O. MANTIUS.

EVAPORATOR.

APPLICATION FILED MAR. 13, 1908.

1,054,926.

Patented Mar. 4, 1913.

2 SHEETS—SHEET 1.

Fig. 1

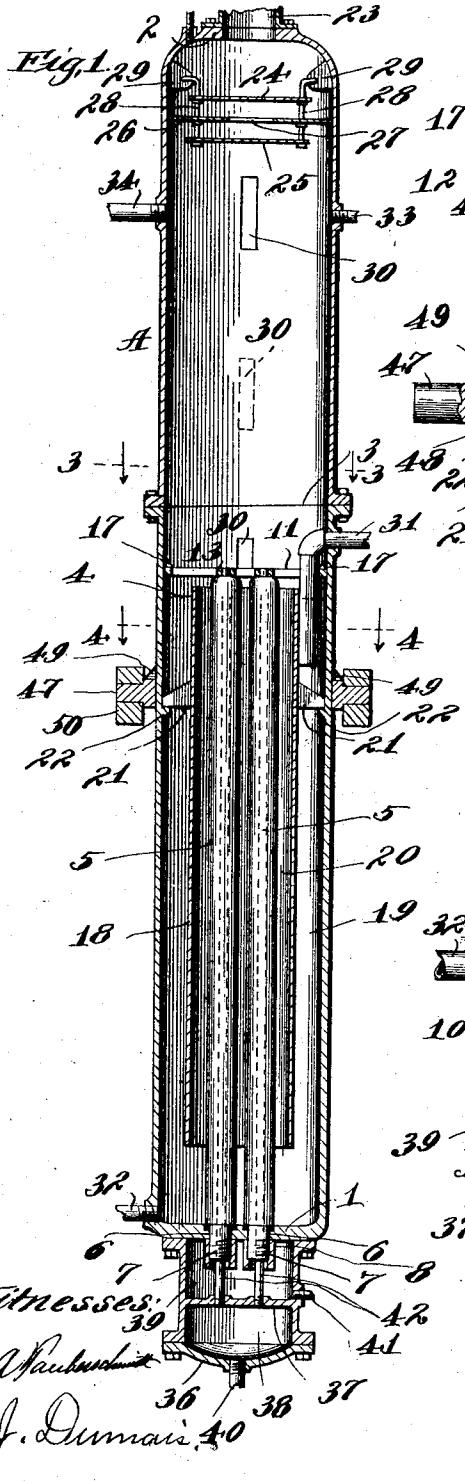
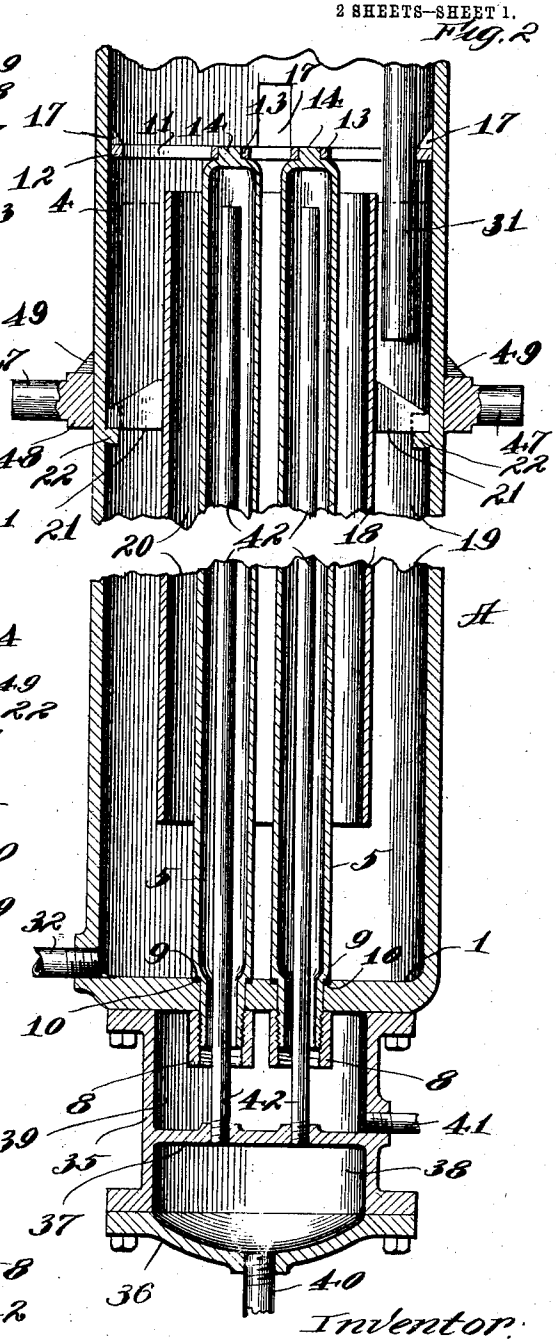


