

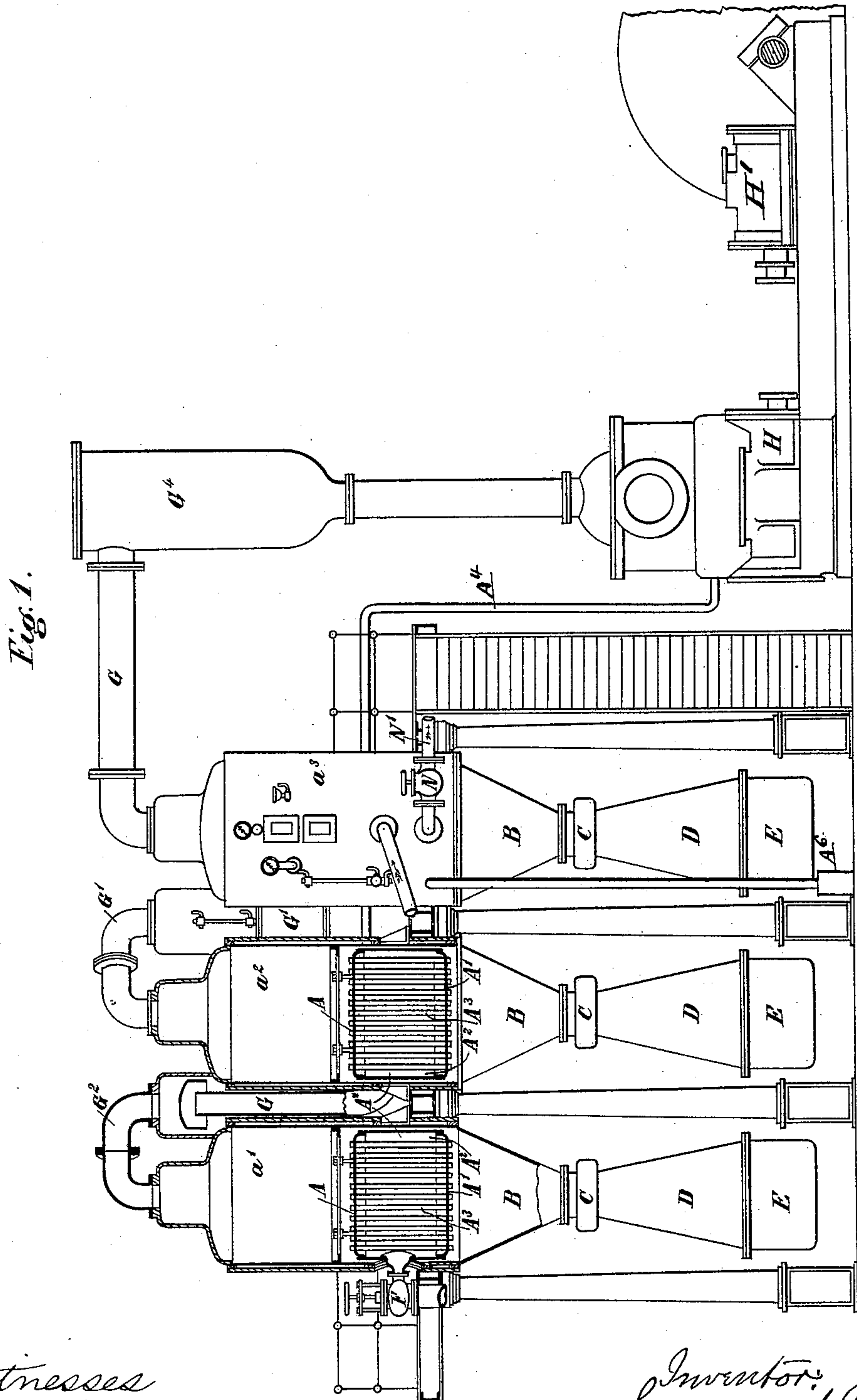
(No Model.)

