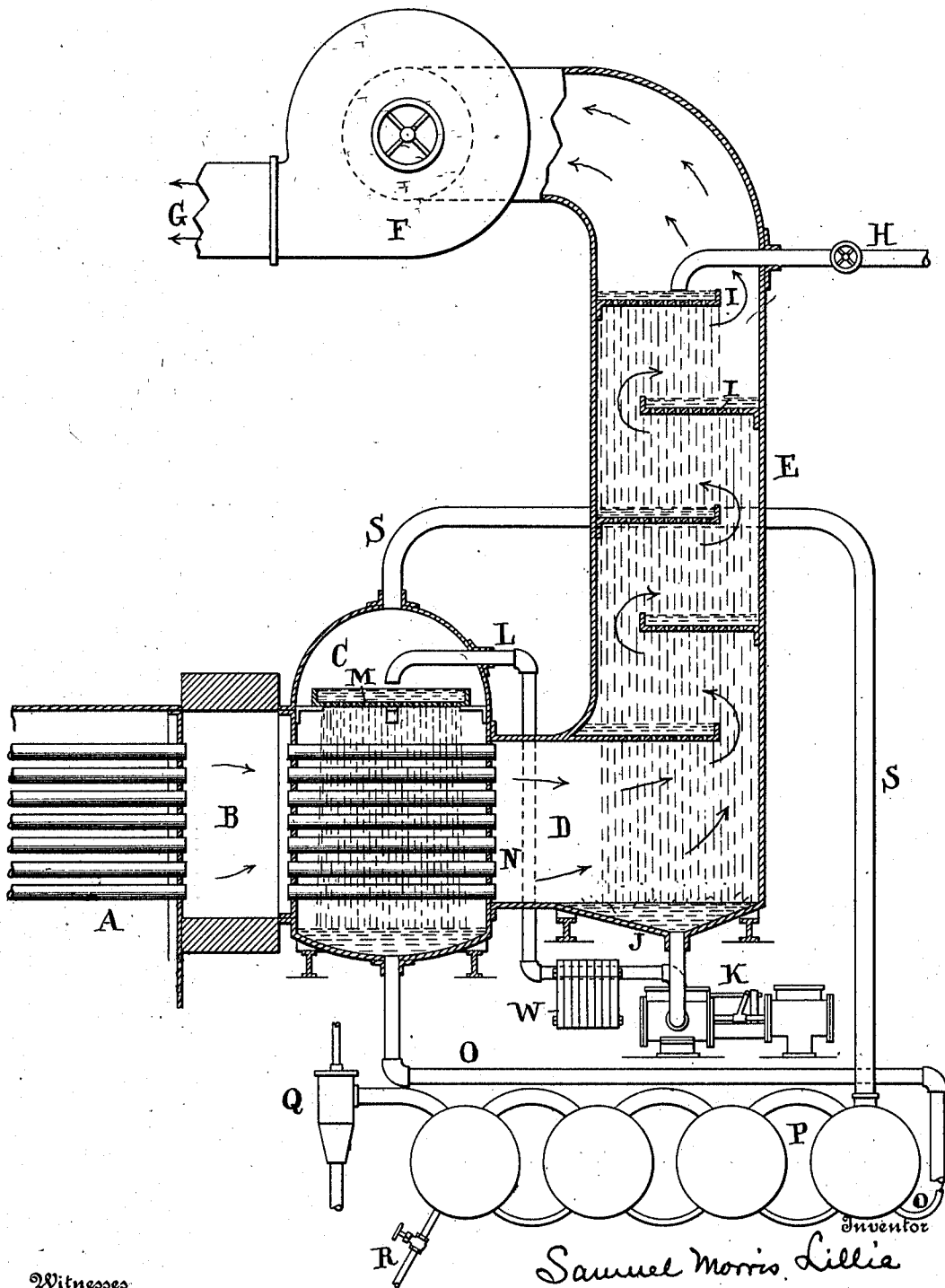


S. M. LILLIE.
 APPARATUS FOR EVAPORATING SOLUTIONS.
 APPLICATION FILED OCT. 3, 1907.

980,108.

Patented Dec. 27, 1910.



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APPARATUS FOR EVAPORATING SOLUTIONS

980,108.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, SAMUEL MORRIS LILLIE, of the city and county of Philadelphia and State of Pennsylvania, have invented an Improvement in Apparatus for Evaporating Solutions, of which the following is a specification.

My invention has reference to apparatus for evaporating solutions and consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawing, which forms a part thereof.

This application is a division of my application Serial No. 369,248, filed April 20th, 1907, and is restricted to the apparatus for carrying on the method or process forming the subject matter of the said application.

