(No Model.)

A. GILAIN.

EVAPORATING OR DRYING APPARATUS.

No. 277,704. Patented May 15, 1883.

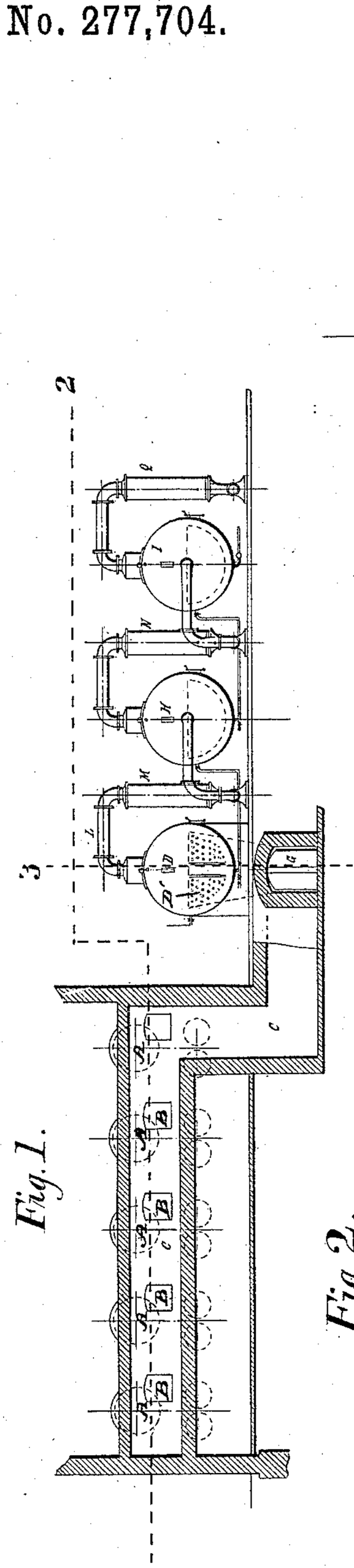

Fig. 1.

