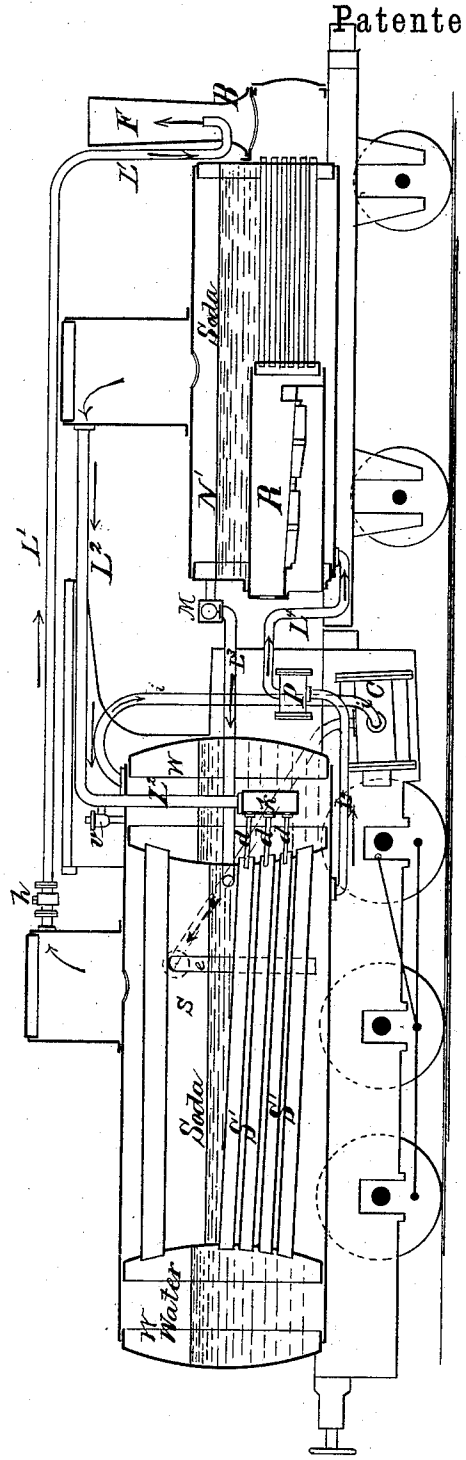
(No Model.) 2 Sheets—Sheet 1.

M. HONIGMANN.

METHOD OF DRIVING STEAM ENGINES.

