

(No Model.)

4 Sheets—Sheet 1.

A. YOUNG.

APPARATUS FOR EVAPORATING SACCHARINE OR OTHER LIQUIDS.

No. 401,238.

Patented Apr. 9, 1889.

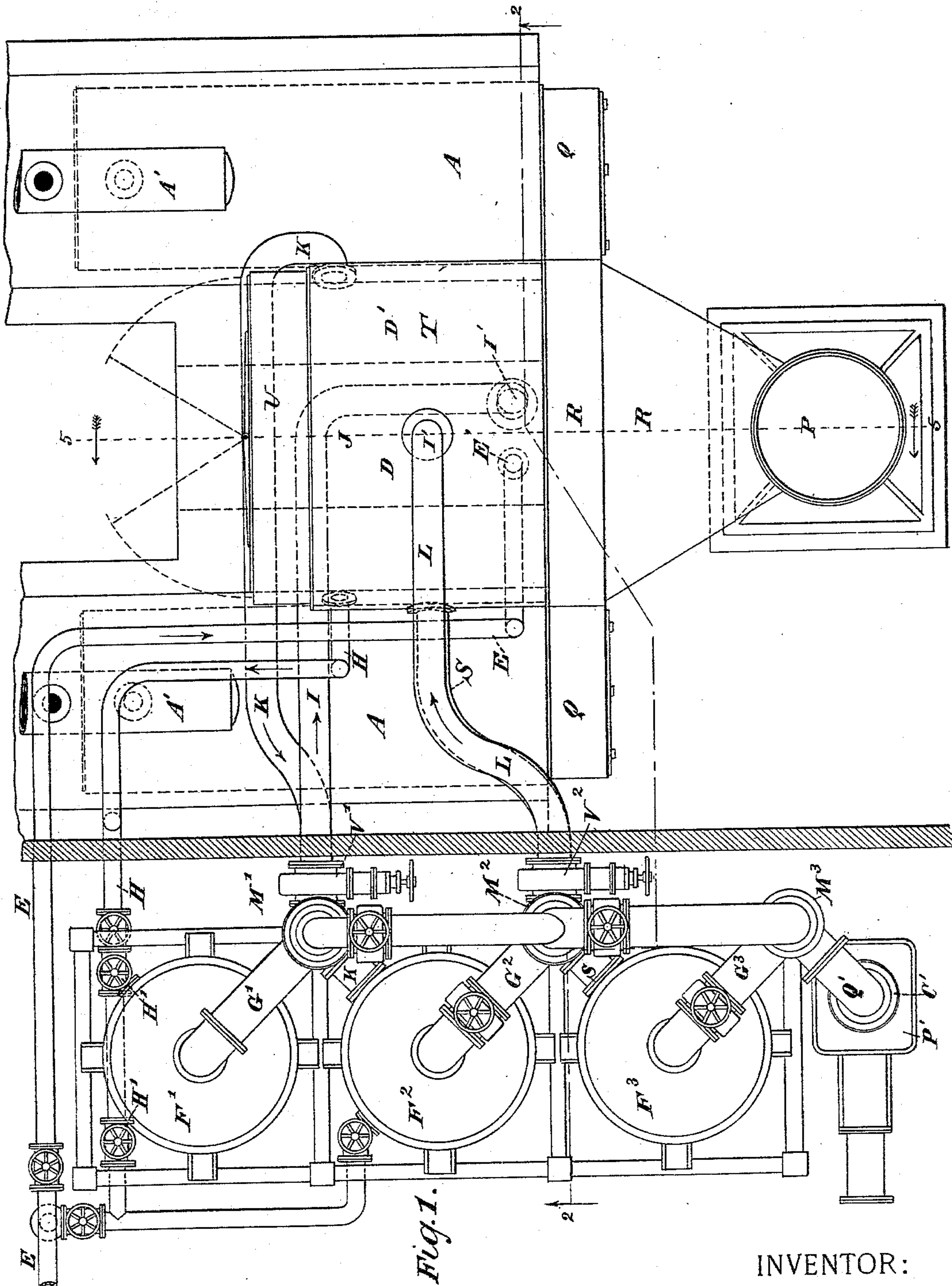


Fig. 1.