4 Sheets—Sheet 1.

S. PICK.  
VACUUM EVAPORATING APPARATUS.

No. 464,389.

Patented Dec. 1, 1891.



Witnesses  
J. A. Blackwood  
N. L. Hollamer.

Inventor:  
Sigmund Pick  
by M. Doolittle  
Atty

(No Model.)

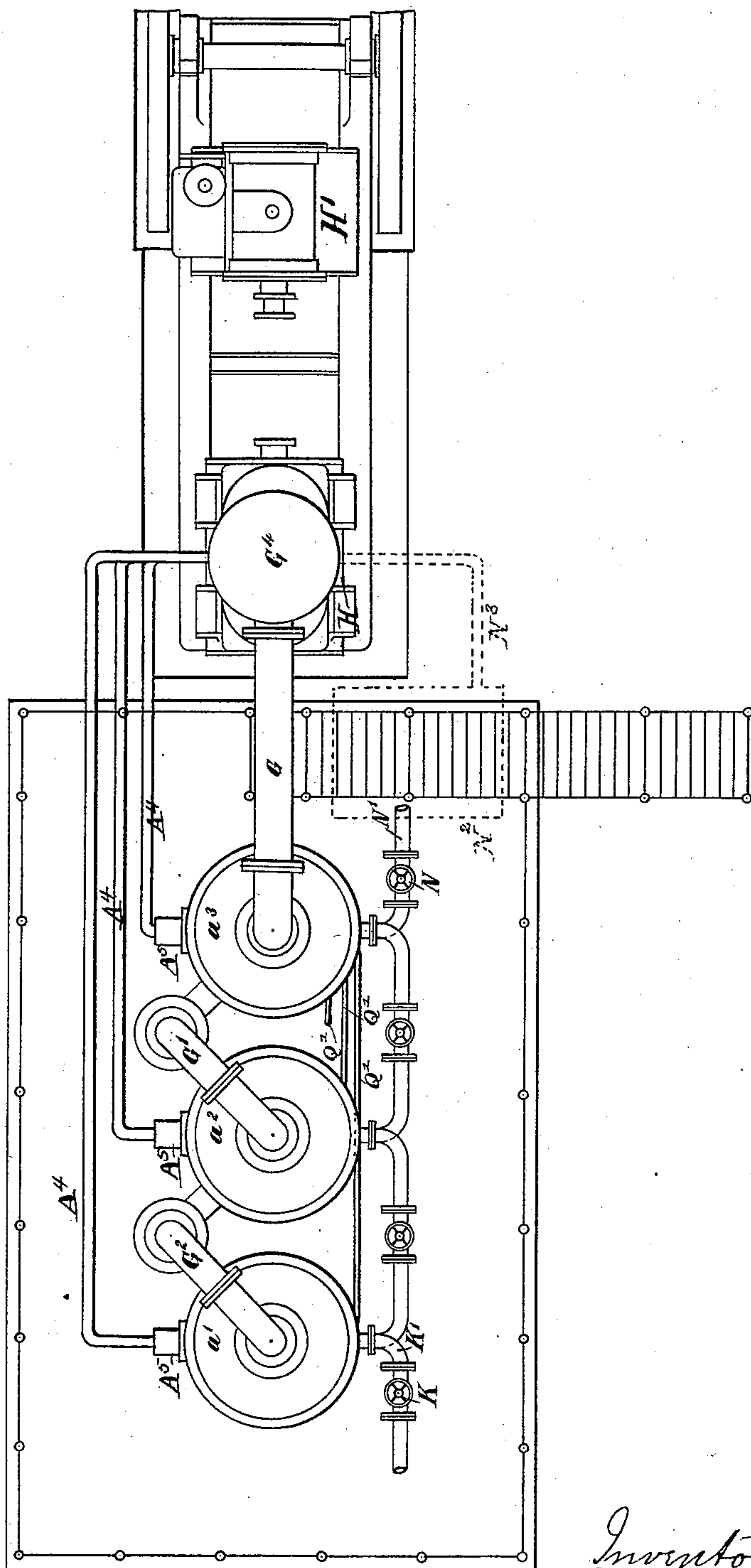
4 Sheets—Sheet 2.