No. 340,718. Patented Apr. 27, 1886.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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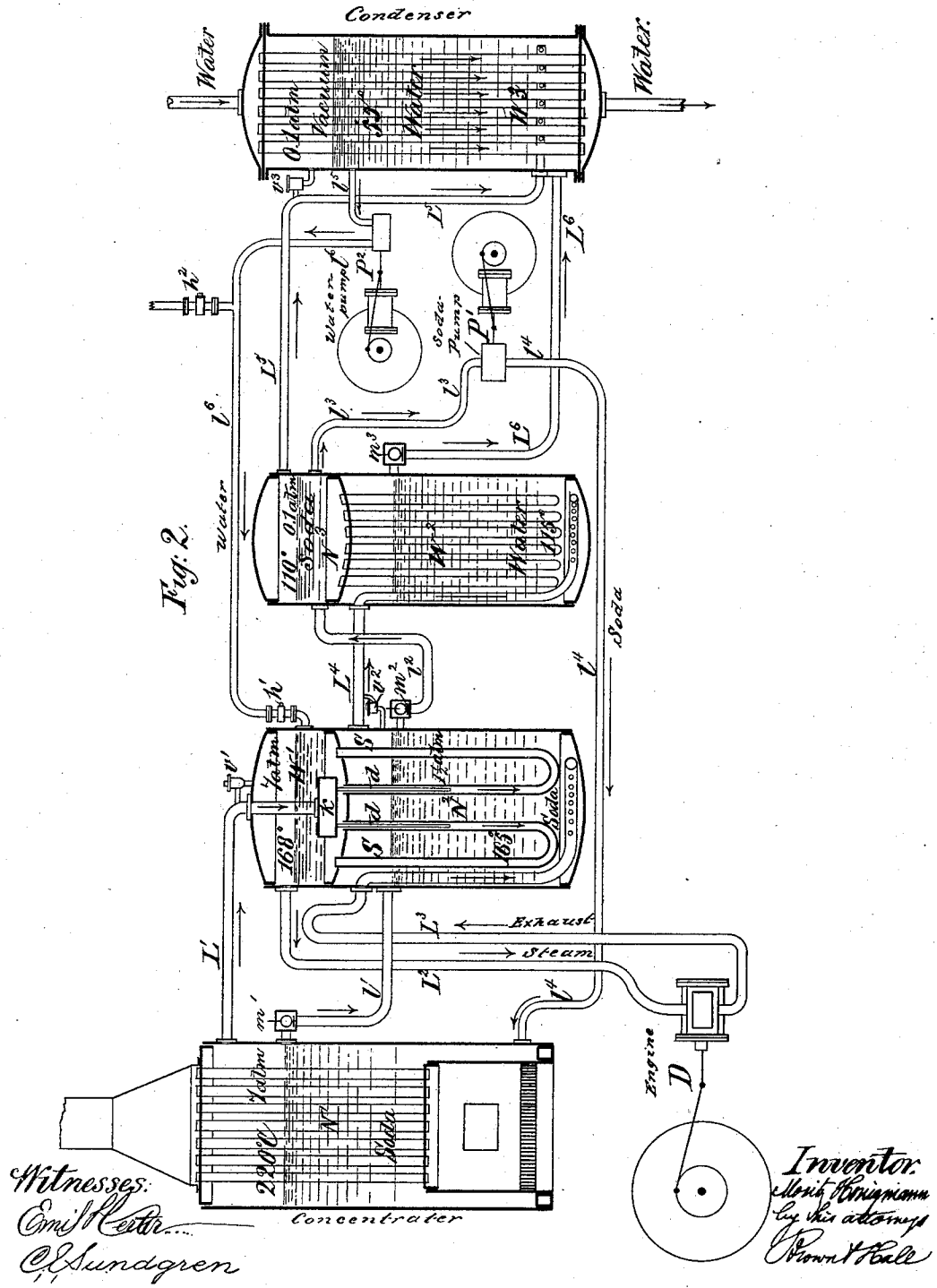

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UNITED STATES PATENT OFFICE.

MORITZ HONIGMANN, OF AIX-LA-CHAPELLE, GERMANY.

METHOD OF DRIVING STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 340,718, dated April 27, 1886.

Application filed November 14, 1885. Serial No. 182,794. (No model.)

To all whom it may concern:

Be it known that I, MORITZ HONIGMANN, of Aix-la-Chapelle, in the Empire of Germany, have invented a new and useful Improvement in Apparatus for Generating Steam for Motive Power, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to the generation of steam for driving steam-engines by the heat evolved by the absorption of water-vapors into a liquid—as a solution of caustic soda—having a high boiling-point.

The invention consists in a certain improvement, hereinafter described and claimed, in the apparatus for such generation of steam, whereby greater economy is obtained.

Figure 1 is a central longitudinal vertical sectional view illustrating the application of my improvement to locomotives, representing the boiler, the principal parts of the engine, and a concentrating-vessel for reconcentrating the lye or heat-absorbing liquid. Fig. 2 is a central longitudinal sectional view illustrating the application of the invention to a stationary engine, and showing an engine with boilers and concentrating apparatus.

I will first describe Fig. 1.

S W W designate the soda steam-boiler, consisting of a cylindrical structure divided into three compartments, of which the middle one, S, constitutes the soda-vessel containing the soda solution or other liquid having a high boiling-point, into which the exhaust-steam from the engine is absorbed, and the two end compartments W W constitute the water-spaces in which the steam used in the engine is generated, the said end compartments being connected by tubes S′, running through the soda-vessel S. The structure S W W is mounted on wheels, like an ordinary locomotive-boiler.

C designates the engine-cylinder, the induction-pipe *i* of which takes steam from one of the compartments W of the soda-boiler, and the eduction-pipe *e* of which conducts the exhaust-steam into the liquid or solution in the soda-compartment S of said boiler.