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Arthur G. Fraser & Co.

WITNESSES:

John Becker.

C. K. Fraser.

(No Model.)

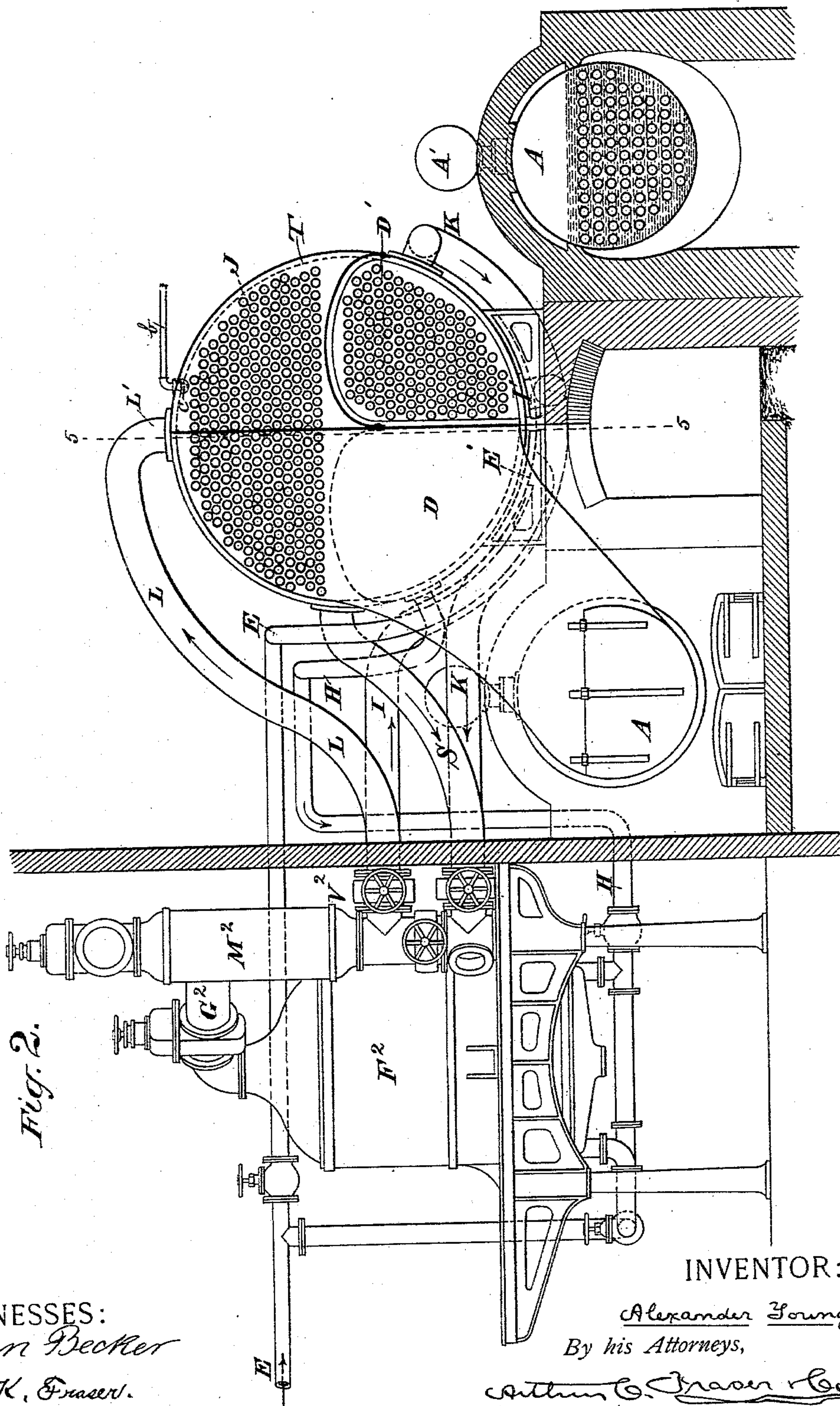
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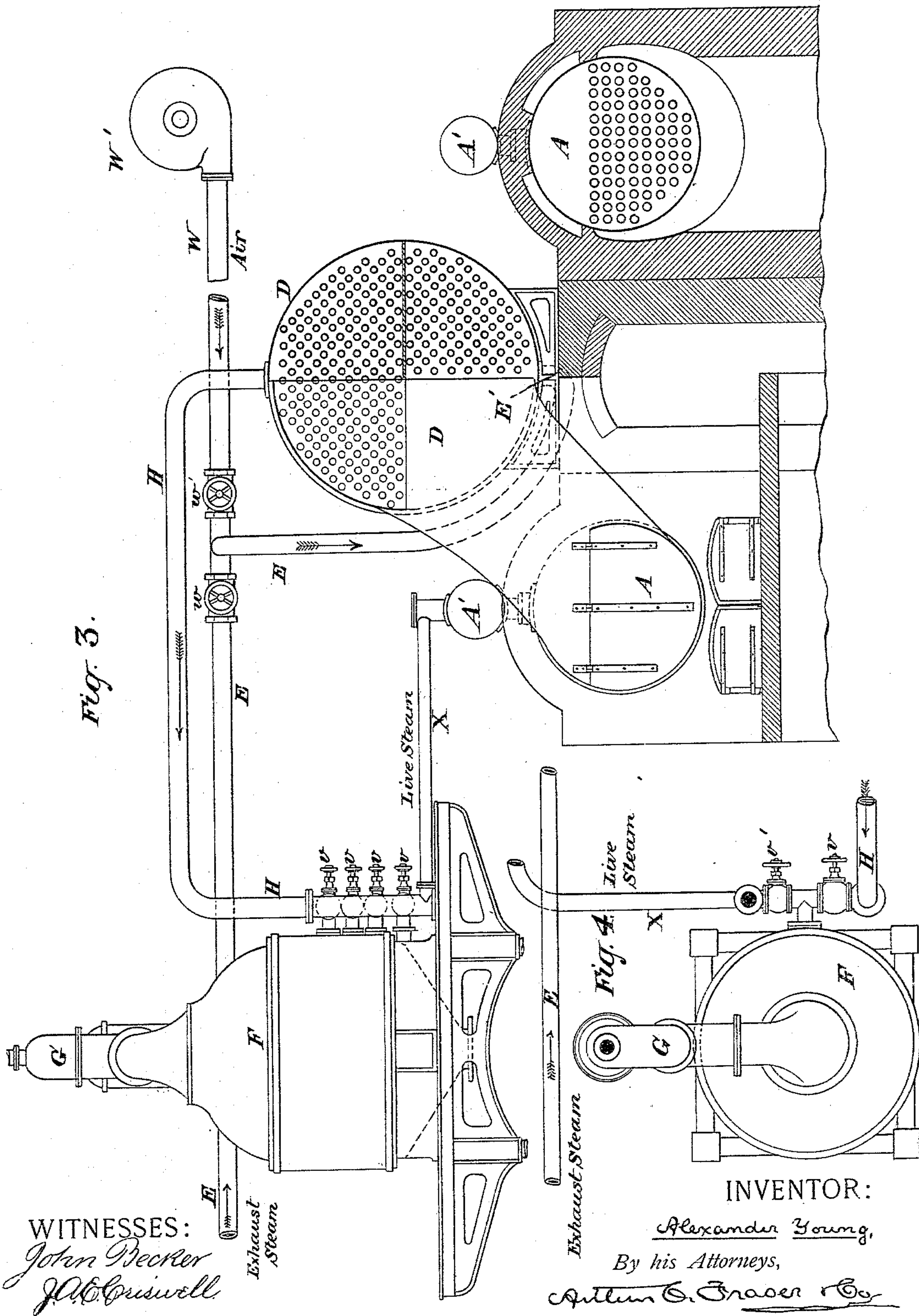
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