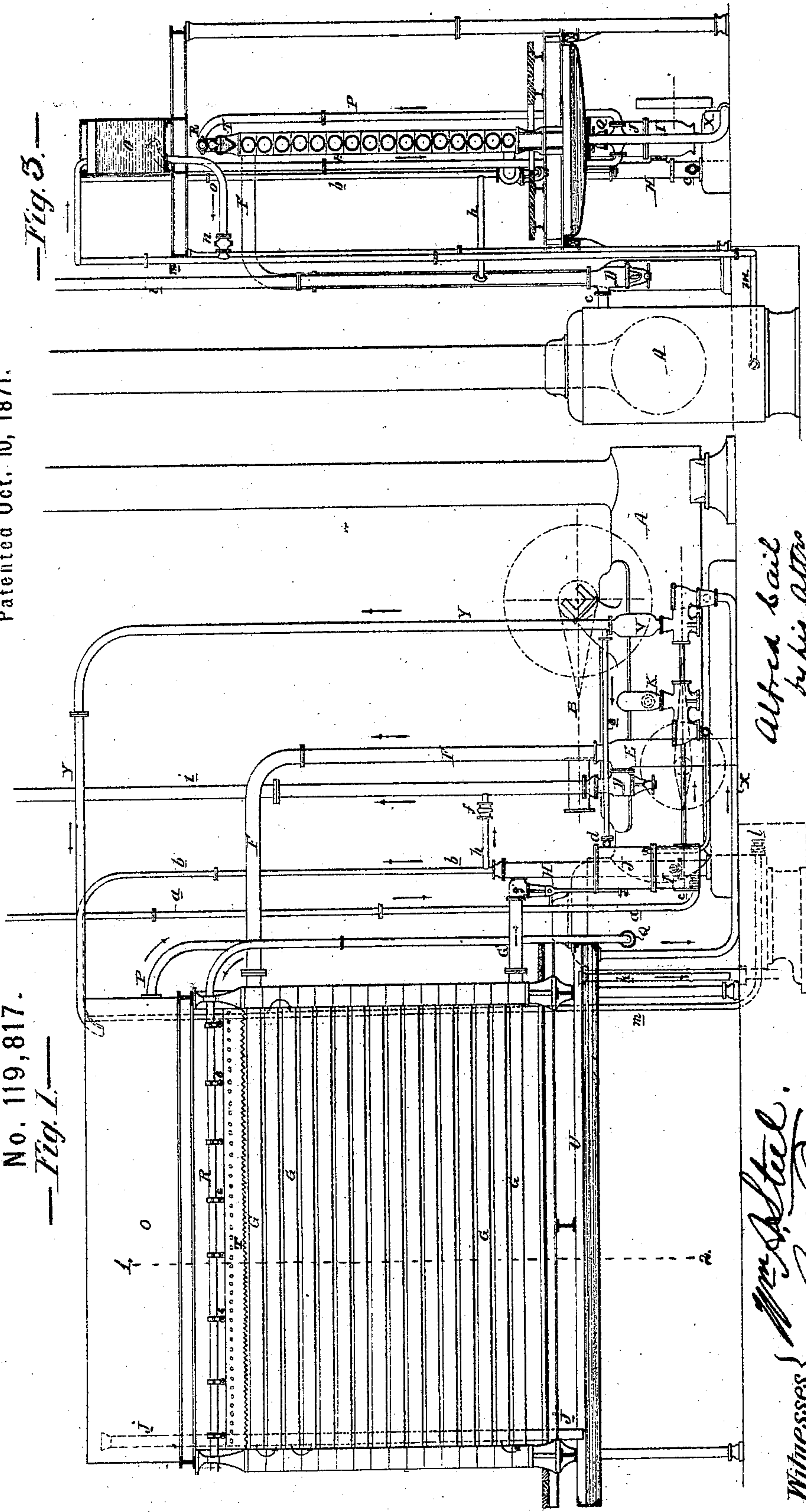


—Alfred Cail—
—Improvements in Steam Condensers, and in Supplying—
—Steam Generators with Water.

Patented Oct. 10, 1871.

No. 119,817.

