(No Model.)

D. O. FRANCKE.

WOOD PULP BOILER.

No. 304,092. Patented Aug. 26, 1884.

Fig. 1.

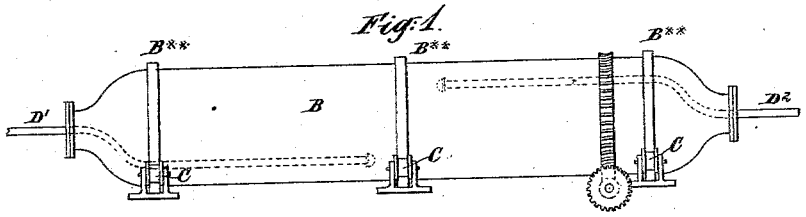


Fig. 2.

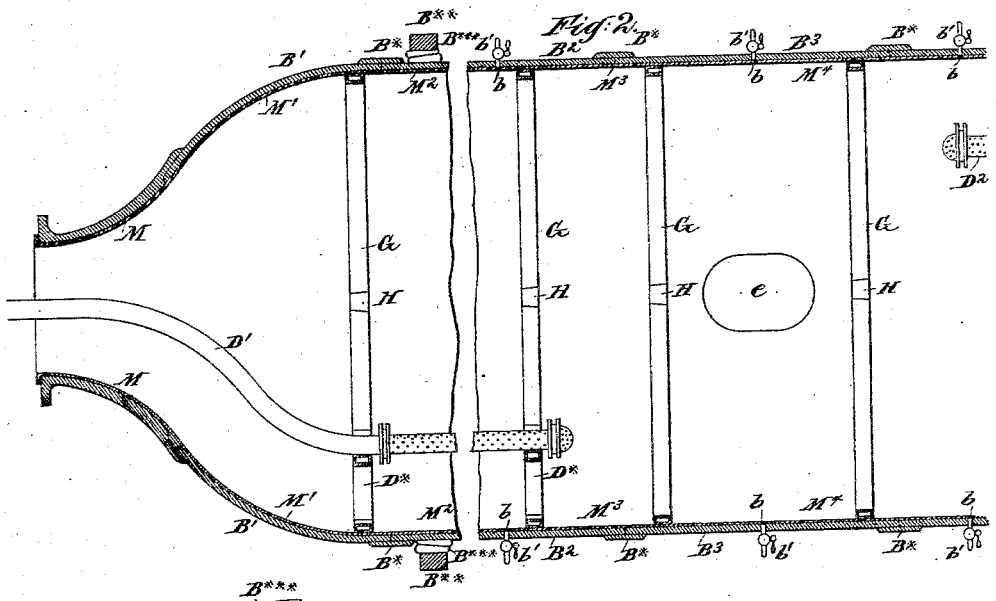


Fig. 3.

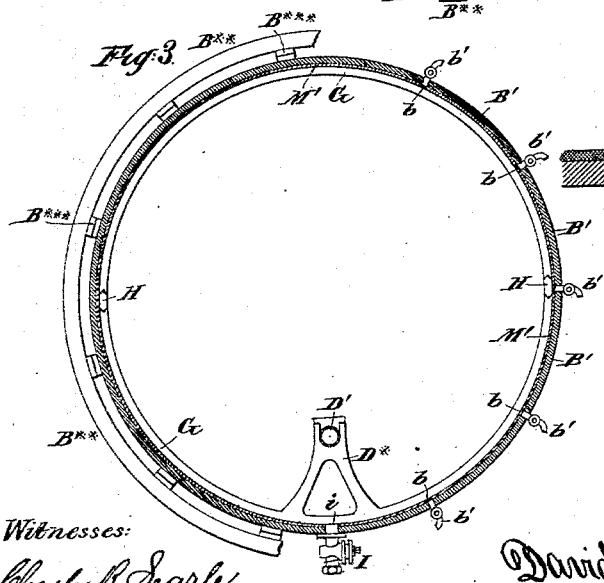
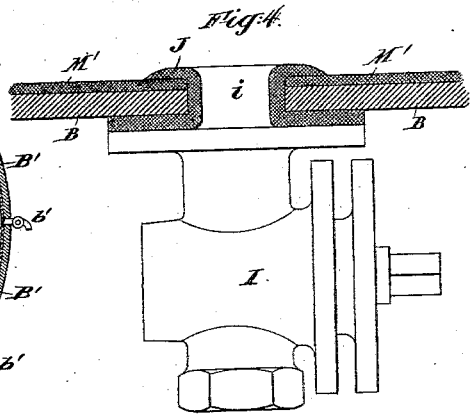


