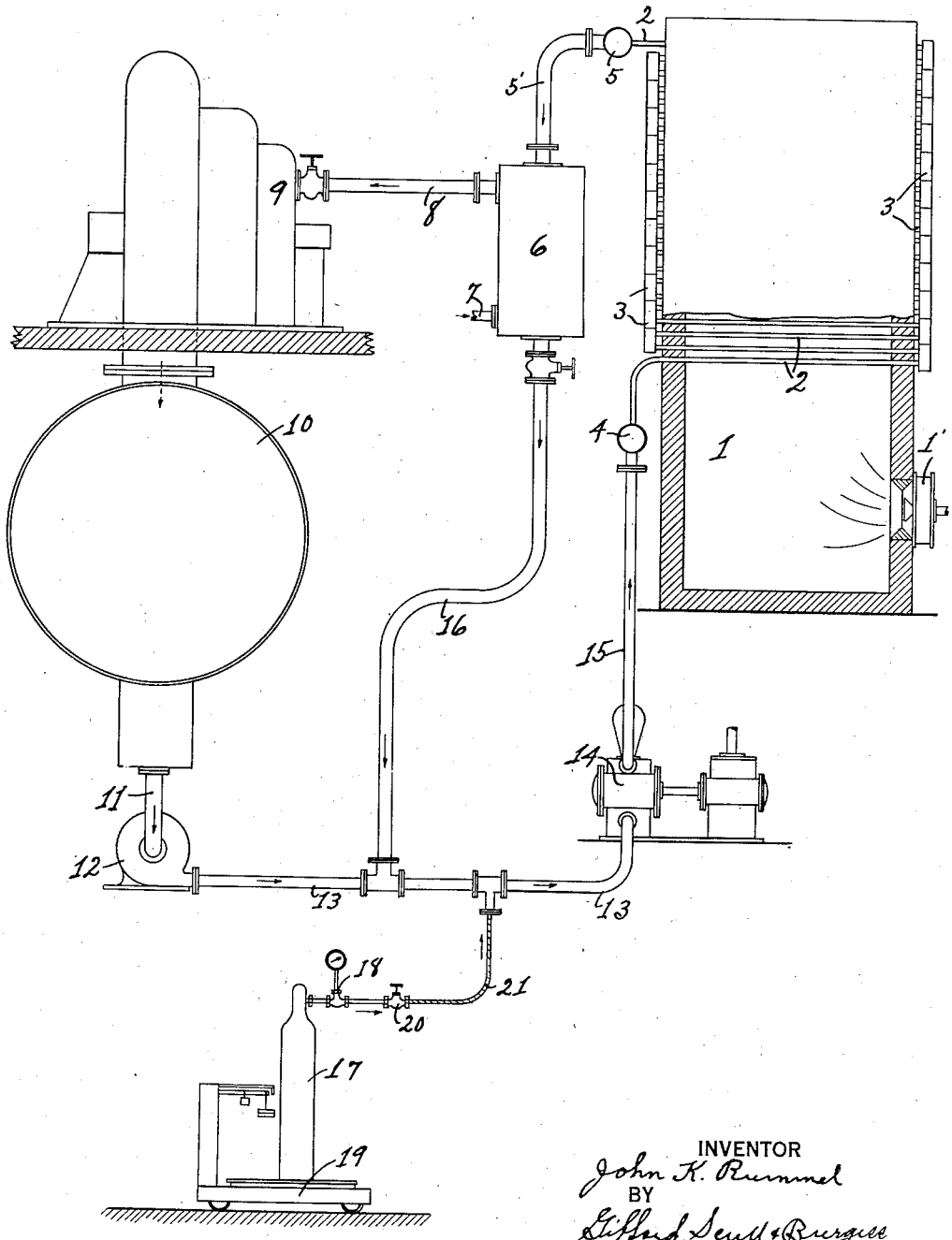
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STEAM GENERATOR AND METHOD OF PREVENTING TURBINE ACCUMULATIONS

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STEAM GENERATOR AND METHOD OF PREVENTING TURBINE ACCUMULATIONS

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11 Claims. (Cl. 210—16)

This invention relates to a boiler into which carbon dioxide is introduced to prevent the accumulation of caustic soda or other sodium compounds. It has been found in practice that such accumulations of caustic soda or other sodium compounds result in some of these compounds being carried with the steam into the steam turbine that is being operated by steam from the boiler with a consequent loss in efficiency and danger to the plates and nozzles of the steam turbine. By this invention these difficulties are overcome.

The invention will be understood from the description in connection with the accompanying drawing which illustrates somewhat diagrammatically how the invention can be carried out.

In the drawing, reference character 1 indicates the furnace of a boiler that may be fired, for example, by means of the fuel burners 1'. A boiler is located in position to be heated by hot products of combustion from the furnace 1. This boiler comprises rows of tubes 2 extending across the furnace with their ends connected to superposed headers 3 on opposite sides in such a manner that water enters the row of tubes from the horizontally disposed inlet header 4 and passes back and forth through the tubes that are connected in series with each other, the tubes in each row being connected in parallel with each other. The outlet ends of the upper row of tubes 2 are connected to the outlet header 5 from which a pipe 5' leads to the receptacle 6, which operates as a steam and water separator. A feed water inlet pipe 7 is connected to the receptacle 6 from a feed pump or the like (not shown).