—Fig. 1.—



—Fig. 3.—

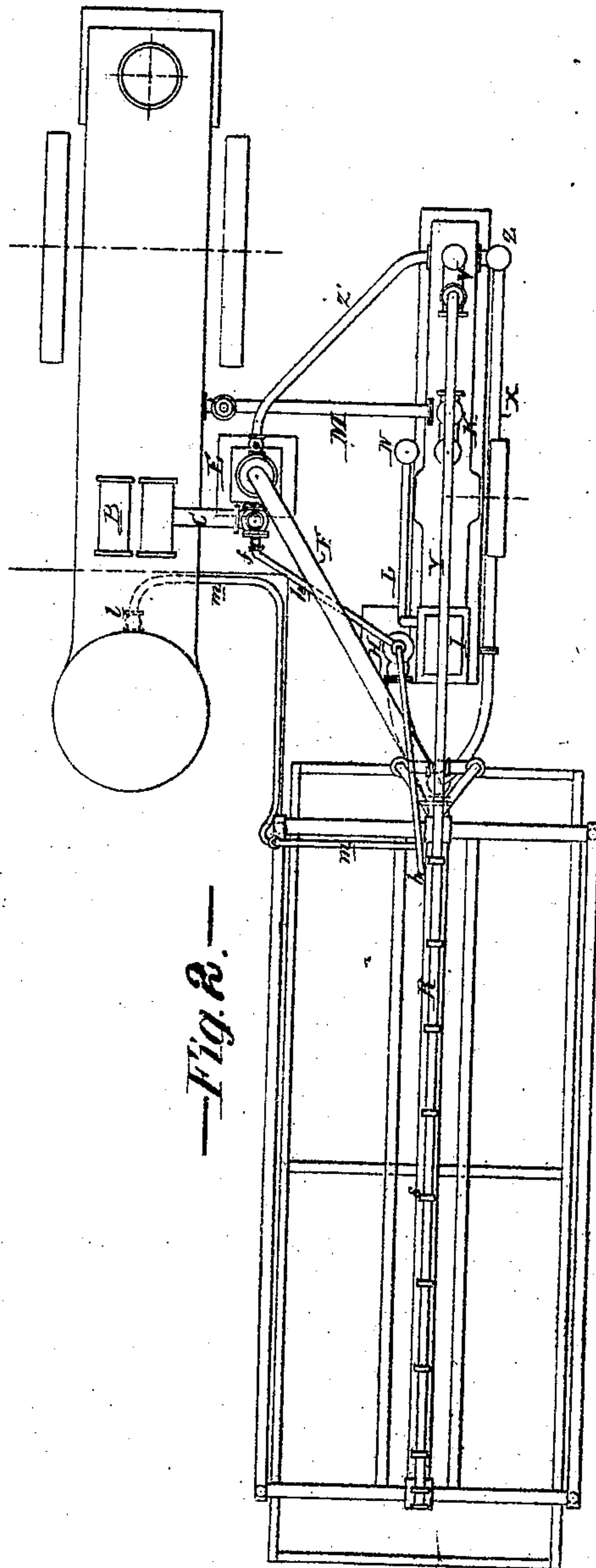
Witnesses {
Mr. A. Steel.
John C. Parker

Alfred Cail
by his Attro
J. H. Brown and Son

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—Fig. 2.—

Witnesses { *Wm. A. Steel,*
John Parker

Alfred Cail
by his Attor.
Stowson and son

UNITED STATES PATENT OFFICE

ALFRED CAIL, OF PARIS, FRANCE.

IMPROVEMENT IN STEAM-CONDENSERS, &c.

Specification forming part of Letters Patent No. 119,817, dated October 10, 1871; antedated October 7, 1871.

To all whom it may concern:

Be it known that I, ALFRED CAIL, engineer, of Paris, in the Empire of France, have invented Improvements in Steam-Condensers and in Supplying Steam-Generators with Water, of which the following is a specification:

My invention consists principally in the use, in connection with steam-engines and generators, of what I have termed an evaporating-condenser, and also of certain arrangements, fully described hereafter, to be used in connection with the said condenser for the purpose of producing a thorough condensation of the exhaust steam and the return of the same in the form of distilled water to the generator. The principal objects of my invention have been to produce an economical condensation of steam and to prevent the accumulation of calcareous and other deposits upon the interior of the generator, all of which will be fully explained hereafter.

Figure 1 is a side elevation of a steam-engine and generator with my improved condenser and arrangement for supplying the generator with water. Fig. 2 is a plan view of the same; Fig. 3, a transverse section on the line 1 2, Fig. 1.