S. PICK.  
VACUUM EVAPORATING APPARATUS.

No. 464,389.

Patented Dec. 1, 1891.

Fig. 2.



Witnesses  
Jos A Blackwood  
N. L. Gollamer.

Inventor:  
Sigmund Pick  
by M. M. Doolittle  
Att'y

(No Model.)

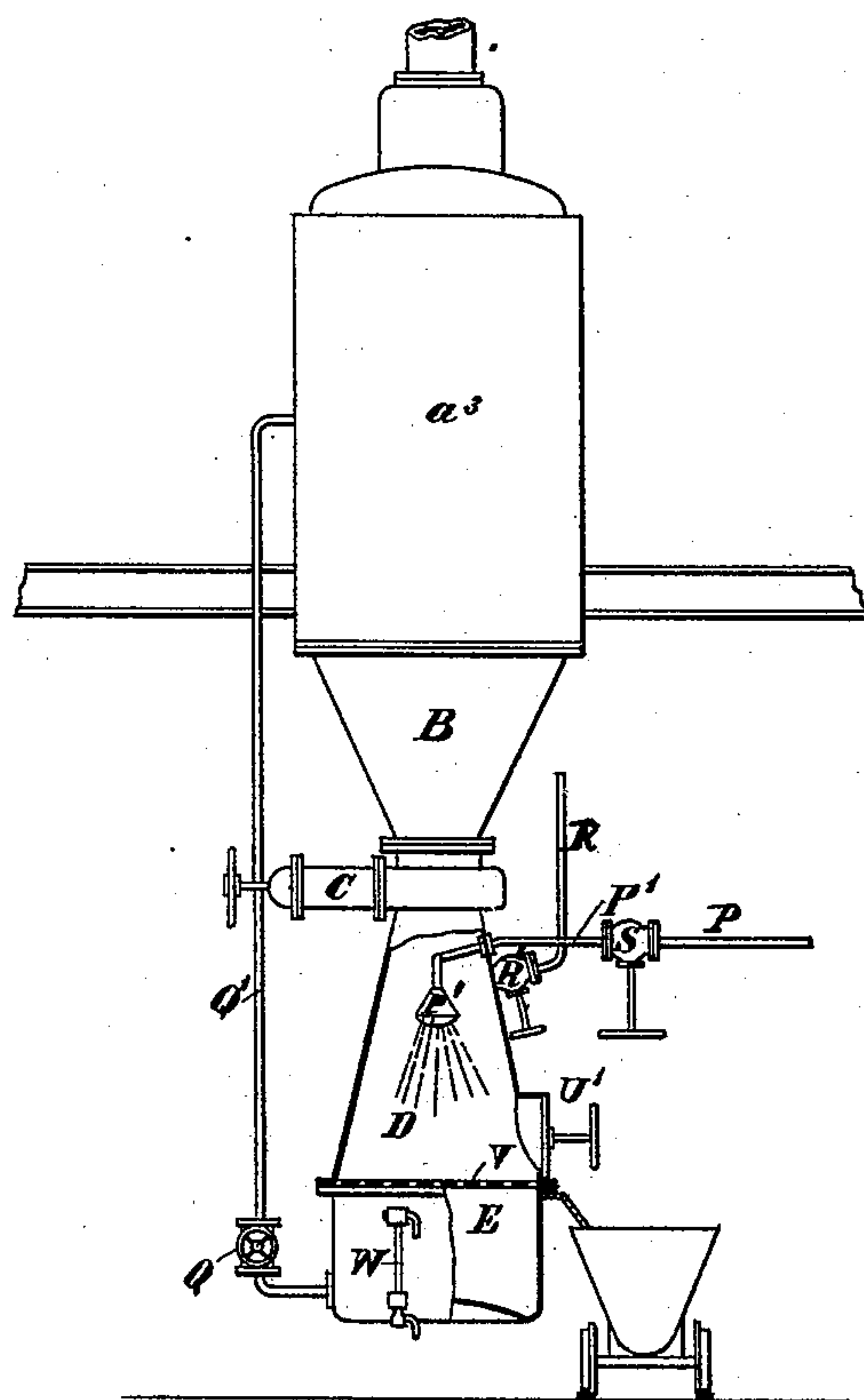
4 Sheets—Sheet 3.