Fig. 2



Witnesses:

G. A. Faulkner

L. J. Dumais

Inventor:

Otto Mantius,

By Chas. E. Waldo,

Atty

O. MANTIUS.

EVAPORATOR.

APPLICATION FILED MAR. 13, 1908.

1,054,926.

Patented Mar. 4, 1913.

2 SHEETS—SHEET 2.

Fig. 3.

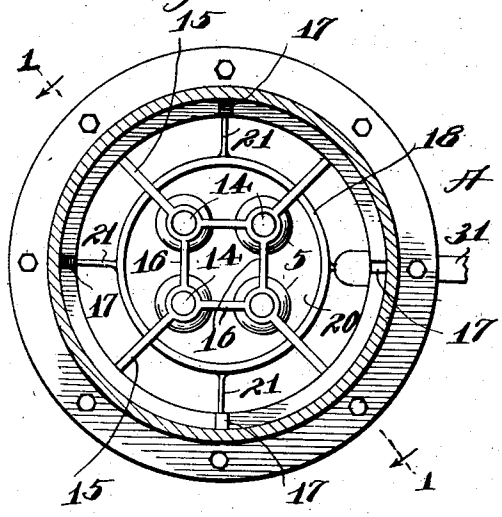


Fig. 5.

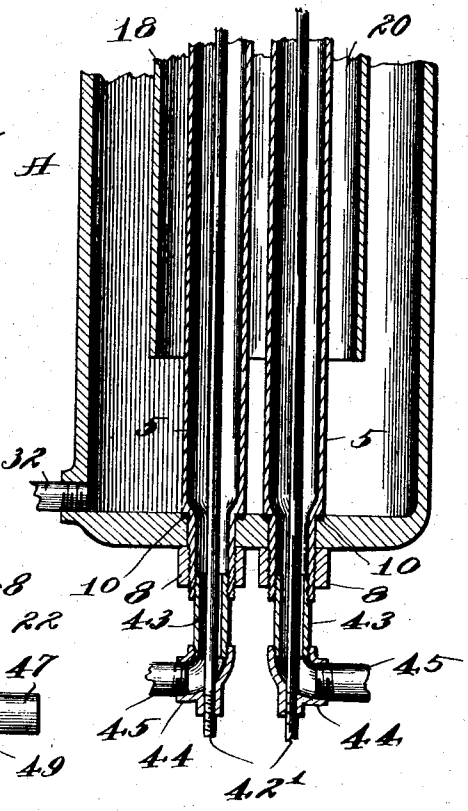
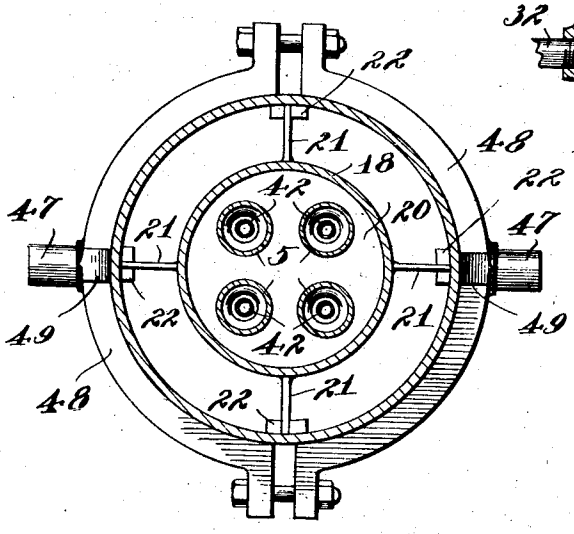