A represents a tubular generator of ordinary construction, and B a horizontal steam-engine with two cylinders coupled together upon a single frame, which is fixed to the top of the generator. The cylinders have a common escape-pipe, C, which communicates with a box or chest, D, there being two valves within the latter arranged so as to either permit the exhaust steam to escape at once to the open air or to conduct it to the condenser. A casing or reservoir, E, intended to receive the deposit of oily or other matters drawn by the exhaust steam, is attached to the box D, and from the top of the said reservoir the exhaust steam is conducted by a pipe, F to the evaporating-condenser G. The latter consists, in the present instance, of a single row of communicating horizontal tubes laid one above the other; but two or more rows of tubes or an ordinary spiral coil may be substituted for this arrangement, if desired. The evaporating-condenser communicates at the bottom with a small tubular condenser, H, consisting, as usual, of a series of tubes surrounded by water, and intended to condense in its tubular drum the last portions of steam in contact with the tubes, a current of cold water passing through the latter.

The lower tube G' of the evaporating-condenser is furnished, at a point adjacent to the condenser H, with a cock, g, intended in case of stoppage to intercept the communication between the air-pump and the evaporating-condenser, and to thus preserve the vacuum in the latter, the communication between the steam-cylinders and the condenser having been previously intercepted by such an adjustment of the valves in the box D as to permit the escape of the exhaust steam into the open air. I represents the horizontal air-pump, communicating with the bottom of the condenser H and performing the double duty of maintaining a vacuum in both condensers and of forcing the distilled waters of condensation into a reservoir, J, placed above it. The feed-pump K withdraws the distilled water from the reservoir J through a pipe, L, and forces it through a pipe, M, into the generator A. A cock, N, on the pipe L regulates the supply of distilled water to the feed-pump. O represents a reservoir placed above the evaporating-condenser G, and supplied with water to be used in the condensation of the steam. This reservoir should have a capacity at least equal to the volume of water contained in the generator. The water of the reservoir O is supplied to a distributing-pipe, R, arranged beneath the same by a return-pipe, P, which has at its lowest point a cock, Q, by which the communication between the reservoir and distributing-pipe may be established or interrupted, as required. The pipe R is provided with a number of cocks, S, arranged to regulate the supply of water to a horizontal trough, T, which is perforated with a number of holes or otherwise constructed so as to discharge the water onto and over the exposed tubes of the evaporating-condenser in small streams or drops. The water, after flowing over the tubes of the evaporating-condenser, is received into a tank, U, and withdrawn from the latter through a pipe, X, and returned to the reservoir O through a pipe, Y. A valve, Z, in the pipe X regulates the supply of water to the pump V. A pipe, a, communicating with a tank, supplies the tubular condenser H with cold water, and the latter, after passing through the tubes of the condenser, is conducted by a pipe, b, into the reservoir O to replace the water lost by evaporation in passing over the tubes of condenser G. A stop-cock, c, in the pipe a regulates the supply

of natural water to the condenser H. A supply of water already purified and intended to take the place of the small quantity lost in distillation is conducted into the receiver J by a pipe, *e*, a cock, *d*, regulating this supply. *i* represents the tube of escape from the box D to the open air, and to this tube and to the pipe *b* is connected a short pipe, *h*, furnished with a cock, *f*. The object of this latter arrangement is to enable a quantity of water to be conducted into the tube *i* and upon the valve closing the passage to the open air, a hydraulic joint being thus formed and all entrance of air into the condenser prevented. The reservoir O above the evaporating-condenser and the tank U beneath the same are furnished with overflow-pipes *j* and *k*. The deposits of water in the reservoir E may be withdrawn from the same from time to time by the water-pump V through a pipe, *z'*, Fig. 2. When the generator is to be cleansed or repaired all of the distilled water may be drawn from the same through a pipe, *m*, and be preserved in the reservoir O, the pressure of steam in the generator forcing out the water on opening a cock, *l*, in the discharge-pipe. The water thus preserved in the reservoir O can be returned to the generator through the pipes *o* and *m* on opening the cock *n*. (See Fig. 3.)