S. PICK.  
VACUUM EVAPORATING APPARATUS.

No. 464,389.

Patented Dec. 1, 1891.

*Fig. 3.*



Witnesses.  
*Jr. Walter Sychanov*  
*Eugenio J. Marulli*

Inventor.

*S. Pick*

(No Model.)

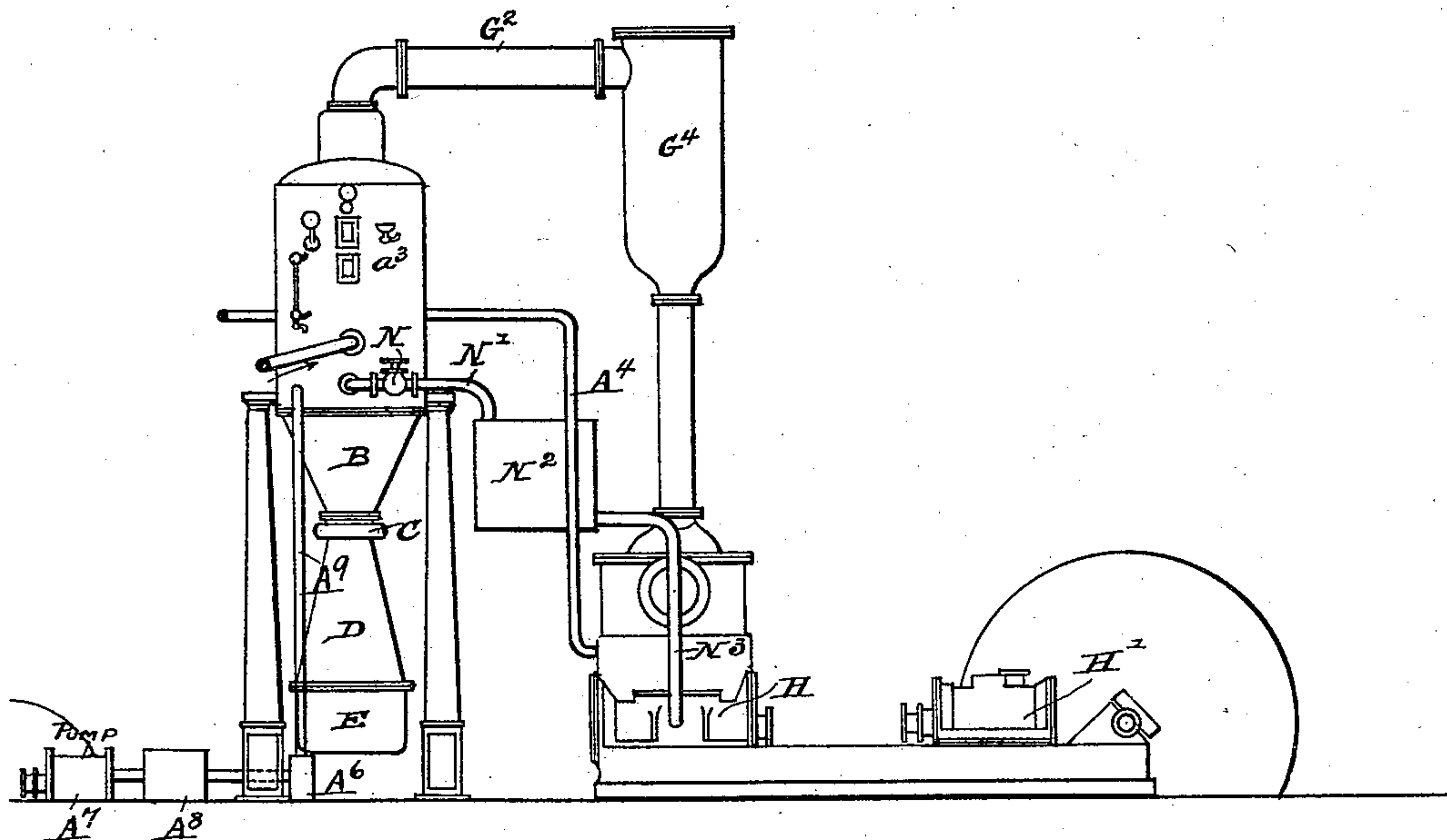
4 Sheets—Sheet 4.

