a water-receiving shell, water-heating electrodes supported in the shell, a pump for supply feed water to the shell, means for causing intermittent operation of the pump, and means for withdrawing water from the shell just before and/or during and/or just after at least some of the periods of operation of the pump.

The means for withdrawing water from the shell may be a pipe connected to the shell, or passing through the shell wall into the interior of the shell, and valve means

controlling the flow of water through said pipe. The valve means may be electrically operated, opening and closing of the valve means being effected in timed relationship with the intermittent operation of the feed water pump. For example, the means for causing intermittent operation of the feed water pump may comprise an adjustable electric timer and the latter may be arranged to open said valve means for a pre-set period prior to each intermittent operation of the feed water pump. Preferably, the timer would be arranged to close said valve means prior to initiating an operation of the feed water pump.

The accompanying drawing is a schematic view of an electrode steam boiler in accordance with the invention.

The electrode steam boiler shown in the drawing has a shell 1 in which three electrodes 2, 3, 4 are supported and connected by leads 5 to a three-phase A.C. supply network 6. A pump 7 driven by an electric motor 8 is arranged to supply feed water to the shell 1 via a pipe 9 from a suitable water source (not shown). The motor 8 is connected to the network 6 via a switch 10.

An electric timer 11 is connected to the network 6 and is controlled by signals received from a controller 12. The latter is supplied with current from a current transformer 13 which measures the current flowing in one of the electrode supply leads 5. As the water level in the shell 1 drops, due to generation of steam, the current in the leads 5 will decrease and therefore the current supplied to the controller 12 by the transformer 13 will also decrease. Decrease of the latter current to a predetermined value indicates that feed water should be supplied to the shell 1 to make up for the loss of water caused by the generation of steam. When this predetermined current flows to the controller 12, a signal is sent by the controller to initiate operation of the timer 11 as described more fully hereinafter.

A water outlet pipe 14 is connected to the shell 1 and is provided with an electrically-operated valve 15. The numeral 16 designates the outlet pipe for steam generated in the shell 1.

When the controller 12 sends a signal to the timer 11 indicating the need for water to be supplied to the shell 1, the timer first sends an impulse to the valve 15 and the latter is opened for a predetermined interval of time (which interval is adjustable at the timer) to allow water to flow from the shell through the pipe 14. When the valve 15 closes at the end of this predetermined interval of time, the timer 11 sends a further impulse to a solenoid 17 which closes the switch 10 to operate the pump 7 and supply the feed water to the shell. As the water level builds up in the shell, the current supplied to the controller 12 increases and at a predetermined value of this current the controller 12 sends a signal to the timer 11 to initiate de-energisation of the solenoid 17 so that the switch 10 re-opens to stop the pump 7.

In the embodiment of the invention described above, the pipe 14 is shown as being connected to the wall of the shell 1. If desired the pipe 14 may extend through the wall of the shell 1 and extend into the latter, for example as indicated by the dotted lines 14a, to a region adjacent the lower ends of the electrodes 2, 3 and 4. In yet another embodiment, the pipe 14 may be connected to the feed water supply pipe 9, as indicated by the dotted line 14b.

Again, the feed water supply pipe 9 is shown as being connected to the shell 1, but if desired this pipe may

feed water to jets arranged to direct the incoming water into spaces between the electrodes as described in U.S. Patent Application Ser. No. 106128 filed Jan. 13th 1971 entitled "Improvements in and relating to electrode boilers."

What is claimed is:

1. A method of cyclically operating an electrode steam boiler of the type comprising electrodes supported in the interior of the boiler and maintained at least partly immersed in the water in said boiler for at least a portion of a boiler operating cycle and extending into the water in said boiler in direction transverse to the plane of the water level in said boiler, comprising the steps of monitoring the magnitude of the current flowing through at least one of said electrodes while said electrodes are partly immersed in the water in said boiler to indirectly monitor the lowering of the water level in said boiler resulting from the conversion of the water in said boiler into steam; feeding additional water into said boiler beginning at a time after the magnitude of said current has fallen to a predetermined first value as a result of the fall of the water level to a predetermined first level due to the conversion of the water in said boiler into steam and only until the magnitude of said current rises to a predetermined second value indicative of a rise of the water level in said boiler to a predetermined second level higher than said first level; withdrawing water from the boiler beginning at a time after the magnitude of said current has fallen to said predetermined first value but not during said feeding of additional water; and terminating said withdrawing of water before the magnitude of said current again falls to said predetermined first value.