The operation of the condensing apparatus is as follows: The exhaust steam from the cylinders passes first through the pipe C, which is made purposely of large section so as not to obstruct its passage; then through the box D, reservoir E, and pipe F, in the course indicated by the arrows, to the uppermost tube of the evaporating-condenser G. The steam then passes through the latter and into the immersed tubular drum or condenser H, which communicates with the air-pump I, the latter maintaining a vacuum in both condensers and withdrawing the water of condensation from the same and forcing it into the receiver J, from which it is withdrawn and fed to the boiler by means of the feed-pump K. The trough T above the evaporating-condenser discharges its water in a thin sheet or in drops over the exterior of the condensing-tubes, which are thus completely enveloped, the cooling water being constantly supplied to the trough by the cocks S of the distributing-pipe, so as to maintain a constant running upon the tubes, through the interior of which the exhaust steam is passing. This causes a rapid passage of heat from the exhaust steam to the water running over the tubes, which water evaporating in the free air or under the accelerating action of a current of ascending air leads to a very active cooling and condensation of the exhaust steam, which condensation is necessarily completed in the tubular condenser H, above referred to. The stream thus brought to the condition of distilled water is drawn by the air-pump into the receiver J, and from the latter is forced into the generator, as before described. The generator, after having been once filled, is supplied with distilled water, so that it suffers no longer from incrustations, and preserves its metallic surfaces clear of

all foreign matters, such as calcareous salts, &c. The boiler consequently maintains its power of calorific transmission, which manifests itself so plainly in a new generator, and which diminishes gradually until it amounts to considerable differences, confirmed by an enormous increase of consumption of fuel in proportion as the calcareous deposits appear upon its surfaces.

Another important result is obtained by my invention in regard to the purification of natural water. As it is very difficult, practically, to recover in water distilled by the condensation of escaped steam all the water consumed in the generator in the creation of steam, and while the losses resulting from the waste might require a replacing of the water, which must be taken from the natural water of the locality which is more or less impregnated with calcareous or other foreign matter, it is of great importance to guard against introducing this water into the generator in its impure state. In my arrangement the natural water is first thrown into the evaporating-condenser and deposits there the most of its calcareous salts. It is then collected in a reservoir, serving henceforth as feed-water for the generator. Thus, in an arrangement of this kind, it will be seen that it will only require the water of the locality to be used at the first time of starting. For being careful to preserve this valuable store of purified water the apparatus is so arranged that in case of stoppage, for any cause whatever, the generator may be emptied, the water contained therein being thrown by the pressure of steam into an elevated reservoir, where it is kept for future use, it being caused to descend again into the generator when operations are resumed. Finally, that no precautions be neglected to avoid using the water in its natural state, even upon the very day of starting the generator, (which would be apt to produce upon the heating-surfaces very perceptible incrustations,) it is recommended that arrangements be made for the collection and employment of rain water to be used for feeding the generator.

To resume, by the above arrangement and combination, never before used in this connection, has been realized the double desideratum—an apparatus for the production of steam which will not suffer from the deplorable effects of incrustations, and economy in the consumption of steam from good condensing apparatus without being obliged to use the great quantities of water which ordinary immersing and injecting-condensers require.

It should be understood that I reserve the right of applying my invention to all engines to be used on land or at sea, including traction engines and locomotives.

I do not claim, broadly, a well or reservoir to collect the water passing from the condenser; nor a pump to raise the water from the well and discharge it again over the condenser; nor the reservoir for collecting the water prior to discharging the same on the condenser, as such devices, separately, have heretofore been used; but

I claim—

1. The combination, with the condensing-tubes, arranged substantially as described, of the tanks O and U, pipes X and Y, and water-pump V, as set forth.

2. The combination of the said condenser G and reservoir O with distributing-pipe R and perforated trough T, substantially as set forth.

3. The combination of the evaporating-condenser G with the condenser H, substantially as and for the purpose specified.

4. The combination of the condensers G and H with the air-pump I, reservoir J, and feed-pump K, substantially as specified.

5. The combination of the connecting-pipe *e*, the pipe Y, and reservoir J, for the purpose specified.

6. The combination of the box D, reservoir E, condenser G, pipes F, escape-pipe *i*, and valve-pipe *h*, all as set forth.

7. The pipe *h* with its cock *f*, arranged substantially as described.

8. The arrangement, in respect to the generator and elevated tank O, of the pipes *m* and *o*, with their cocks *l* and *n*.

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

ALFRED CAIL. [L. S.]

Witnesses:

EMILE RICHARD,
ADOLPHE BISSON.

(150)