Fig. 4.



Witnesses:

Charles R. Searle.

M. F. Boyle

Inventor:

David Otto Francke

by his attorney Thomas D. Stetson

UNITED STATES PATENT OFFICE.

DAVID OTTO FRANCKE, OF KORNDAL, MÖLNDAL, SWEDEN.

WOOD-PULP BOILER.

SPECIFICATION forming part of Letters Patent No. 304,092, dated August 26, 1884.

Application filed May 22, 1884. (No model.)

To all whom it may concern:

Be it known that I, DAVID O. FRANCKE, of Korndal, Mölndal, Sweden, have invented certain new and useful Improvements in Wood-Pulp Boilers, of which the following is a specification.

The improved apparatus is intended more especially for the reduction of wood to the condition of pulp for paper manufacture; but it may be useful for many analogous purposes.

I have in my experiments treated wood-pulp, using a process set forth in a patent to me dated March 25, 1884, No. 295,865. I will describe the invention as so worked.

Although I use the single term "boiler" to designate my construction, it is, in fact, composed of two separate disconnected thicknesses or independent shells or boilers, one within the other. The innermost is of a material which is unaffected by the solution. I will describe it as lead. The outermost gives strength. I will describe it as iron or steel. By this means I overcome the difficulties incident to the use of ordinary lead linings in iron boilers. In case of a defect in my inner boiler my apparatus reveals the fact instantly and shows approximately the point at which the failure has occurred. I effect the heating of the contents of my boiler by the direct introduction of steam from a boiler at a higher pressure.

The following is a description of what I consider the best means of carrying out the invention.

The accompanying drawings form a part of this specification.

Figure 1 is a side elevation of the entire boiler. Fig. 2 is a longitudinal section of portions of the boiler on a larger scale. Fig. 3 is a corresponding transverse section. Fig. 4 is a partial section and elevation of a detail. It is on a still larger scale.

Similar letters of reference indicate corresponding parts in all the figures where they occur.

The outer shell, B, of the boiler is of steel made in several distinct lengths or sections, (indicated by additional marks, as B' B²,) each united to the next by what is sometimes called a "jump-joint"—that is to say, the edge of one section abuts directly against the edge of an adjacent section, and both sections are secured by riveting, brazing, welding, or other efficient means to an inclosing-ring, B*, of such width as to lap sufficiently upon each section. The inner shell, M, is of thick lead, applied in distinct lengths or sections, (indicated by additional marks, as M' M², &c.,) united along their several edges. The boiler is mainly cylindrical, but the ends are partially spheroidal, terminating in trunnions, (not represented,) which are hollow and equipped with suitable stuffing-boxes and steam-pipe connections leading from one or more boilers, (not shown,) which supply steam at a high pressure.

D' D² are perforated pipes extending from the trunnions inward to points near the center of the boiler, where their ends are each nearly closed by a perforated plate. These pipes allow the steam received through the trunnions to be introduced directly into the contents of the boiler.