Fig. 4.



Witnesses:

G. A. Rauberschmidt

L. J. Dumais.

Inventor:

Otto Mantius.

By Gus. E. Waldo.

Atty

UNITED STATES PATENT OFFICE.

OTTO MANTIUS, OF CHICAGO, ILLINOIS, ASSIGNOR TO ZAREMBA COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF MAINE.

EVAPORATOR.

1,054,926. Specification of Letters Patent. Patented Mar. 4, 1913.

Application filed March 13, 1908. Serial No. 420,814.

To all whom it may concern:

Be it known that I, OTTO MANTIUS, a subject of the Emperor of Germany, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Evaporators, of which the following is a specification.

This invention relates to evaporators and relates particularly to evaporators especially designed and adapted for the high concentration of solutions of caustic soda, caustic potash and other strong alkaline solutions.

As is well known, the high concentration of strong alkaline solutions can only be effected at high temperatures, say 230 degrees F., in a high vacuum, corresponding to a steam pressure in the evaporator of substantially 100 pounds. As is also well known, strong alkaline solutions rapidly attack and corrode steel, wrought iron, brass, &c., the corroding action thereof increasing with the temperature and the degree of concentration. Experience shows, however, that cast iron, having a continuous and very hard surface or scale is attacked very little under conditions which would soon destroy either steel, wrought iron or brass.

Among the objects of the invention are, therefore, to provide an evaporator the surfaces of which exposed to the action of the liquor being treated consist of cast iron having continuous hard surfaces or scales; to eliminate to the greatest extent possible all joints in the parts of the evaporator exposed to the action of the material being treated, particularly at points below the liquor level; and to provide for using heating tubes sufficiently strong to withstand the high steam pressure to which they will be subjected in use and supported in such manner that their connections to their supports will be unaffected by the pressure to which they are subjected, and so constructed that said joints may be readily tightened by means accessible outside of the evaporator.

A further object of the invention is to provide an evaporator adapted for the high concentration of alkaline solutions constructed and arranged to create a liquor circulation in the evaporator, the circulation being of high velocity along the heating surfaces of the evaporator.

To effect the foregoing objects, an evaporator of my invention comprises the various features, combinations of features and details of construction hereinafter described and claimed.

In the accompanying drawings, in which my invention is fully illustrated—Figure 1 is a vertical central section of my improved evaporator taken substantially on the line 1—1 of Fig. 3. Fig. 2 is an enlarged view, similar to Fig. 1, of the lower end of my improved evaporator. Figs. 3 and 4 are enlarged plan sections taken substantially on the lines 3—3 and 4—4, respectively, of Fig. 1; and Fig. 5 is an enlarged view similar to Fig. 1, showing a modified form of my improved evaporator.

Referring now to the drawings, A designates, as a whole, the shell or casing of the evaporator, consisting, as shown, of a vertically disposed cylinder the height of which is relatively much greater than its diameter, desirable dimensions in practice being,—height from 12 to 16 feet, diameter 18 to 48 inches. The ends of the shell or casing A are closed by means of heads 1 and 2, preferably formed integral with the side walls thereof, and to provide access to the interior of said shell or casing and for casting the same, it is made in two separate sections connected together by a suitable transverse joint 3, the relative lengths of the sections of said shell or casing being preferably such that the joint 3 will be above the liquor level in said evaporator, indicated by the dotted line 4.