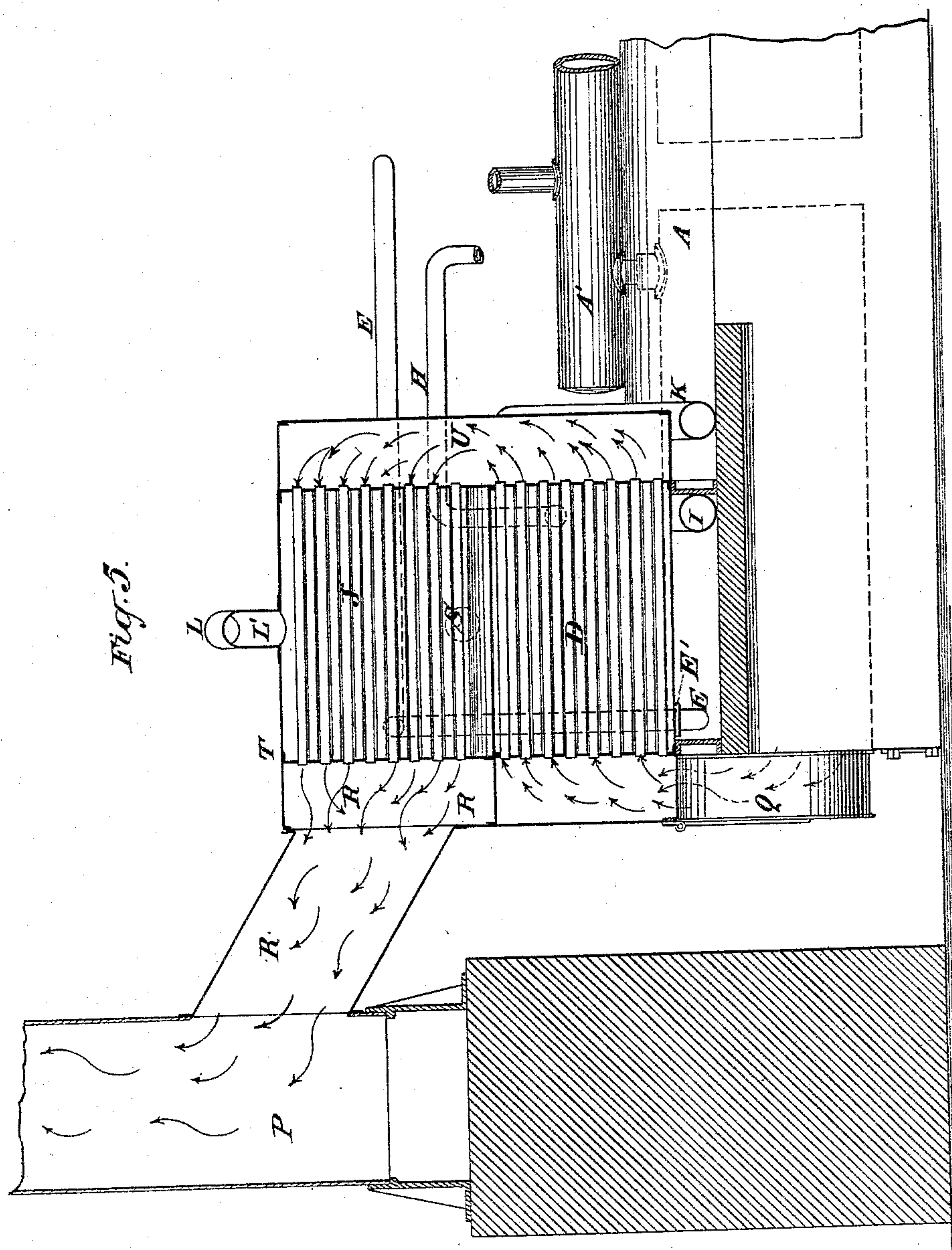
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Patented Apr. 9, 1889.