A valved pipe 8 extends from the upper or steam space of the receptacle 6 to the turbine 9. The exhaust steam from the turbine 9 is discharged into the condenser 10 from which a pipe 11 leads to a centrifugal pump 12. A pipe 13 leads from the outlet of the centrifugal pump 12 to the feed pump 14 from which a pipe 15 leads to the header 4.

A valved pipe 16 leads from the lower or water space of the receptacle 6 to the pipe 13.

A carbon dioxide tank 17 that is provided with a pressure gauge 18 is placed upon a weighing scale 19. A valved pipe 20 leads away from the upper portion of the tank 17 and is connected by the flexible connection 21 to the pipe 13, so that a regulated amount of carbon dioxide may be introduced into the water that enters the pump 14 and may be measured as it enters.

By introducing carbon dioxide into the water, the formation of caustic soda is prevented, due to the fact that the carbon dioxide causes the formation of sodium carbonate or sodium bicarbonate to take place.

Tests have shown that when water entering the boiler tubes contains as high as about 50 parts per million of sodium carbonate equivalent with, say, about 20% or more of it in the form of sodium bicarbonate, no appreciable hydrolysis of the sodium carbonate will take place in the boiler. The sodium carbonate will remain as dust in the superheated steam that leaves the boiler and will not produce any more harmful effects upon the turbine efficiency or blades than other solid material produces. This dust does not have a strong tendency to form deposits within the turbine as is the case with caustic soda, which, because of its physical and other properties, solidifies and often acts as a binder for the precipitation of other solids upon the turbine blades and nozzles. A calculation will show that with 50 parts per million of sodium carbonate equivalent present in the boiler feed water, the addition of 4.15 lbs. of carbon dioxide per million lbs. of feed water is sufficient to convert about 20% of the sodium carbonate equivalent into sodium bicarbonate. It has been found that the amount of carbon dioxide required to convert the sodium compounds into the form that will not form or assist in the adherence of deposits upon the turbine blades or nozzles is sufficient when enough carbon dioxide has been added to cause about 20% of the sodium carbonate equivalent to be converted into sodium bicarbonate.

In certain cases, it may be advisable to add other compounds with the CO_2. For example, if the alkali concentration becomes too high, phosphoric or sulphuric acid or their acid salts may be added to neutralize a part of the excess alkalinity and thus reduce the amount of CO_2 that otherwise would be required.

I claim:

1. The process of treating boiler water which comprises introducing feed water containing sodium compounds into a boiler and adding carbon dioxide.

2. The process of treating boiler water which comprises introducing feed water containing sodium compounds into a boiler and adding a regulated amount of carbon dioxide.

3. The process of treating boiler water which comprises introducing feed water containing sodium compounds into a boiler and adding a sufficient amount of carbon dioxide to cause sodium bicarbonate to be formed.

4. The process of treating boiler water which comprises introducing feed water containing sodium compounds into a boiler and adding a sufficient amount of carbon dioxide to cause as much as about 20% or more of the sodium carbonate equivalent to be converted into sodium bicarbonate.

5. The process of treating boiler water which comprises introducing feed water containing about 50 parts per million of sodium carbonate into a boiler and adding approximately four pounds of carbon dioxide per million pounds of water.

6. The process of treating boiler water which comprises introducing feed water containing sodium compounds into a boiler and adding sufficient mineral acid to neutralize a part of the sodium alkalinity therein, while adding carbon dioxide in sufficient amount to form sodium bicarbonate in said feed water.

7. In a steam turbine-boiler power plant, the method of minimizing deposits in the turbine of adhesive sodium compounds carried over in steam generated in the boiler from water containing a sodium compound, consisting of adding carbon dioxide to the boiler water.

8. In a steam turbine-boiler power plant, the method of minimizing deposits in the turbine of solids carried over in steam generated in the boiler from water containing a sodium compound which tends to be converted therein into a second sodium compound having a high adhesive property, consisting of adding carbon dioxide to the boiler water in sufficient quantity to minimize the amount of said first compound so converted.

9. In a steam turbine-boiler power plant, the method of minimizing deposits in the turbine of solids carried over in steam generated in the boiler from water containing a sodium compound which tends to hydrolyze at high temperature into a second sodium compound having a high adhesive property when separated, consisting of adding carbon dioxide to the boiler water in sufficient quantity to minimize the hydrolysis reaction.

10. The method of treating steam boiler water containing a sodium compound tending to hydrolyze at high temperatures into another sodium compound having a high adhesive property when separated from the water, consisting of adding carbon dioxide to the boiler water in sufficient quantity to convert a substantial portion of said compound into bicarbonate, and thereby minimize the hydrolysis reaction.

11. The method of treating steam boiler water containing a sodium compound tending to hydrolyze at high temperatures into another sodium compound having a high adhesive property when separated from the water, consisting of adding carbon dioxide to the boiler water in sufficient quantity to substantially increase the partial pressure of carbon dioxide in the water and thereby minimize the hydrolysis reaction.

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