The heating tubes 5 extend lengthwise of the shell or casing A and are grouped at the center thereof so as to leave relatively wide spaces at the sides of said shell or casing. Said heating tubes are supported in the following manner:—Formed in the lower head or end 1 of the shell or casing A in proper position, are holes or openings 6 to which are fitted the reduced lower ends 7 of the heating tubes 5 and threaded to the ends of said reduced end portions 7 outside of the head or end 1 of said shell or casing, are nuts 8. The joints between the shoulders 9 on the heating tubes 5 and the head or end 1 of the shell or casing, are packed by means of suitable gaskets 10 which may be made of any suitable material, as lead, a mixture of asbestos and rubber, or the like, which will resist the action

of the solution undergoing treatment. In case of leakage in these joints, they may be readily and conveniently rendered tight by merely setting up the nuts 8. The heating tubes 5 are open at their lower ends for reasons presently described.

To prevent lateral movement of the upper ends of the heating tubes 5, which would soon cause the joints at the connections of said heating tubes to the lower head 1 of the evaporator casing A to open and leak, means are provided for securing or holding the upper ends of said tubes rigidly in position. As shown, said means consist of a spider, indicated as a whole by 11, comprising an outer ring 12, which fits closely into the interior of the evaporator casing A, and a plurality of centrally disposed thimbles 13 adapted to fit over projections 14 on the upper ends of the heating tubes 5, respectively, said outer ring 12 and thimbles 13 being connected into a rigid, unitary structure by arms 15 and 16. Said spider 11 rests loosely upon the projections 14 and is held in position, when the evaporator is assembled, by lugs 17 on the inner surface of the casing A.

Supported within the casing A of the evaporator and surrounding the heating tubes 5, is a baffle 18 of such length and so positioned that it will extend from a point a short distance, say from nine inches to one foot, above the lower end of the evaporator casing upwardly to a point slightly above the liquor level 4. Said baffle is smaller than the casing, thus leaving a space 19 between said baffle and the sides of said casing which will be in open communication with the space 20 within said baffle adjacent to the lower end of the evaporator casing. The space 20 within said baffle 18 will thus form a passageway for the upward circulation of the liquor as it becomes heated by contact with the heating tubes 5 and the space 19 will form a downtake for the downward circulation of the liquor discharged from the upper end of the baffle 18 in the operation of the evaporator.

In cross section, the area of the passageway 20 will be much smaller than that of the space 19, thus providing for a much higher liquor velocity upwardly along the heating tubes than downwardly in the downtake 19, it being found in practice that much higher efficiency is attained with a high liquor velocity when in contact with the heating surfaces and consequently much greater economy in the operation of the evaporator. The size of the baffle 18 may be varied to provide any desired relation between the passageways 19 and 20, to meet varying conditions and requirements or as opinions may differ as to the proper relation, the smaller the relative size of the passageway 20 the higher the liquor velocity therein, and vice versa.

As shown, the baffle is supported by arms or projections 21 thereon, the ends of which rest in notched seats formed in projections 22 formed on the inner surface of the evaporator casing A. The position of the baffle 18 within the casing A is defined by contact of the ends of the arms 21 with the side of the casing A or with rigid portions of the projections 22. The casing A is provided in its upper end 2 with a vapor outlet 23 and to prevent entrainment of the liquor with the current of vapor passing out through the vapor outlet 23, a suitable baffle is provided, consisting, as shown, of upper and lower plates 24 and 25, smaller in diameter than the interior of the casing A and an intermediate plate 26 of substantially the same size as the interior of the casing A and having a central opening 27, said plates being spaced apart and hung on rods 28 suspended from lugs 29 on the inner surface of the evaporator casing. The evaporator casing A is also provided with usual peep holes 30; a liquor inlet pipe 31 preferably directed downwardly in the liquor circulation downtake or space 19; a liquor outlet 32, which preferably communicates with the interior of the casing at the extreme lower end thereof; a vacuum break 33; and a water connection 34 to provide for washing out the evaporator. All of the features last enumerated are old and well known in the art and may be of any desired or approved construction.