N′ designates the concentration vessel or boiler, mounted on a carriage or truck, which is connected with the carriage or truck on which the boiler S W is mounted. This concentrating-boiler is multitubular, like an ordinary locomotive-boiler, and provided with a furnace, R, and smoke-stack F. The said concentrating-boiler N′ and soda-compartment S of the soda-boiler are connected at their bottoms by pipes L^4 and a pump, P, for transferring the spent solution from S to N′, and they are connected above by a pipe, L^3, in which is a float-valve, M, for returning the solution to S after reconcentration. The steam produced by the reconcentration of the lye in the concentrating-boiler N is conveyed to a distributing-chamber, *k*, through the pipe L^2 and check-valve *v*, and is injected through nozzles *d* into the water-tubes S′ of the water-boiler, so as to produce a rapid circulation of water through the said tubes. The heat from this steam is transmitted through the said tubes to the surrounding soda solution in the boiler S, thus assisting to concentrate the said solution and generate steam therefrom. The steam generated from said solution, passing off through the pipe L′, escapes at the blast-pipe B in the chimney F and increases the draft of the furnace R. The lye is pumped constantly or periodically by the pump P through the pipe L^4 from the soda steam-boiler into the concentrating-boiler, whence the concentrated lye runs back to the soda steam-boiler through the tube L^3 and float-valve M. The pipe L′ is provided with a valve, *h*, to be closed when the engine is running without a fire and when the generation of steam in N′ is stopped. The concentration of the lye may, however, be carried on in N′ during the working of the steam-engine by means of the soda steam-boiler.

The advantage of this invention consists in the simplification of the working and the economy of fuel, as the same steam is used twice for the working of the engine: first, it becomes absorbed by the soda-lye, and then, after re-evaporation by means of the fire, it is forced under pressure into the water of the soda steam-boiler. A further economy can be obtained by means of an apparatus such as is shown in Fig. 2, which I will now describe. The concentrating-boiler N′, heated by a furnace, is fed continually with soda-lye by the pipe l^4, and produces steam under pressure, which is injected through the pipe L′ into the water in the water-vessel W′ of soda steam-boiler N^2, a check-valve, *v*′, preventing the return of the water to the boiler N′. The soda steam-boiler

N^2 is provided with a set of bent water-circulating tubes, S′, the steam being conveyed to a distributing-chamber, K, from the pipe L′, and injected through nozzles *d* into the said water-tubes S′. The soda steam-boiler works the steam-engine D with the steam generated in W′ and passed through the pipe L^2, the exhaust-steam passing back into the soda-compartment N^2 of the said boiler through the pipe L^3, and the steam which is not here absorbed by the soda escapes through the pipe L^4, provided with the valve v^2, into the water-space of a second boiler, W^2, which contains a system of pipes containing soda-lye. As the soda solution in N^3 is *in vacuo*, the temperature of W^2 is so low that the inflowing steam is absorbed, and the absorption heat is used for the concentration of the said soda. The pipes L^5 and check-valve v^3 serve to connect the chamber N^3 with the vacuum-chamber which surrounds the tubes of the multitubular condenser W^3. The vacuum is produced by the condensation in W^3 of the vapors from N^3, and the pump P^2 returns the condensed water to the steam-generator W′ through the pipes l^3 and valve h', the cock h^2 being employed for letting in water or letting off a surplus, the same water being always used for the generation of steam. A pump, P′, pumps continually or periodically lye from N^3 through the pipes l^3 and l^4 into the concentrating-boiler N′, whence it passes through a self-acting float-valve, *m′*, and the pipe *l′* into the soda steam-boiler. The float-valve m^3 and pipe L^6 connect the water-compartment W^2 with the vacuum in W^3. Similarly, the lye is drawn out from the soda steam-boiler through a valve, m^2, and the pipe l^2 into the boiler N^3. It will now be readily seen that the concentration is effected independently of the working of the engine. The steam is generated in about equal quantities in N′, N^2, and N^3. If the fire in N′ evaporates seven kilograms of water per kilo of coal, then the whole of the evaporation is $3\times7=21$ kilos; but as concentrated soda is equivalent to power, since during the working of the steam-engine the soda absorbs the exhaust-steam and generates steam under pressure by the heat developed by absorption, the fuel used for the working of the steam-engine is, by means of this apparatus, only about one-third of that used by an ordinary engine. This process can only be worked by making use of the invention which is the subject of my United States Letters Patent No. 324,696, dated August 18, 1885, consisting in the concentration of lyes in the soda steam-boiler by means of steam under pressure, which is conveyed into the water of the steam-generator, whereby the changing of the lyes from one boiler to the other was avoided.

