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Patented Aug. 5, 1902.

L. MAHY & P. HAILLEZ.

BOILER.

(Application filed July 2, 1901.)

(No Model.)

3 Sheets—Sheet 1.

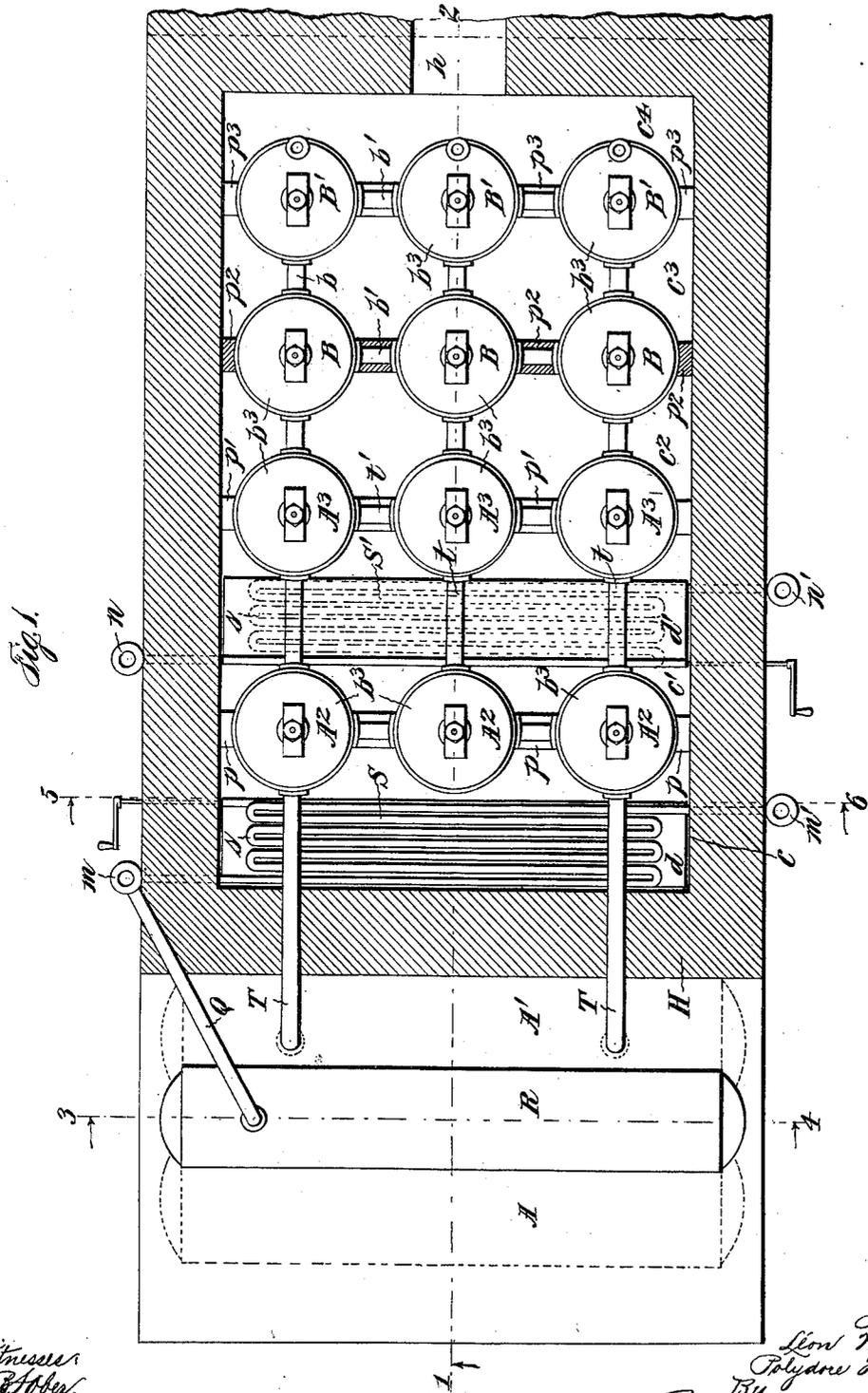


Fig. 1

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L. MAHY & P. HAILLEZ.
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3 Sheets—Sheet 2.