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APPARATUS FOR EVAPORATING SACCHARINE OR OTHER LIQUIDS.

SPECIFICATION forming part of Letters Patent No. 401,238, dated April 9, 1889.

Application filed July 5, 1888. Serial No. 279,071. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER YOUNG, a subject of the King of Hawaii, residing in Honolulu, on the Island of Oahu, Hawaiian Islands, have invented certain new and useful Improvements in Apparatus for Evaporating Saccharine or other Liquids, of which the following is a specification.

This invention relates to improved means for operating vacuum or evaporating pans for the evaporation, concentration, or granulation of solutions of sugar and other substances, as salt, &c.

The object of my invention is to economize the heat contained in the fuel which generates the steam by which the vacuum-pans are heated. To this end I employ the gases of combustion, after they have done duty in generating steam, to superheat exhaust steam or vapor, which in turn is employed to heat the coils of the vacuum-pans.

According to my invention I construct the steam-boiler with one or more superheaters or superheating-compartments, to which the partially used or expanded steam is returned from the steam-engine or other place of use, and in which it is superheated before being passed to the evaporating-vessels. Thus in the case of a series of evaporating-pans—such as a “multiple effect” for concentrating liquids in vacuum—the steam which is first generated is used in the first pan or cell, and the exhaust therefrom on its passage to the second pan or cell is returned to the boiler and passed through one of the superheaters or superheating-compartments, and on its passage from the second to the third pan or cell it is again returned to the boiler and superheated in another superheater. The superheating is effected as many times as the steam is used or expanded. The hot gases from the furnace are first utilized in the ordinary manner for the generation of steam in the steam generator or boiler, after which these gases traverse the successive superheaters or superheating-compartments, and are made effective for superheating the partly-used steam circulating through said compartments. Each of the superheaters is provided with a large heating-surface, upon which the hot gases which remain after having done their work in the steam-generating boiler, and which in or-

dinary boilers are conducted directly to the chimney and discharged into the air, act very effectively, since they are of much higher temperature than the exhaust steam or vapor to be superheated. The superheaters are so arranged that the waste gases are made to act first, when their temperature is highest, upon the heating-surface of the superheater through which passes the highest pressure of exhaust steam or vapor, and to act last, when their temperature is lowest, upon the superheater through which passes the lowest pressure of exhaust steam or vapor, whereby the greatest practicable difference of temperature is maintained between the superheating medium and the steam or vapor to be superheated.

My invention may be utilized in various ways in connection with triple-effect vacuum-pans or vacuum strike-pans, or with other devices for using steam successively for evaporating purposes.

In the accompanying drawings, Figure 1 is a plan of a triple-effect vacuum apparatus with its supplying-boiler, superheaters, and connecting-pipes; and Fig. 2 is a front elevation thereof, partly in section on the line 2 2 in Fig. 1. Fig. 3 is a front elevation of a vacuum strike-pan with its supplying-boilers, superheaters, and connecting-pipes; and Fig. 4 is a plan of the strike-pan and its connecting pipes and valves. Fig. 5 is a vertical mid-section through the superheaters on the line 5 5 in Figs. 1 and 2.

Referring to Figs. 1 and 2, A A designate two ordinary steam-boilers, the products of combustion from which pass through smoke boxes or flues Q Q upwardly to the superheaters. These superheaters, although essentially distinct, are constructed by preference as compartments of a superheating-vessel, T. This vessel is cylindrical and is divided longitudinally by vertical and horizontal partitions into four compartments, two below and two above. The two lower compartments constitute the primary superheaters D and D', which first receive the products of combustion from the respective boilers A A. The two upper compartments together constitute the secondary superheater J, which receives the products of combustion after they have traversed the primary superheater. The products of combustion enter the lower super-

heaters at one end and flow through them to the other end, where they enter a breech or smoke-box, U, by which they are directed upwardly into the upper superheater, through which they flow back, and on emerging from
5 which they pass into the smoke-box R, and thence up the chimney or stack P.

The superheaters D, D', and J are constructed after the manner of a multitubular
10 boiler, the hot gases passing through the tubes or flues and the steam circulating around the tubes; but obviously the reverse construction might be used, or any other construction by means of which an efficient heating-surface
15 can be secured may be adopted.