By the present invention the concentrating apparatus and the soda steam-boiler form one apparatus, and the engine can be worked with or without fire.

It is to be noted that this invention carries out quite a new mode of operating the soda steam-boiler, which permits of working with a low boiling-point of the lye of about from 140° to 155° centigrade, whereas hitherto the high boiling-points of over 200° centigrade have always been used. To enable the use of these low boiling-points, the atmospheric boiling-point of the lye must be lower than its temperature. For instance, in Fig. 2 the temperature of the lye of the soda steam-boiler is 165° centigrade; but its atmospheric boiling-point is about 150° centigrade. There is therefore an overpressure of at least one-half atmosphere in the soda-vessel. The overpressure decreases a little the effect of the steam-engine; but this disadvantage is counterbalanced by the advantage that a lye with a lower boiling-point can be used, allowing the use of a double and triple effect concentration.

The boiling-points of the lye are shown in the following table:

Soda steam-boiler.

Water-boiler.		Soda-lye atmospheric boiling-point.	Overpressure in the soda-boiler; therefore, also, in the exhaust-steam.
Overpressure.	Temperature.		
5 atmospheres.	160° Celsius.	147.5° Celsius.	½ atmospheres.
5 "	160° "	138° "	1 "
6 "	166.5° "	154° "	½ "
6 "	166.5° "	144.5° "	1 "
8 "	177.5° "	155.5° "	1 "
10 "	186° "	151° "	2 "
15 "	203° "	158° "	3 "
20 "	215° "	155° "	5 "

This new mode of working is comprised in the present invention.

Although soda-lye has been mentioned, it will be understood that any other solution having a high boiling-point may be substituted, and that, instead of a soda steam-boiler such as is herein described, any other vessel can be employed wherein the exhaust-steam is absorbed in a solution having a high boiling-point and surrounding a steam-generator.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, with a soda steam-boiler comprising a vessel for containing a solution of high boiling-point, into which exhaust-steam is absorbed, and a generating-vessel for containing water from which steam is to be generated by the heat produced by such absorption, of an evaporating-vessel for the reconcentration of said solution, and a pipe connecting said evaporating-vessel and said generating-vessel, substantially as herein described, for conducting the steam generated in said evaporating-vessel into the water in the said generating-vessel, and so utilizing the heat of said steam to assist in evaporating the solution in said soda steam-boiler, and at the same time utilizing the water of said steam to partly supply the steam-generating vessel of said boiler, as herein set forth.

2. The combination, with the soda steam-boiler comprising a vessel for the steam-absorbing solution and a generating-vessel for

the water for generating steam by the heat evolved from said solution, of an evaporating-vessel for reconcentrating the said solution, a steam-pipe leading from said evaporating-vessel into said generating-vessel, and a check-valve in said pipe to prevent the return of the water from the said generating-vessel to said evaporating-vessel, substantially as herein described.

3. The combination, with the soda steam-boiler comprising a vessel for the steam-absorbing solution and a generating-vessel for the water for generating steam by the heat evolved from said solution, of an evaporating-vessel with a heating-furnace for reconcentrating said solution, a steam-pipe leading from said evaporating-vessel into the soda steam-boiler, for heating both the water and solution in said boiler, and a steam-pipe from the vessel containing the steam-absorbing solution to the chimney of said furnace, substantially as and for the purpose herein specified.

4. The combination, with the solution-vessel of the soda steam-boiler and an evaporating apparatus for reconcentrating the said solution, of a pump and connections for transferring the solution from the said vessel to the said evaporating apparatus, and a pipe between said vessel and said evaporating apparatus for the return of the solution in a concentrated state to the said vessel, and a float-valve in the latter pipe for regulating said return, all substantially as herein described.

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

MORITZ HONIGMANN.

Witnesses:
GEO. F. LINCOLN,
JOH. HECKMANNS.