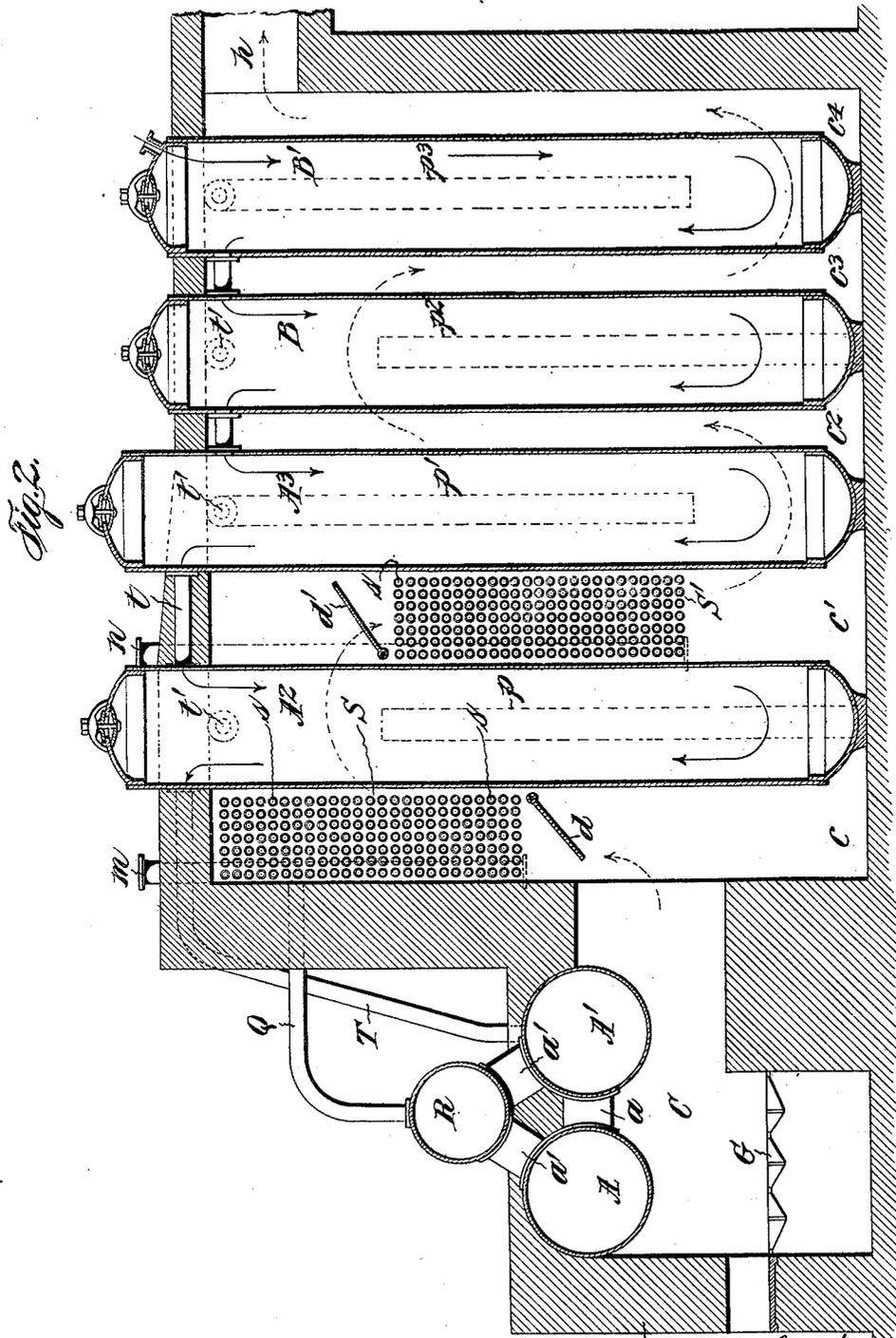


Fig. 2.

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UNITED STATES PATENT OFFICE.

LÉON MAHY AND POLYDORE HAILLEZ, OF GHENT, BELGIUM.

BOILER.

SPECIFICATION forming part of Letters Patent No. 706,188, dated August 5, 1902.

Application filed July 2, 1901. Serial No. 66,893. (No model.)

To all whom it may concern:

Be it known that we, LÉON MAHY and POLYDORE HAILLEZ, subjects of the King of Belgium, residing at Ghent, in the Kingdom of Belgium, have invented certain new and useful Improvements in Boilers, of which the following is a full, clear, and exact specification.