S. PICK.  
VACUUM EVAPORATING APPARATUS.

No. 464,389.

Patented Dec. 1, 1891.

Fig. 4.



Witnesses

*Joseph Blackwood*  
*Albert B. Blackwood*

Inventor

*Sigismund Pick*  
*by Wm. H. Doolittle*

Attorney



# UNITED STATES PATENT OFFICE.

SIGISMUND PICK, OF SZCZAKOWA, AUSTRIA-HUNGARY.

## VACUUM EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 464,389, dated December 1, 1891.

Application filed April 15, 1890. Serial No. 348,004. (No model.) Patented in England April 6, 1887, No. 5,124.

*To all whom it may concern:*

Be it known that I, SIGISMUND PICK, a subject of the Emperor of Germany, residing at Szczakowa, Galicia, Austria-Hungary, have invented Vacuum Apparatus for Evaporating Liquors Containing Salts and for Separating such Salts when Rendered Insoluble by Evaporation, (for which English Letters Patent No. 5,124, bearing date April 6, 1887, have been obtained,) of which the following is a specification.

This invention relates to apparatus wherein liquid is evaporated by means of steam, the said steam being either above, or at, or below the atmospheric pressure. Various pressures of steam may be used in different parts of the same apparatus when it contains more than one part, and the steam generated by the evaporation of the liquid in one part of the apparatus may be used to evaporate other liquid in another part of the apparatus as in the well-known Rillieux triple-effect apparatus, which is in use in many sugar-works. Such apparatus as heretofore constructed is sometimes employed for the evaporation of clear liquors up to a certain strength; but it is not applied to the evaporation of liquors from which salts are precipitated during the evaporation, because of the difficulty of separating the salts from the liquor while the evaporation continues, and thus making the process a continuous one. Apparatus according to this invention obviates this difficulty and affords other advantages.

In the accompanying drawings, Figure 1 is a side elevation partly in vertical section. Fig. 2 is a plan, and Fig. 3 is an end elevation, partly in vertical section, of apparatus according to this invention. Fig. 4 is a side exterior view in elevation, showing connection of one of the boilers and filter apparatus with separator, reservoir, condenser, and air-pump.

$a^1 a^2 a^3$  are boilers (preferably three in number) connected together as in the usual Rillieux apparatus. Each of these boilers is provided with a heating-chamber consisting of tube-plates  $A A'$ , that are preferably horizontal and occupy the entire cross-sectional area, or nearly so, of the boiler in which they are placed and which, with side plates  $A^*$ , con-