The object of my invention is to utilize the hot waste gases or products of combustion from furnaces of boilers and other apparatus for producing a preliminary heating of the fluid to be evaporated prior to its final treatment in a multiple effect or other evaporating or concentrating apparatus, whereby the caloric of said waste gases or products of combustion or matters held in suspension or in gaseous form may be extracted and absorbed into the solution to be evaporated or concentrated.

My invention comprehends apparatus in which is carried on a method of treating the liquor in which it is caused to shower or spray through hot gases or products of combustion from the furnace of a boiler or other apparatus and become heated by direct contact with them, and subsequently treated to evaporation by indirect heating. My apparatus makes use of the said hot gases or products of combustion to further heat the aforesaid directly heated liquor by indirect heating as in the first stage in the subsequent evaporation or concentration.

My apparatus is further adapted to utilize the sprayed liquor upon hot gases charged with matters in suspension or in gaseous form to extract the said matters and also the heat, and subsequently to subject the charged solution so produced to further heating or to concentration as in a multiple effect evaporating apparatus.

My invention also specifically consists of apparatus in which to practice the said method and comprising a vertical flue through which the hot gases or products of

combustion are caused to pass upwardly, combined with means for causing a downwardly traveling spray of fluid (through the said flue) to be evaporated, and an evaporating apparatus for subjecting the directly heated liquor to an indirect further heating or evaporation by the same hot gases or products of combustion.

My invention also comprehends details of construction which, together with the features above set forth, will be better understood by reference to the drawings, in which is shown apparatus, more or less diagrammatically, partly in section and partly in elevation, embodying my invention.

A represents an apparatus, such as a steam boiler, from which hot gases and products of combustion are secured, said gases and products passing through flue B, thence through the evaporating tubes N of an evaporator C, then into a chamber D and from which they pass upwardly through the flue E to the atmosphere. If desired, a forced draft may be maintained by an exhaust fan F at the upper end of the flue E, which fan may discharge into the atmosphere. The boiler or other apparatus A is provided with any of the usual furnaces or means for producing hot waste products of combustion or gases of any description.

The evaporator C consists of a chamber having a series of evaporating tubes N over which the liquor to be evaporated is caused to pass in spray or streams. Said liquor may be supplied by a feed pipe L to a perforated pan M within the chamber and above the tubes N. The hot vapors pass off at the top of the chamber by pipe S and the liquor may be drawn off from the bottom by a pipe O.

The chamber D has a well J at its bottom to collect the descending liquor from the vertical flue E; and from this well the liquor is delivered by a pump K to the evaporator C by the pipe L, through a filter W, if desired.

The vertical flue E may be made in any suitable manner, of sheet metal or otherwise, and is provided with a series of baffle plates I, preferably made in the form of perforated trays and extending from opposite walls alternately and projecting part way across the flue. In this way a circuitous passage is provided for the upward passage of the hot gases and products of com-

bustion as indicated by the arrows, and the liquor to be evaporated or condensed is caused to flow downward in a dense shower as indicated by the dotted lines. Such liquor as is not vaporized passes into the well J at the bottom of the flue E and is subsequently subjected to further treatment.

The exhaustor F may be of any suitable construction. By its use the spray of liquor in the flue E may be very dense and a rapid circulation of hot gases and products of combustion be maintained through it. If a tall chimney is available it is possible to dispense with the exhaustor, but I prefer it in most cases. The cooled gases pass from the exhaustor at G.

In addition to evaporating the liquor by the evaporator C, further evaporation may be carried on by the evaporating apparatus P which may be a single or multiple effect apparatus as preferred. In the illustration I have shown diagrammatically a quadruple effect, to which the hot liquor from the evaporator C is supplied by pipe O to the first effect of the series and after concentration, is delivered by pipe R from the last effect. The vapors pass from effect to effect in the usual manner and the vapors from the last effect of the series are condensed by the condenser Q.

From an examination of the arrangement of the parts of the apparatus as a whole it is evident that the evaporating apparatus C may be considered as the first effect of the entire evaporating apparatus though the heating is not done by condensation of steam as in the ordinary multiple effect apparatus.

It will be observed that the first heating and evaporation of the liquor in the flue E is by direct contact with the heating medium, and subsequent heating and concentration by indirect heating, first by flues heated by hot non-condensable gases and products of combustion and finally by indirect heating by hot condensable vapors such as steam.

The ordinary utilization of my invention in heating and evaporating water and for concentrating solutions will be apparent from the foregoing explanations. I will, however, state a specific use of my invention in which not only heating and evaporation with concentration takes place but also removal of objectionable substances held in suspension, said removal involving chemical reaction and subsequent filtration.