Our invention has relation to steam-generators; and it has for its object a construction of generator the generating capacity of which is greater than that of generators of usual construction, and this object we attain by the relative arrangement of preheaters and vaporizers and the means for establishing a rational and continuous circulation there-through, whereby the heat from the furnace is not only completely utilized, or substantially so, but whereby such heat is utilized to the best advantage, as will now be fully described, reference being had to the accompanying drawings, in which—

Figure 1 is a top plan view of the generator, the roof and portions of the vertical walls being removed and shown in section for the purpose of exposing to view certain pipe connections. Fig. 2 is a vertical longitudinal section, and Figs. 3 and 4 transverse sections, taken, respectively, on lines 1 2, 3 4, and 5 6 of Fig. 1; and Fig. 5 is a sectional detail view drawn to an enlarged scale.

Our improved generator is contained in a housing H of masonry, as brickwork, and comprises, preferably, two horizontal primary vaporizing drums or cylinders A A', connected together by tubular connections a a'. They are so located transversely of the combustion-chamber C above the grate G as to be in direct contact with the products of combustion or so that more than their lower half will be in such contact, as shown in Fig. 2, said drums being connected by tubular connections a' a' with a steam-collecting drum R, located outside of the housing H and from which steam may be taken for use, or the steam therein may before use be superheated, as hereinafter explained. The generator comprises, further, a plurality of vertical auxiliary vaporizing drums or cylinders, of which we have shown six arranged in series of three transversely across the housing H and projecting through the roof thereof. The drums A² A³

of each set of three are interconnected near their upper ends by circulating-tubes t', while said drums A² A³ of the two sets are connected together in pairs by circulating-tubes t at a higher level than the tubes t', one or two of the drums A² being connected by pipes T with the primary vaporizer A'. The generator further comprises a plurality of preheaters consisting of vertical drums of less height than the vaporizers A² A³, and of these preheaters we have also shown six arranged, like said vaporizers, in two sets of three drums B and B', respectively, those of each set being interconnected near their upper ends by pipe connections b and in couples by like connections b', while the three drums B are also connected near their upper ends with the vaporizers A³.

In practice and for the purpose of establishing a uniform and constant circulation of the water through the preheaters and auxiliary vaporizers the pipe connections t', b, and b' are all on the same level. The feed-water may be fed to one or more or all of the last set of preheaters B', which are provided for this purpose with a suitable branch b².

All the drums A² A³ B B' are provided at or near their lower ends with a purge-pipe and cock in the usual manner and which we have deemed unnecessary to show, this being a necessity and a common practice, each of said drums being likewise provided, according to their diameter, with a hand man hole normally closed by a suitable cover b³, the drums B and B' projecting also through the roof of the housing H.

In order that a rational and continuous circulation may be established through the preheaters B B' and the auxiliary vaporizers A³ A², we arrange partitions between the three drums of each set and the lateral walls of the housing, these partitions being staggered, so as to provide an up and down zigzag flue from the left end of the housing to its right end, from which the final and practically cold products of combustion escape through a flue h, connected with a chimney. (Not shown.) The first set of partitions p, between the drums A² and the lateral walls of the housing H, rise from the floor of said housing near to the roof thereof. The partitions p', between the drums A³ and housing-walls, on the contrary,

extend from the roof near to the floor of said housing, while the partitions p^2 and p^3 are respectively arranged like the partitions p and p' . The housing is thus divided into a series of chambers $c c' c^2 c^3 c^4$, one-half of the drums projecting into two adjacent chambers, the drums A^2 into chambers $c c'$, the drums A^3 into chambers $c' c^2$, the drums B into chambers $c^2 c^3$, and the drums B' into chambers $c^3 c^4$. The products of combustion from the combustion-chamber C flow in an up and down direction to the escape-flue h . Consequently those portions of the drums facing in a direction opposite to the flow of the products of combustion—*i. e.*, that portion of the drums on the left of the partitions $p p' p^2 p^3$ —will be more highly heated than the portion on the right of said partitions, owing to the gradual yield of heat from said products of combustion, as they flow first in an upward direction from the combustion-chamber, then in a downward direction, and so on. Practice has fully demonstrated that the difference between the temperature on opposite sides of the partition is sufficient to cause an alternating up and down flow of the feed-water through the drums—that is to say, the cooler water will flow down along the cooler side of the drums and then upward along the more highly-heated walls of said drums in a direction opposite to the direction of flow of the products of combustion, which direction is indicated by dotted arrows, while the direction of flow of the water is indicated by full arrows in Fig. 2.