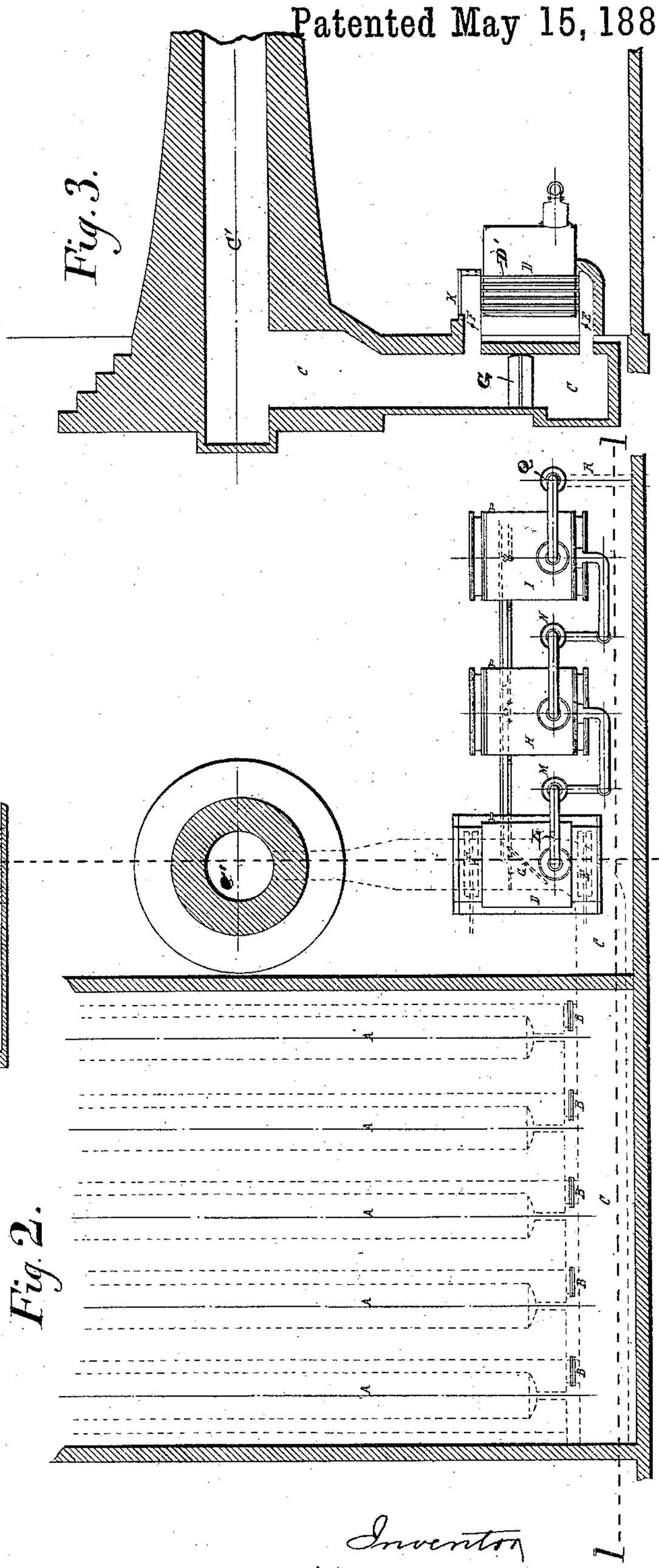

Fig. 2.

Fig. 3.

Attest
H. E. Knight
Wm. F. Gaffard.

Inventor
Achille Gilain
By Knight Bros
Attys

UNITED STATES PATENT OFFICE.

ACHILLE GILAIN, OF EMBRESIN, BELGIUM.

EVAPORATING OR DRYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 277,704, dated May 15, 1883.

Application filed January 11, 1883. (No model.) Patented in Belgium October 31, 1882, No. 59,426.

To all whom it may concern:

Be it known that I, ACHILLE GILAIN, residing at Embresin, in the Kingdom of Belgium, have invented new and useful Improvements in Evaporating or Drying Apparatus, (for which no patent has been obtained in any other country except in Belgium on the 31st of October, 1882, No. 59,426,) of which the following is a specification.

For many years the problem of the evaporation of liquids has been the order of the day. The numerous attempts made to arrive at a practical and economical result testify to the importance of this question. The invention of apparatus for evaporating *in vacuo* has been a great progressive step, and continued efforts daily add new matter to our knowledge on the subject.

In the apparatus for evaporating *in vacuo* at present employed vapor has invariably been used as the source of heat. The vapor so employed has either been generated expressly for the purpose or been derived from the exhaust or waste of engines.

The present invention is applicable to the evaporation and concentration of saccharine solutions, liquids resulting from diffusion or osmose aciduous or alkaline solutions or compounds, or, in general, any liquid as well as for the purpose of drying saccharine juices, &c., in grains.

The invention consists in the employment of apparatus for evaporating *in vacuo* in which steam is not introduced into a single or the first of a series of sugar-vessels, but the sugar-vessel, or vessel containing the liquid or material to be evaporated, condensed, or dried, is placed in the gas-passage between the last flue of one or a series of generators and the chimney in such manner as to utilize the waste heat of the products of combustion. These heated gases, traversing the tubular flues provided therefor in the evaporating-vessel, evaporate the liquid therein contained. The vapors given off within the evaporator are conducted to a condenser and air-pump, if a single evaporating-vessel be used, or else into the vapor-chamber of a second evaporator, where they serve anew as source of heat. In this last-mentioned case the remainder of the apparatus is exactly similar to the apparatus for evaporating in a train of evaporating-pans described in all the works to date treating of this matter. It is this last method—utilizing the waste gas of the generators—which in practice will find the most frequent application.

The following are among the advantages attained by my invention: First, the employment of the direct heat of the flames of combustion is considerably more economical than those apparatus in which the losses due to the production of the vapor employed are augmented by condensation in the passages and the frequent and inevitable leakages; second, the employment of the tubular vessel placed on the way from the heating-furnace to the stack permits the recovery and utilization of a large portion of the heat which would otherwise pass off by the stack, this waste heat in most similar apparatus far surpassing in extent that which is necessitated for draft; third, the employment of the tubular vessel, placed as before indicated, allows for the sole expense of its application of the augmentation without expense of fuel of the power of apparatus for evaporating *in vacuo*, which in most cases—in sugar manufacturing notably—is far too weak; fourth, the employment of this form of evaporating-vessel permits the using at need of the waste or exhaust steam from an engine supplied by the generator before mentioned in addition to the vapor from the first evaporator, which greatly augments the power of the following evaporator; or, fifth, the apparatus may be effectually worked without the use of the exhaust-steam, thus permitting the employment of perfected engines with variable cut-off and at low pressure, whence there results a still further and considerable economy of fuel.