2. A method as defined in claim 1, wherein said step of feeding additional water consists of effecting a single uninterrupted feeding of water terminating when the magnitude of said current reaches said second value.

3. A method as defined in claim 1, wherein said step of withdrawing water consists of effecting a single uninterrupted withdrawal of water.

4. An arrangement comprising an electrode steam boiler of the type comprising electrodes supported in the interior of the boiler and maintained at least partly immersed in water contained in said boiler for heating such water and extending into the water in said boiler in direction transverse to the plane of the water level in said boiler; monitoring means for monitoring the magnitude of the current flowing through at least one of said electrodes while said electrodes are partly immersed in the water in said boiler to indirectly monitor the lowering of the water level in said boiler resulting from the conversion of the water in said boiler into steam; feeding means operatively associated with said monitoring means and operative for feeding additional water into said boiler beginning at a time after the magnitude of said current has fallen to a predetermined first value as a result of the fall of the water level to a predetermined first level due to the conversion of the water in said boiler into steam and operative for effecting such feeding of additional water only until the magnitude of said current rises to a predetermined second value indicative of a rise of the water level in said boiler to a predetermined second level higher than said first level; and withdrawing means operatively associated with said monitoring means and operative for withdrawing water from said boiler beginning at a time after the magnitude of said current has fallen to said first

value and only until a time before the magnitude of said current again falls to said predetermined first value.

5. An electrode steam boiler comprising a water-receiving shell, water-heating electrodes supported in said shell, means for supplying current to said electrodes, a pump for supplying feed water to said shell, means for monitoring the current supplied to at least one of said electrodes, means controlled by said monitoring means for starting said pump during a period commencing after said current falls below a first predetermined value and for subsequently stopping the pump when the current subsequently rises to a second and higher predetermined value, and further means controlled by said monitoring means for withdrawing water from the shell in a period following the fall of the current to said first predetermined value during which the feed water pump is inoperative.

6. A method of cyclically operating an electrode steam boiler of the type comprising electrodes supported in the interior of the boiler and maintained at least partly immersed in the water in said boiler for at least a portion of a boiler operating cycle and extending into the water in said boiler in direction transverse to the plane of the water level in said boiler, comprising the steps of monitoring the magnitude of the current flowing through at least one of said electrodes while said electrodes are partly immersed in the water in said boiler to indirectly monitor the lowering of the water level in said boiler resulting from the conversion of the water in said boiler into steam; feeding additional water into said boiler beginning at a time after the magnitude of said current has fallen to a predetermined first value as a result of the fall of the water level to a predetermined first level due to the conversion of the water in said boiler into steam and only until the magnitude of said current rises to a predetermined second value indicative of a rise of the water level in said boiler to a predetermined second level higher than said first level; withdrawing water from the boiler beginning at a time after the magnitude of said current has fallen to said predetermined first value and terminating said withdrawing of water before the magnitude of said current again falls to said predetermined first value.

7. The method claimed in claim 6, in which each period of water withdrawal from the boiler ends immediately before the commencement of an interval of feed water supply, so that water withdrawal occurs when the concentration of salts in the boiler water is highest.

8. The method claimed in claim 6, in which the quantity of water withdrawn during each withdrawal period is set to a predetermined value, which value is adjustable.

9. The method claimed in claim 6, in which the water is withdrawn from a region in the boiler adjacent to the lower ends of the electrodes.

10. A boiler as claimed in claim 5, in which the means for withdrawing water from said shell is a pipe connected to said shell and valve means controlling the flow of water through said pipe.

11. A boiler as claimed in claim 5, in which the means for withdrawing water from said shell is a pipe passing through the shell wall into the interior of said shell and valve means controlling the flow of water through said pipe.

12. A boiler as claimed in claim 10, in which said valve means is electrically operated, opening and closing of said valve means being effected in timed relation-

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ship with the intermittent operation of said feed water pump.

13. A boiler as claimed in claim 12, in which said monitoring means comprises an adjustable electric timer arranged to open said valve means for a pre-set period prior to each period of operation of said feed water pump, and to close said valve means prior to initiating operation of said feed water pump.

14. A boiler as claimed in claim 11, in which said valve means is electrically operated, opening and clos-

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ing of said valve means being effected in timed relationship with the intermittent operation of said feed water pump.

15. A boiler as defined in claim 14, in which said monitoring means comprises an adjustable electric timer arranged to open said valve means for a pre-set period prior to each period of operation of said feed water pump, and to close said valve means prior to initiating an operation of said feed water pump.

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