In the production of beet sugar my apparatus may be used as follows: The alkaline or lime treated beet juices are sprayed downward through the flue E and are therein simultaneously heated and subjected to the action of the carbonic acid of the gases. Carbonate of lime is so produced and is carried down with the juices and held in

suspension in the liquor. The lime is in this way placed in a condition by which it may be removed by filtration. The liquor is then pumped by pump K through the filter W and delivered by pipe L to the evaporator and subsequently passes by pipe O to the multiple effect evaporating apparatus P in which it is concentrated. The liquor is free from suspended matters after passing through the filter so that not only is the liquor in fine condition for concentration but scale producing substances are kept out of the evaporating apparatus. This example of the use of my invention shows that not only may it be employed for evaporation and also concentration, but also for elimination of suspended matters and matters in gaseous form, the latter being through the chemical affinity between the gases in the liquor and the gases in the heating medium.

Various other uses for my invention in the industrial arts will be apparent to those skilled in such arts.

Primarily, my invention has utility in economy in that waste heat is utilized as the means for raising the liquor to be concentrated to a high degree of temperature before the final concentration in steam heated single or multiple effect apparatus; further, by this apparatus I am enabled to dispense entirely with the necessity of an external source of steam. Secondly, my apparatus may be employed for washing hot gases of products held in suspension or in gaseous form and subsequently concentrating the said washing solution for obtaining the matter so extracted.

There are many uses for my improved apparatus and hence I do not restrict myself to any special application of my invention, the application being merely a secondary matter.

It is evident that, if desired, the liquor in the evaporator or heater C may be maintained above the level of the tubes so as to be in direct contact therewith instead of allowing it to flow over the tubes as hereinbefore described.

The apparatus shown is only intended as an illustration of the combination of elements making up a structure adapted for the proper carrying out of my improved method of heating and evaporating, and for utilizing the products of combustion from boilers and the like for heating and treating a liquid, and for concentrating the same by evaporation, and I do not confine or restrict myself to the details thereof.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In apparatus for treating liquids, the combination of a vertical flue receiving hot gases of combustion processes at the bottom,

a liquid supply pipe entering the flue near its top, means within the flue for intimately commingling the gases and liquid during the passage of the liquid to the bottom, means independent of the flue for further heating the liquor by the heat of the hot gases before passing to the flue, positively acting means for circulating the liquor from the flue to the means for further heating it, and a filter through which the liquid passes before being delivered to the means for further heating it.

2. In apparatus for treating liquids, the combination of a flue through which hot gases from combustive or chemical combinations are passed, means for spraying liquor downward upon the gases when passing upward through the flue, an evaporator having tubes heated by the hot gases, and means for collecting the sprayed liquor in its heated condition and supplying it to the evaporator tubes in the form of spray whereby it may be heated in contact with the tubes thereof.

3. In apparatus for treating liquids, the combination of a flue through which hot gases are passed, means for spraying liquor upon the gases when passing through the flue and thereby transferring the heat of the gases to the liquor, an evaporator heated by the hot gases, means for collecting the sprayed liquor in its heated condition and supplying it to the evaporator whereby it may be further heated and provide a hot vapor, and a multiple effect evaporating apparatus receiving the hot vapors and utilizing them as the heating medium.

4. In apparatus for treating liquids, the combination of a vertical flue receiving hot gases at the bottom, a liquid supply pipe entering the flue near its top, means within the flue for intimately commingling the gases and liquid during the passage of the liquor to the bottom, means for further heating the liquor by the heat of the hot gases before passing to the flue, and positively acting means for circulating the liquor from the flue to the means for further heating it.

5. In apparatus for treating liquids, the

combination of a vertical flue receiving hot gases at the bottom, said gases being from a source other than the liquor to be treated, an exhaustor at the top of the flue for drawing the hot gases through it, a liquid supply pipe entering the flue near its top, means within the flue for producing a dense spray for intimately commingling the gases and liquid during the passage of the liquid to the bottom, means independent of the vertical flue for further heating the liquor by the heat of the hot gases before passing to the flue, and positively acting means for circulating the liquor from the bottom of the flue to the means for further heating it.

6. In apparatus for treating liquids, the combination of a flue through which hot waste gases pass said gases being from a source other than the liquor to be treated, means for spraying liquor through the flue in contact with the hot gases to absorb the heat thereof, means for producing a hot vapor from the heated liquor, multiple effect evaporating apparatus for concentrating the heated liquor, said multiple effect being heated by the hot vapors after leaving the influence of the hot gases and thereby utilizing the heat of the waste gases as its source of heat, and means for positively circulating the heated liquor from the flue to the multiple effect evaporating apparatus.

7. In apparatus for treating liquids, the combination of means for heating liquor by direct intimate contact with hot products of combustion, a multiple effect evaporating apparatus, and means for supplying both the liquor and hot vapors thereof after being heated by the waste products of combustion to the multiple effect apparatus whereby the liquor is supplied in a hot condition and is concentrated by its own hot vapors.

In testimony of which invention, I have hereunto set my hand.

S. MORRIS LILLIE.

Witnesses:

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R. M. KELLY.