To the end that my invention in its preferred form may be more fully understood, I will proceed to describe it with reference to the accompanying drawings, in which the tubular evaporator is shown as situated in the escape-flue or a group of generators and connected directly to another vessel, which receives the vapors and liquids of the first, and which is itself connected to a third vessel, whence the vapors flow to a condenser and air-pump, the whole forming, for the circulation of the liquids and vapors, an apparatus similar to that for evaporating in a train of evaporating-pans.

It is evident that the vessel in the escape-

flue can at will be connected directly to an air-pump, or to another vessel, or to a train of evaporating-vessels.

In the drawings, Figure 1 is a vertical section of my improved apparatus on the line 1 1, Fig. 2. Fig. 2 is a horizontal section thereof on the line 2 2, Fig. 1. Fig. 3 is a vertical section, taken at right angles to that shown in Fig. 1, on the line 3 3, Figs. 1 and 2.

A A are a series of steam-generators.

B B are a series of dampers, which when open admit the still heated products of combustion to a common escape-flue, C, by means of which they are conducted to the stack C′. The construction of the heat-generator being no part of the present invention, a further description thereof is not considered necessary.

D is the evaporating-vessel, constructed with sides of sheet-iron and heads of bronze or wrought or cast iron. The heads are pierced for the connection thereto of a number of tubes, D′, of iron or brass, serving as flues through the vessel for the escaping products of combustion in the flue C. The sum of the sections of the tubes D′ may be equal to or even less than the section of the stack. The vessel D is furnished with the necessary means of introducing and permitting the exit of liquid, as well as other usual accompaniments of a vacuum-pan—that is, pressure-gage, thermometer, windows, try-cocks, &c.

E, F, and G are dampers, the first controlling the passage to the stack and the others to the evaporator. To throw the heated gases into the apparatus, the damper G is closed and the dampers E and F opened. When the evaporator is at rest the damper G is opened and the dampers E and F closed. The quantity of heat applied to the evaporator, and consequently the speed of evaporation, may be regulated by simultaneously opening the dampers E, F, and G to any desired extent, according to the effect desired.

K is a man-hole, permitting access to the tubes for cleaning.

L is a pipe conducting the vapors of the first vessel, D, into the safety-column M, whence they pass to the vapor-chamber of the second vessel, H, whence they pass in the same manner to a second safety-column, N, and from there to the vapor-chamber of the third vessel, I. The vapors of this last vessel pass to the safety-column Q, and thence by the conductor R to the condenser and air-pump.

The apparatus for conveying the liquid and for the production of the vacuum are similar to those usually employed for these purposes.

It will be seen that the present invention permits of the direct utilization of the gases from a furnace or from the flues of generating apparatus for the evaporation and concentration *in vacuo* by means of simple or multiple tubular vacuum-pans.

Actual tests of the apparatus show the economy of fuel given and the valuable additions which will be rendered thereby to plants already made in which the evaporating-power is at little cost greatly augmented.

I reserve the right to employ the apparatus above described and placed in the escape-flue of a furnace or of a group of generators for the evaporation in the open air of all the liquids mentioned in the first part of this specification, to employ the process above described in connection with engines with variable cut-off or at low pressure, or to utilize the heat of the exhaust-steam before its arrival at the condenser, whether by making it pass through tubes to warm the liquid to be condensed, or by passing it through a worm in the evaporating-vessel, or by its application to any desired object, always, however, passing the exhaust-steam through a means of utilizing the same during its passage from the exhaust to the condenser.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. In an evaporating and condensing apparatus, the vessel D, situate in the discharge-flue of a furnace, and having tubular flues D′, for the passage of the escaping products of combustion, and means for the entrance of fluid and discharge of fluids and vapors, substantially as and for the purpose set forth.

2. The combination of vessel D, having tubes D′, with dampers E F G, situate in the escape-flue of a furnace, as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ACHILLE GILAIN.

Witnesses:
EMILE PICARD,
ADOLPF STEIN.