Man-holes *e*, properly re-enforced and equipped with strongly-secured covers, allow a man to enter the boiler, when required, to effect repairs; but my invention reduces the liability of the lead to require attention, and in case of failure at any point directs the workman to the point requiring attention. The lead need not be pure. Ordinary lead of commerce will suffice. I prefer that the lead shell have a thickness of about one-quarter of an inch. From some cause, probably the difference in expansion and contraction between the lead shell and the outer shell, the lead shell is likely to fail after a period. One steel shell will outlast many lead shells. When it is required to change the lead-shell, it is cut out and removed through the man-holes or trunnions without difficulty. The introduction of the new shell requires some care, but it can be effected by rolling up the new lead and introducing it through the man-holes and carefully unrolling and fitting to its place and joining the edges. Between the lead M and the steel B is a thin space. The steel shell affords the requisite strength for the entire structure, and the lead shell alone is presented to contact with the contents of the boiler. As heretofore worked, the lead lining of boilers is liable to failure by cracking so minutely as to be difficult of detection, but a small quantity of fluid leaking from the interior of the boiler into the

space between the lead lining and the steel induces great mischief. When the inner lead boiler is made, air will remain between the lead and the steel. When the solution at a high temperature fills the lead boiler, this air expands and after one or two operations breaks the lead M. To avoid this, I provide a great number of small orifices *b* through the steel plate, to connect with the space between the lead and steel boilers, which orifices let out the expanded air as soon as the heat rises inside the lead boilers, instead of breaking the lead. My orifices *b* serve a double purpose. Sooner or later the lead boiler must commence to give way by cracking. This cracking commences so minutely that it is difficult to detect, and the solution or fluid which escapes through these minute cracks would in a short time consume the steel. Steam penetrates easier through these cracks than solution. Consequently when a crack in the lead under the rotation is turned upward, which part of the boiler is empty, the nearest orifice gives or throws out escaping steam, and when turned down shows small drops of solution, in the latter part of the operation, mixed with the dissolved parts of the wood. By close observation of the orifices, when steam from inside the lead has shown itself, there is no difficulty in fixing the whereabouts of the crack within a narrow space. If the steam is from the inside of the lead boiler, it smells of the solution. This it does not do if the escape depends on moisture or air between lead and steel.

G are internal bracing-rings, made each in two pieces, and held distended by wedges H, introduced at the joints. These bracing-rings and wedges are made of a composition—as brass—that will be unaffected by the solution, and which will have a greater expansion and contraction than iron. I take care to envelop each with a thick covering of lead. These internal bracing-rings are arranged about three feet apart. They press outwardly with sufficient force to support the weight of the upper portion of the lead shell when the structure is empty and cold and press it firmly against the interior of the iron or steel shell when it is filled and hot.

The apparatus will serve best when the lead shell is made in a continuous band extending quite around the interior of the boiler, and of the proper width to reach from one of the internal braces G to the next.

The wedges H, which distend the internal braces, G, may be made of considerable length, and, after being driven to set the braces tightly out against the inner face of the lead, their ends should be smoothly cut off by any suitable cutting-instrument. It is important to leave no recesses to form a lodgment for the pulp, as a retention and reboiling of the pulp injures its color, and on mixing such with the next batch will injure the whole.

The steam-pipes D′ D² are supported by brackets D*, extending inward from the internal braces, G. The latter, being made in sections, can be easily removed through the man-holes and new ones introduced and brought to the proper positions when required.

Those portions of the outer steel shell, B, which run upon the supporting-rollers C are thickened by the addition of re-enforcing material on the exterior. I have in my experiments used boilers having a length of forty feet with a diameter of seven feet. Such a boiler complete and fully charged weighs about forty tons. I re-enforce successfully at the supporting-point by rings B**, of cast-iron, made each in a single piece and centered exactly on the boiler by means of wedges B***.

I provide each of the orifices *b* with a stop-cock, *b*′. Under ordinary conditions these cocks *b*′ are all open and each is ready to discharge any fluid, whether hot air, steam, or solution, which may seek to issue through the orifice *b*, which it controls.

I is a sample-cock controlling an orifice, *i*, made at a convenient point in the boiler, and through which small quantities of the contents of the boiler may be drawn from time to time to examine its condition. The surfaces of the cock I which are exposed to the solution are lead. The orifice *i* is re-enforced by a bushing of lead, J, having a head on the inner face and a head on the outer face. The cock is secured by bolts tapped in holes in the steel shell B.