As shown in Figs. 1 and 2 the steam connections of my improved evaporator are as follows:—Secured to the lower head or end 1 of the evaporator casing is a drum 35, the lower end of which is closed preferably by a removable head 36 and the interior of which is divided by a transverse partition 37 into closed compartments 38 and 39. The lower compartment 38 forms the steam chest of the evaporator and communicating therewith is a pipe 40 adapted for connection with a suitable source of steam supply, not shown. The upper compartment 39 of the drum 35 is in open communication with the interiors of the heating tubes 5 and forms a settling chamber for condensed water, &c., which escapes therefrom through a drain pipe 41, which, in use, will be provided with a high pressure steam trap, not shown. Secured in the partition 37 are steam pipes 42, the lower ends of which are in open communication with the steam chest 38 and which extend upwardly within the heating tubes 5, preferably to within a short distance of their upper ends. The steam will thus enter the upper ends of said heating tubes and its course will be downwardly therein, gradually giving up its heat to the liquor contained in the evaporator as it de-

scends. The upper ends of said heating tubes will thus be heated to the highest degree, the temperature thereof falling gradually toward their lower ends, a relation which will produce the best possible liquor circulation, as the liquor passing upward through the baffle 18 will always be entering what may be termed zones of higher temperature from which the radiation will be more rapid.

The modified form of construction shown in Fig. 5, which I will now describe, relates merely to a modified form of steam connection, other parts of the evaporator being the same in construction as heretofore described and being indicated by the same reference characters. As shown in said Fig. 5, the steam connections to the evaporator are as follows:—Connected to the lower ends of the heating tubes 5 outside of the evaporator casing A, as by means of nipples 43, are side-outlets 44, secured in the lateral openings of which are drain pipes 45, which will preferably communicate with a high pressure steam trap, not shown, as in the construction heretofore described. Secured in the other openings of said connections 44, as nearly as practicable in axial alinement with the heating tubes 5, are the steam pipes 42^1. As shown said steam pipes 42^1 are screw threaded into said openings and project outside of the same to provide for making steam connections directly thereto.

With the construction shown in Fig. 5, any leakage in the joints connecting the heating tubes 5 with the lower end or head of the evaporator casing A can be at once detected and said joints rendered tight by setting up the nuts 8, without disconnecting any part of the evaporator.

With the construction shown in Figs. 1 and 2, leakage in the joints around the heating tubes could only be detected by the presence of alkali in the water discharged from the drain pipe 41 or by removing the drum 35 and making an examination and, in either case, to tighten said joints would involve detaching the drum 35 in order to tighten the nuts 8.

With an evaporator constructed as described, it is obvious that all of the interior surfaces of the evaporator exposed to the action of the liquor being treated will be continuous and hard so as to resist to the utmost the corroding action of the liquor being treated, with the exception of the joints at the lower ends of the heating tubes 5, which are protected by the gaskets 10, and the joint 3 between the sections of the evaporator casing A, which, as stated, is preferably located above the liquor level 4. All pipe connections exposed to the action of the liquor will be of extra heavy wrought iron.

My improved evaporator may be supported in any desired manner. As shown it is indicated as mounted on trunnions 47 formed on a ring 48 clamped around the body of the evaporator, the position of which is defined by lugs 49 on the evaporator casing A. The trunnion bearings may be formed in any suitable fixed support indicated at 50. Trunnion bearings are primarily for convenience in removing and replacing the parts of the evaporator inclosed within the casing A, particularly the heating tubes 5 and the baffle 18. Where the space above and below the evaporator is sufficient to permit the various parts to be removed and replaced vertically, the evaporator may be mounted permanently in vertical position. When trunnion bearings are used, as indicated, means are provided for locking or securing the evaporator in vertical position. As said means are in no way related to the present invention, they are not shown.