stitute a heating-chamber  $A^2$ . Extending from one tube-plate to the other are tubes  $A^3$ , that connect the space above the chamber with the space beneath it. Into the heating-chamber  $A^2$  in boiler  $a^1$  steam is passed from another boiler or from some other source by means of a pipe and valve  $F$ . The upper part of boiler  $a^1$  is by means of pipe  $G^2$  placed in communication with the heating-chamber  $A^2$  of boiler  $a^2$ , the upper part of which is in like manner placed in communication with the heating-chamber of boiler  $a^3$  by a pipe  $G'$ . The upper part of boiler  $a^3$  is in communication, through a pipe  $G$  and a separator  $G^4$ , with a condenser  $H$  and air-pump  $H'$ . The part of each boiler below its heating-chamber is preferably in the form of a funnel  $B$ , having at its lower end a sluice-valve  $C$ , below which is fixed a vacuum-filter  $D$ , hereinafter described. The heating-chambers  $A^2$  of boilers  $a^1 a^2 a^3$  are each connected by a pipe  $A^4$ , Fig. 2, with the condenser  $H$  and air-pump  $H'$ , in order that non-condensable gases can be exhausted from them. Suitable means, such as reducing-valves, as at  $A^5$ , can be placed on these pipes, or some of them, if desired, to regulate the pressure in the heating-chambers to which the pipes are connected. The steam as it condenses in each heating-chamber is drawn off by a pipe  $A^9$  through a steam-trap  $A^6$  by a pump  $A^7$ , between which and the steam-trap a collecting-vessel  $A^8$  is placed. Each vacuum-filter comprises a tapering top part  $D$  and a cylindrical bottom part  $E$ . The filtering material—for example, a perforated plate or sheet of wire-gauze with cloth and a layer of minerals—is fixed at  $V$  between the two parts  $D$  and  $E$ . The top part has an air-inlet pipe  $R$  with valve  $R'$ , a water-inlet pipe  $P$ , ending in a rose  $P'$ , and a man-hole  $U'$ , through which salt is withdrawn. The bottom part  $E$  of each filter is provided with a gage-glass  $W$ , and each is connected by a pipe  $Q'$ , having a valve  $Q$ , with the top part of the boiler  $a^3$ , in which the highest degree of vacuum within the several boilers is maintained.

The action of the apparatus is as follows: The three boilers are charged to the usual water-line with the liquor to be evaporated,



and steam—either live steam from a boiler or exhaust-steam from an engine—is passed through the valve F into the heating-chamber A<sup>2</sup> of boiler a', and passing around the tubes A<sup>3</sup> heats the same and the liquor therein. The steam produced by the evaporation of liquor in boiler a' passes into the heating-chamber of boiler a<sup>2</sup>, and that produced in boiler a<sup>2</sup> passes into the heating-chamber of boiler a<sup>3</sup>. The steam produced in boiler a<sup>3</sup> passes through the pipe G into the separator G<sup>4</sup>, wherein particles of liquor carried over by the steam are separated, from whence the steam passes into a condenser and vacuum-pump H H'. A strong vacuum is thus formed in boiler a<sup>3</sup>, and the liquor therein consequently boils at a very low temperature. The heating of this liquor is effected by the steam from boiler a<sup>2</sup>, this steam passing around the tubes of its heating-chamber A<sup>2</sup>, wherein it condenses. Through the condensation of this steam a vacuum is formed in the boiler a<sup>2</sup>, so that the boiling-point of the liquor in this boiler, which is heated by steam from the boiler a', is also lowered. The condensation of the steam in the heating-chamber of boiler a<sup>2</sup> in like manner forms a vacuum in this boiler a' and consequently lowers the boiling-point of the liquor therein. Thus it will be understood that the highest temperature of the liquor exists in boiler a' and the lowest in a<sup>3</sup>, while the highest degree of vacuum will be in boiler a<sup>3</sup> and the lowest in boiler a'. In this way an energetic evaporation is obtained in each boiler. The liquor to be heated passes in the same manner as the steam—that is to say, from boiler a' to boiler a<sup>2</sup> and from boiler a<sup>2</sup> to boiler a<sup>3</sup>. It enters a' through a valve K and pipe K' by gravity from a reservoir above, or is forced in from a lower reservoir by atmospheric pressure in consequence of the vacuum within the boiler. The liquor that is most concentrated leaves the boiler a<sup>3</sup> through a pipe N' and valve N and passes into a closed reservoir N<sup>2</sup>, that is arranged below the level of boiler a<sup>3</sup>, and is connected through an air-pipe N<sup>3</sup> with the condenser H. As the same vacuum will exist in this reservoir as in boiler a<sup>3</sup>, the liquor will run into it by gravity. The rate of flow of liquor can be regulated by the valve N, according to the rate of evaporation.