In Fig. 1, F', F², and F³ are the three cells or vacuum-pans of the triple-effect evaporating apparatus commonly used for concentrating sugar-sirup and other liquids. We will suppose
20 that the steam generated in the boilers A A is conducted from the steam-domes A' A' thereof by a suitable steam-pipe to a steam-engine or other steam-user, (not shown,) and that the exhaust-steam from such engine, &c., passes
25 back by a pipe, E, which extends to the superheater D and enters the under side thereof at E'. The steam from this pipe, in passing up through the superheater D, becomes superheated by contact with the hot pipes
30 therein, through which the products of combustion are flowing, and this superheated steam passes out from the side of the superheater by a pipe, H, which leads therefrom and extends down beneath the first cell, F', of
35 the triple-effect and communicates with the heating-surface therein through the medium of a suitable valve or valves, H' H'. The vapor rising from the liquid being boiled in the first cell, F', by the superheated exhaust-steam thus admitted thereto passes off from
40 this cell through the pipe G' into the save-all M', and thence through valve V' into a pipe, I, which passes underneath the vessel T and enters the superheater D' thereof at I'. The steam from this pipe passes up through this
45 superheater, becoming superheated therein, and then passes out at the side of the vessel by a pipe, K, to the second cell, F², of the triple-effect with which it communicates through a suitable valve. The vapor rising
50 from the liquid boiled in this second cell by the superheated vapor from the first cell then passes through pipe G² and save-all M², and thence by a valve, V², to the pipe L, which
55 leads to the top of the superheater J and enters the latter at L'. The vapor in passing through this superheating-compartment has its temperature raised and passes out therefrom by a pipe, S, which leads to the lower
60 part of the third cell, F³, of the triple-effect, and communicates with the heating-surface thereof through a suitable valve. The vapor rising from the liquid boiled in this third cell by the superheated vapor from the second
65 cell passes through the pipe G³, save-all M³, and pipe Q' to the condenser C' and vacuum-pump P'. Thus it is seen that the ex-

haust-steam from the engine or other original steam-user is superheated in the superheater D and passes to the first cell of the triple-effect, where it does duty in boiling the liquid contained in that cell, that the vapor rising from the liquid boiled in the first cell is superheated in the superheater D' and does duty in boiling the liquid contained in the second cell, and that the vapor rising from the liquid boiled in the second cell is superheated in the superheater J and does duty in boiling the liquid contained in the third cell, whence it passes to the condenser and vacuum-pump
70 in the usual manner.

My invention effects a considerable economy by the utilization of a greater portion of the heat generated from the fuel for effective use in the heating of the liquid in the vacuum
85 pans or cells. The hot gases or products of combustion, after doing their work in the generating-boilers A A, and in the condition in which ordinarily they are discharged into the chimney, are passed through the respective
90 superheaters in succession, and thereby give up a considerable portion of their heat, (by transmission through the tubes or other heating-surface of the superheater,) and this heat is taken up by the vapors which are passed
95 through the superheaters, and is by such vapors conveyed to the vacuum-pans, to be utilized in the heating and consequent vaporization of the liquids therein.

The hot gases or products of combustion
100 are employed first, while their temperature is highest, for superheating a comparatively low grade of vapor, and subsequently, when their temperature is reduced, for superheating a higher grade of vapor, or a vapor or
105 steam at a lower pressure and lower temperature. Thus in each superheater the greatest practicable difference of temperature is maintained between the superheating medium or gases and the steam or vapor to be super-
110 heated; or, in other words, the hot gases, after having been used for generating steam, are utilized while their temperature is highest to superheat the spent steam or vapor which has already the highest temperature, and when
115 their temperature has become reduced they are utilized for superheating spent steam or vapor which (being of lower pressure) has primarily a lower temperature.