When the steam is to be taken from the collecting-drums R exclusively, the series of vertical drums can be set quite close together, as is the case with the vaporizers A^3 and preheaters B and B' ; but if the steam is to be first superheated we preferably so arrange the vaporizers A^2 relatively to the left end of the wall of the housing H as to widen the chamber c sufficiently to accommodate the superheater C , or said heater may be arranged in the chamber c' , as shown, according to the temperature to which the steam is to be superheated, while, if desired, a superheater may be located in both chambers and connected independently to the collector R . These superheaters $S S'$ consist of a multiplicity of horizontal coils of pipes s whose terminals are connected to vertical pipes $m m'$ and $n n'$, respectively, closed at their lower ends. The pipes $m m'$ and $n n'$ may, if desired, be connected together in pairs, the superheated steam being taken from the connection between pipes $n n'$, while pipe m of the superheater S is connected by pipe Q with the steam-collector R . Below the superheater S is arranged a damper d , which can be operated from the outside of the housing, said damper when closed practically shutting off the products of combustion from the superheating-coils S , said products flowing in an upward direction in chamber c , chiefly along the exposed sides of the drums A^2 . A

similar damper d' is arranged above the superheater S' , which damper when closed causes the products of combustion to flow downward, chiefly along the exposed sides of the drums $A^2 A^3$ in chamber c' .

In Fig. 5 we have shown a preferred connection between the terminals of the superheating-coils s and the vertical pipes m or m' and n or n' , the latter having screwed thereto a thimble m^2 , screw-threaded at its outer end and having its bore of outwardly-increasing diameter, into which fits the correspondingly-tapering terminal s' of a coil s , said terminal having an annular external collar s^2 , on which bears an internal shoulder of a nut n^2 , that screws on the thimble m^2 , a perfectly steam-tight joint being thus obtained in a simple manner and packing dispensed with.

From the above description the operation of the generator and mode of generating steam will be readily understood, and we may simply add that we make the auxiliary vaporizers $A^2 A^3$ of greater length than the preheaters B and B' , so as to provide at their upper ends a chamber for the collection of steam and air and the discharge thereof into the primary vaporizing-drum A' through pipe T , together with water. Finally, we may state that it will also be obvious to those skilled in the art to which the invention relates that impurities contained in the feed-water, whether held in suspension or in solution, are or can be by well-known means be precipitated during the flow of the water through the preheaters or through the latter and the vaporizers $A^2 A^3$, so that the water reaching the vaporizers $A A'$ will be practically pure.

Having thus described our invention, what we claim as new therein, and desire to secure by Letters Patent, is—

1. A steam-generator comprising a furnace, a horizontal boiler above the furnace-grate, a series of auxiliary boilers and preheaters and means causing the products of combustion from the furnace to flow successively in opposite directions along opposite sides of each of the auxiliary boilers and preheaters, for the purpose set forth.

2. A steam-generator comprising a furnace, a horizontal boiler above the grate thereof, a steam-collector above said horizontal boiler, a series of auxiliary boilers and preheaters and means causing the products of combustion from the furnace to flow successively in opposite directions along opposite sides of each of said auxiliary boilers and preheaters; in combination with a superheater connected with the steam-collector and located in the path of the products of combustion, for the purposes set forth.

3. A steam-generator, comprising a furnace, a horizontal boiler above the grate thereof, a steam-collector above said boiler, a series of auxiliary boilers and preheaters and means causing the products of combustion to flow successively along opposite sides of each of said auxiliary boilers and preheaters; in com-

bination with a superheater in the path of said products of combustion and connected with the steam-collector and means for diverting said products of combustion from said superheater, for the purpose set forth.

4. A steam-generator comprising one or more primary vaporizers in direct contact with a heating medium, a series of interconnected auxiliary vaporizers, a connection between a primary vaporizer and the first auxiliary vaporizer or vaporizers of a series of such, a series of interconnected preheaters and a connection between the last auxiliary vaporizer or vaporizers of the series of such and the first preheater or preheaters of the series of such; in combination with means causing the aforesaid heating medium to flow successively along opposite sides of one or more auxiliary vaporizers and one or more preheaters, in a direction opposite to the direction of flow of the water therethrough, for the purpose set forth.

5. A steam-generator, comprising one or more primary vaporizers in direct contact with a heating medium, a series of vertical auxiliary vaporizing-drums interconnected at their upper ends at different levels, a connection from the higher level of the first auxiliary vaporizer or vaporizers of the series with a primary vaporizer, a series of vertical preheating-drums of less height than the auxiliary vaporizing-drums and connected together at or near their upper ends, and a connection between the last auxiliary vaporizer or vaporizers of the series and the upper end of the first preheater or preheaters of the series of such; in combination with means causing the aforesaid heating medium to flow successively along opposite sides of one or more auxiliary vaporizers and of one or more preheaters in a direction opposite to the flow of water therethrough, for the purpose set forth.