The separation of the salts, which are precipitated during the evaporation and consequent concentration of the liquor, is effected in the following manner. The sluice-valve C of each boiler is opened and the top part of the filter below it filled with liquor. The precipitated salt will then drop through the opening controlled by the sluice-valve into the filter below and will rest on the filtering material at V. When the top part D of the filter is filled with salt, or nearly so, the sluice-valve C is closed, the valve Q on the pipe Q'

opened, and the valve R' on the air-inlet pipe R slightly opened. The liquor will then be forced by atmospheric pressure from the filter back into the top part of boiler a<sup>3</sup> and the salt drained. If considered necessary, the salt can be washed by opening the stop-cock S and admitting water to the rose P'. After the salt has been drained the valve Q and water-valve S are closed, the man-hole U' opened, and salt removed. The man-hole is then closed and the sluice-valve C again opened, so that the settling of salts in the filter can again take place. If the liquor to be evaporated contains several salts that are precipitated at different degrees of concentration of the liquor, the composition of the precipitate in the various apparatus will be different, so that a separation of the various salts can be effected.

What I claim is—

1. In an apparatus for evaporating liquors containing salts, the combination of two or more boilers, such as a' a<sup>2</sup> a<sup>3</sup>, each having a steam-heating chamber with a condenser and air-pump, a pipe leading from said condenser and air-pump and having a branch connection with each of said chambers through which the non-condensable gases are drawn from said chambers to said condenser, a pipe connection with each of said chambers, with a steam-trap and collecting-vessel for drawing off the condensed steam, and a vacuum-filter arranged beneath each of said boilers and consisting of upper and lower parts, between which is the filtering medium, a pipe for admitting air to the upper part of said filter, a valve arranged to control the passage between the lower part of said boiler and the upper part of said filter, and a pipe arranged to connect the lower part of said filter with the upper part of each of said boilers, substantially as herein described.

2. In apparatus for the purpose above specified, the combination of a boiler having an outlet-pipe at the top provided with a tubular heating-chamber and having a lower funnel-shaped part B, a vacuum-filter consisting of an upper part D, a lower part E, and interposed filtering medium V, said upper part D having a valved inlet for air, a valved inlet for water, and a man-hole for removal of separated salt, a valve C, arranged between the lower part of said boiler and the upper part of said filter, and a valved pipe Q', arranged to connect the upper part of said boiler with the lower part of said filter, substantially as herein described, for the purposes set forth.

3. In an apparatus for the purpose herein specified, the combination of a series of boilers, such as a' a<sup>2</sup> a<sup>3</sup>, each provided with a heating-chamber with an air-pump and a communicating-pipe, vacuum-filters D E, pipes connecting the lower parts of said filters with the upper parts of the boilers, a separator, a condenser, and pipes G G' G<sup>2</sup>, the upper part



of said boilers being placed in communication with the heating-chamber of the next boiler by one of said pipes, and the upper part of the last boiler placed in communication with the condenser and air-pump by said separator and another of said pipes, substantially as described.

In testimony whereof I have signed my

name to this specification in the presence of two subscribing witnesses.

SIGISMUND PICK.

Witnesses:

VIKTOR GRZYCHOWSKI,  
*Kraków, Ulica Dubies, Nr. 13.*

EUGERLOSJNARATHI,  
*i Krakowie, Ulica Sgo. Tomas, Nr. 15.*