In practicing my invention the superheating of different grades of vapor may be continued through any number of cells and superheaters. Further, the exhaust-steam from the heating pipes or drums of each cell or pan of a multiple-effect may be resuperheated as
125 many times as there are cells by having a sufficient number of superheaters for that purpose; also, instead of superheating the vapor from the boiling liquid, the exhaust-steam from the heating pipes or drums of each
130 cell of the multiple-effect may be superheated by passing it through a superheater, and thence to the heating pipes or drums of the following cell, and so on throughout all the

cells of the apparatus consecutively, in which case the vapor rising from the boiling liquid in all the cells will pass directly to the condenser, so that the vacuum in all the cells will be of the same degree.

If it should be found that the temperature of the superheated exhaust-steam is so high as to be objectionable, or that an increase of volume would be advantageous, a spray of water may be introduced into the superheater or into the pipes conveying the superheated exhaust-steam from them, for the purpose of reducing the temperature and increasing the volume of the superheated exhaust-steam prior to its entrance into the next cylinder. As a means of introducing such a spray into the superheater J, I have shown in Fig. 2 a water-pipe, *b*, entering the top of the compartment and terminating therein in a rose or sprinkler, *c*.

If the waste gases, after passing through the final superheater, are of too low a temperature to produce a good natural draft, a forced draft may be used.

Doors or man-holes should be placed in the superheaters, through which to remove any dirt which may accumulate in them.

Different arrangements of superheaters may be made to suit the requirements of different purposes, localities, or circumstances.

Figs. 3 and 4 show my invention as applied to a vacuum strike-pan, and also show how superheated air or air mixed with steam may be used. The construction of the superheater and its relation to the boilers A A are the same as in Figs. 1 and 2. E is the return-pipe for the exhaust-steam, leading to the superheater. W is an air-pipe leading from an air compressor or blower, such as that shown at W'. This pipe has a valve, *w'*, and communicates with the exhaust-steam pipe E between the superheater and a valve, *w*, which controls the passage of exhaust-steam. By closing the valve *w* and opening valve *w'*, air alone may be admitted to the superheater; or by closing *w'* and opening *w* steam alone may be used; or by partly opening both valves a mixture of air and steam may be used. In this instance there is only one superheater, the air or steam to be superheated entering it at E' beneath and passing out at the top through a pipe, H, which leads it to the inlet-valves *v v* of the strike-pan F. This strike-pan is also provided with valves *v'*, Fig. 4, by means of which live steam may be admitted, passing from the steam-dome of one of the boilers A through a pipe, X, in the usual or

any ordinary manner. The superheater D will be provided with water-spray pipes, as already described, in order to charge the heated air in the superheater with vapor or steam.

It will be understood that a compressed-air pipe, W, with its valve *w'*, may be applied in like manner to the superheaters for supplying the triple-effect vacuum-pans, as shown in Figs. 1 and 2, if it be desired to use superheated air in working the triple-effect.

I claim as my invention the following-defined novel features and combinations, namely:

1. The combination, with the cells of a multiple-effect evaporating or vacuum pan, of a steam-generator and two (or more) superheaters arranged to be traversed in succession by the products of combustion, and pipes connecting the respective cells of the pan to the superheaters, whereby the exhaust steam or vapor from one cell is passed through one superheater and then conducted to another cell for heating the latter, and the several connections relatively arranged to pass the exhaust-vapors of higher pressure through the superheater acted upon by the hottest gases and the exhaust-vapors of lower pressure through a superheater acted upon by the gases after their temperature has become reduced, substantially as specified.

2. The combination, with the cells of a multiple-effect evaporating or vacuum pan and the vacuum-pump thereof, of a steam-generator and two (or more) superheaters arranged to be traversed in succession by the products of combustion, and exhaust-pipes connecting the respective cells to the corresponding superheaters and the latter to the heating-surfaces of the next successive cells, whereby the cells are connected in series and the vapors exhausted from each cell are superheated and used for heating the next successive cell, substantially as specified.

3. The combination, with an evaporating or vacuum pan, of a superheater, a pipe conveying steam to said superheater, a pipe conveying air to said superheater, and a pipe leading from said superheater to said evaporating-pan, whereby the latter may be heated by superheated steam or superheated air, or a mixture of both, substantially as specified.

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

ALEXANDER YOUNG.

Witnesses:

JON. AUSTIN,
ED. STILES.