6. A steam-generator, comprising one or more primary vaporizers in direct contact with a heating medium, a steam-collector out of direct contact with the heating medium and connected to said vaporizer or vaporizers, a series of vertical auxiliary vaporizers connected together at their upper ends on different levels, a connection from the higher level of the first auxiliary vaporizer or vaporizers with a primary vaporizer, a series of vertical preheaters of less height than the auxiliary vaporizers and connected together at or near their upper ends, and a connection between the upper end of the last auxiliary vaporizer or vaporizers of the series and the like end of the first preheater or preheaters of the series; in combination with means causing the aforesaid heating medium to flow successively along opposite sides of one or more auxiliary vaporizers and one or more preheaters in a direction opposite to the flow of water therethrough and a superheater in the path of said medium and connected with the steam-collector, for the purpose set forth.

7. A steam-generator, comprising one or

more primary vaporizers in direct contact with a heating medium, a steam-collector out of direct contact with the heating medium and connected to said vaporizer or vaporizers, a series of vertical auxiliary vaporizers connected together at their upper ends on different levels, a connection from the higher level of the first auxiliary vaporizer or vaporizers with a primary vaporizer, a series of vertical preheaters of less height than the auxiliary vaporizers and connected together at or near their upper ends, and a connection between the upper end of the last auxiliary vaporizer or vaporizers of the series and the like end of the first preheater or preheaters of the series; in combination with means causing the aforesaid heating medium to flow successively along opposite sides of one or more auxiliary vaporizers and one or more preheaters in a direction opposite to the flow of water therethrough, a superheater in the path of said medium and connected with the steam-collector and means for diverting the heating medium from said superheater, for the purposes set forth.

8. A steam-generator, comprising a furnace, two horizontal boilers above the furnace-grate, a chamber adjacent to and in communication with said furnace, a series of vertical boilers $A^2 A^3$ arranged in sets of three interconnected at their upper ends, a connection at a higher level between one of the horizontal boilers and two boilers A^2 , vertical preheaters B, B' , of less height than the auxiliary boilers and interconnected at their upper ends, and vertical staggered partitions between the boilers of each set and the chamber-walls to cause the products of combustion from the furnace to flow successively along opposite sides of each set of auxiliary boilers and preheaters in a direction opposite to the flow of water therethrough, for the purpose set forth.

9. A steam-generator, comprising a furnace, two horizontal boilers above the furnace-grate, a steam-collector above and connected with said boilers, a chamber adjacent to and in communication with said furnace, a series of vertical boilers $A^2 A^3$ arranged in sets of three interconnected near their upper ends, a connection at a higher level between one of the horizontal boilers and two boilers A^2 , vertical preheaters B, B' , of less height than the auxiliary boilers and interconnected at their upper ends, and vertical staggered partitions between the boilers of each set and the chamber-walls to cause the products of combustion from the furnace to flow successively along opposite sides of each set of auxiliary boilers and preheaters in a direction opposite to the flow of water therethrough; in combination with a superheater in the path of the products of combustion and connected with the steam-collector, for the purposes set forth.

10. A steam-generator, comprising a furnace, two horizontal boilers above the furnace-

grate, a steam-collector above and connected
with said boilers, a chamber adjacent to and
in communication with said furnace, a series
of vertical boilers A², A³, arranged in sets of
5 three interconnected near their upper ends,
a connection at a higher level between one of
the horizontal boilers and two boilers A², ver-
tical preheaters B, B', of less height than the
auxiliary boilers and interconnected at their
10 upper ends, and vertical staggered partitions
between the boilers of each set and the fur-
nace-walls to cause the products of combustion
from the furnace to flow successively along
opposite sides of each set of auxiliary boilers
15 and preheaters in a direction opposite to the

flow of water therethrough; in combination
with a superheater in the path of the prod-
ucts of combustion and connected with the
steam-collector and means for diverting said
products from said superheater, for the pur- 20
pose set forth.

In testimony that we claim the foregoing
as our invention we have signed our names in
presence of two subscribing witnesses.

LÉON MAHY.
POLYDORE HAILLEZ.

Witnesses:

POLYDORE STOPPELAERE,
FRÉDÉRIC BOONEN.