Operation: As the boiler is rotated by mechanism, (not shown,) the contents of the boiler are gently agitated. The proper valves (not shown) being operated, steam at a sufficient pressure is allowed to flow inward through the pipes D′ D². These pipes agitate the contents of the boiler by being traversed through the same as the boiler slowly revolves, and deliver steam through orifices distributed along their whole length. Thus the heat is delivered in the form of steam, mingling directly with the contents of the boiler and imparting all its caloric thereto, rapidly raising the temperature of the boiler until it is very nearly corresponding to that of the steam-pressure employed. The transfer of heat from the steam to the contents of the boiler results in the production of considerable quantities of water due to the condensation of the steam. This water becomes added to the contents of the boiler. It is therefore important at the commencement that the solution be strong, though not stronger than 4½° to 5° Baumé, and not of sufficient quantity to fill the boiler. As the work proceeds, the water, added by the condensation of the steam, increases the volume and weakens the strength of the fluid contents of the boiler. At the close of the operation the boiler will be nearly full. I produce the solution—the acid sulphite of lime—by causing sulphurous acid, fumes to pass up through a tower containing carbonate of lime

kept wetted with water. The sulphurous fumes are absorbed by the water, making the water acidulous, which then attacks the lime, and in trickling down the tower obtains nearly its equivalent of alkali, leaving a just sufficient excess of the acid. This gives the desired acid sulphite of lime for the proper treatment of the woody matter in the boiler.

By the ordinary methods of treating wood with acid sulphite a large quantity of sulphate forms and remains attached to the fibers of the pulp, which sulphate is practically insoluble, and, adhering to the fibers, remains in the pulp. All known methods of extracting it tend to darken the pulp and make it more difficult to bleach. I am not confident as to the precise chemical reactions occurring, but I have discovered that the absence of highly-heated surfaces reduces the evil. I believe the sulphate depends on a high temperature, at some points higher than is necessary, throughout the solution. Such is required to effect the heating by metallic surfaces. My method of heating by direct steam avoids the necessity for any particles being heated much above the mean temperature of the solution. My steam-pipes are liberally perforated, and allow a perfectly free discharge of the steam. My apparatus, by thus avoiding the presence of any surfaces much hotter than the solution, produces a pulp having, when dried, not more than one per cent. of sulphate, while ordinary methods produce pulp holding as high as ten or twelve per cent of the objectionable ingredient.

Lead is of such a nature that even with the care I take to give it expansion and contraction it is still shorter lived than the steel. When a flaw occurs in any portion of the lead lining of sufficient magnitude to induce a visible escape of steam from the nearest stop-cock *b'*, the attendant marks that stop-cock and then closes all the stop-cocks, thus preventing any serious loss of the contents. As soon thereafter as practicable, a workman enters the boiler and, knowing by the marked stop-cock what part of the lead shell is defective, solders or otherwise repairs the defect, introducing a new sheet of lead if required.

I have in my said patent of March 25, 1884, described a boiler having a portion of each end occupied as steam-space with tubes connecting such spaces, and in which steam flowed from one chamber to another. Such apparatus imparted the heat of the steam to the contents of the boiler only through the medium of the metal of the tubes and of the tube-sheets. A portion of the steam was necessarily allowed to escape at the opposite end of the boiler from that through which it was received, in order to maintain the presence of steam on all the surfaces. My present invention, by introducing the steam directly, imparts the heat of the steam fully and effects the heating more rapidly and with less consumption of steam. It also economizes room by dispensing with the considerable steam-spaces at each end and by dispensing with a large proportion of the tube-spaces. It also (and to this I attach the most importance) conveys the heat to the solution directly without being transmitted through metal. It thus avoids the presentation to the pulp of any surfaces materially hotter than itself.

It will be understood that the wood or analogous material to be treated, previously made quite fine by mechanical means, is introduced into the boiler with the solution, so as to fill the boiler about two-thirds full, and then it is heated by the direct application of steam to about 300° Fahrenheit, or somewhat more or less, and rotated slowly from ten to fifteen hours, as set forth in my said patent of March 25, 1884. After being discharged from the boiler, the dissolved material may be removed by washing in a common rag-engine. The pulp may then be either made into paper directly by any ordinary or suitable process, or it may be dried and stored or transported to distant points.

Modifications may be made in the details without departing from the principle or sacrificing the advantages of the invention. The outer boiler or shell, B, may be iron, instead of steel. Certain parts may be used without the whole. I can use the apparatus without the stop-cocks *b'*, thus leaving the orifices *b* always open. I can inject direct steam and effect thereby the efficient heating of the boiler, and with the economy of space and the increase of fluid toward the close and the absence of sulphate due to this mode of operation without my independent lead shell; or I can use the latter without the direct steam. I can employ both without the bends in the pipes, providing other means for gently agitating the contents of the boiler as it revolves, or allowing the boiler to agitate by the simple friction of its smooth inner surface. I prefer the whole as here shown.

I believe the junction of the edges of the lead plates to each other may be effected by autogenous soldering, sometimes termed "burning." I mean a partial melting of the adjacent edges by an oxyhydrogen blow-pipe or a very hot soldering-iron, or both, or by other means of applying intense heat for a brief period along the line of junction. This operation, performed with proper skill, will join the lead together and present a continuous lead surface to the contents of the boiler.

The paper-pulp produced in my boiler at a single operation, as described, is substantially different from any before known to me in the fact that it is not only relatively free from gypsum, but is more easily bleached, and even without bleaching it is of lighter color than any analogous product known to me. It may be used for many purposes requiring white or nearly white paper without bleaching.

I claim as my invention—

1. A boiler having two independent shells,

the outermost of iron or steel and the innermost of a less corrodible metal arranged to expand and contract independently while the outer contributes to sustain the inner, as herein specified.

2. The boiler-shell B, of iron or steel, having vent-holes *b* distributed, as shown, in combination with an independent lining or inner shell of less corrodible metal, arranged to serve as and for the purpose herein specified.

3. A boiler-shell of iron or steel, in combination with an inner shell of less corrodible material, and with stop-cocks *b'*, communicating with holes *b*, distributed in the outer shell, as herein specified.

4. A rotary boiler for paper-pulp and analogous material, having an outer shell, B, an inner shell of less corrodible material, M, and perforated steam-pipes D' D^2, combined and arranged to serve as and for the purposes herein specified.

5. The internal lead-coated braces, G, formed each in two or more pieces, in combination with the lead-coated wedges H, adapted to serve as herein specified.

6. The internal braces, G, and means, as H, for distending them, in combination with each other, and with the lead shell M and exterior perforated shell, B, arranged for joint operation, as herein specified.

7. In a paper-pulp boiler, the sample-cock I, presenting only lead surfaces to the fluid controlled thereby, in combination with the steel shell B and lead shell M, and with the lead bushing J, arranged for joint operation, as herein specified.

8. The revolving boiler B, outer rings, B**, and wedges or intermediate parts, D***, in combination with each other, and with supporting-rollers C, arranged for joint operation, as herein specified.

9. The method described of treating wood and analogous material with an acid solution for manufacturing paper-pulp by subjecting it to gentle agitation in a solution of proper strength, and applying direct steam so as to heat the solution without presenting surfaces of materially higher temperature, substantially as herein specified.

10. The method described of producing pale and easily-bleachable paper-pulp from wood or analogous material relatively free from gypsum by an acid solution at a single operation by agitating with steam at high pressure admitted directly, substantially as herein specified.

11. The product described, to wit: the paper-pulp produced by acid sulphite from wood of good color and without gypsum, as herein specified.

In testimony whereof I have hereunto set my hand, at Korndal, Mölndal, Sweden, this 28th day of April, 1884, in the presence of two subscribing witnesses.

D. O. FRANCKE.

Witnesses:
CARL MARTEN,
AUG. BERNANDE.