I claim:—

1. An evaporator for effecting high concentration, comprising an upright shell or casing 12 feet long, as a minimum, and having a diameter substantially equal to $\frac{1}{3}$ of its length, as a maximum, upright heating tubes mounted in the lower end of said shell or casing the length of which is substantially equal to $\frac{1}{2}$ of the length of said shell or casing, as a minimum, and a baffle supported within said shell or casing and which defines a passageway upwardly among said heating tubes on one side thereof, and a down-take on the other side thereof, the lower end of said baffle terminating above the bottom of the shell or casing and its upper end terminating substantially on a level with the upper ends of said heating tubes, substantially as described.

2. An evaporator for effecting high concentration comprising an upright shell or casing 12 feet long, as a minimum, and having a diameter substantially equal to $\frac{1}{3}$ of its length, as a maximum, upright heating tubes mounted in the lower end of said shell or casing the length of which is substantially equal to $\frac{1}{2}$ of the length of said shell or casing, as a minimum, and a baffle supported within the said shell or casing and which defines a passageway upwardly among said heating tubes on one side thereof, and a down-take on the other side thereof, the lower end of said baffle terminating above the bottom of the shell or casing and its upper end terminating substantially on a level with the upper ends of said heating tubes, the area in cross section of the upward passageway defined by said baffle being substantially $\frac{1}{3}$ of the area in cross section of the shell or casing, as a maximum, substantially as described.

3. An evaporator for effecting high concentration, comprising an upright shell or casing substantially fourteen feet long and

2½ feet in diameter, upright heating tubes mounted in the lower end of said shell or casing substantially 8 feet in length, and a baffle within said shell or casing and which defines a passageway upwardly among said heating tubes on one side thereof, and a down-take on the other side thereof, the lower end of said baffle terminating above the bottom of the shell or casing and its upper end terminating substantially on a level with the upper ends of said heating tubes, substantially as described.

4. An evaporator for effecting high concentration, comprising an upright shell or casing substantially 14 feet long and 2½ feet in diameter, a central group of upright heating tubes mounted in the lower end of said shell or casing, said heating tubes being substantially 8 feet long, and a baffle substantially 1½ feet in diameter supported within said shell or casing and which surrounds said group of heating tubes, the lower end of said baffle terminating above the bottom of the said shell or casing and its upper end extending substantially level with the upper ends of said heating tubes, substantially as described.

5. An evaporator for effecting high concentration, comprising an upright cast iron shell or casing substantially 12 feet long, as a minimum, and having a diameter substantially equal to ⅓ of its length, as a maximum, upright cast iron heating tubes mounted in the lower end of said shell or casing the length of which is substantially equal to ½ of the length of said shell or casing, as a minimum, and a cast iron baffle supported within said shell or casing and which defines a passageway upwardly among said heating tubes on one side thereof, and a down-take on the other side thereof, the lower end of said baffle terminating above the bottom of the shell or casing and its upper end terminating substantially on a level with the upper ends of said heating tubes, the scale on the surfaces of said shell or casing, heating tubes and baffle exposed to contact with the liquor or substance undergoing treatment being practically unbroken.

6. An evaporator comprising a shell or casing, heating tubes therein an end of each of which projects through and is rigidly secured in the lower end of said shell or casing, the ends of said heating tubes which project outside of said shell or casing being open and their inner ends being closed, means for supporting the upper ends of said heating tubes against lateral movement, said means consisting of a spider comprising a ring fitted to the interior of the shell or casing, thimbles and arms which connect said ring with said thimbles, and projections on the upper ends of said heating tubes which engage said thimbles.

7. An evaporator comprising a shell or casing, heating tubes therein an end of each of which projects through and is rigidly secured in the lower end of said shell or casing, the ends of said heating tubes which project outside of said shell or casing being open and their inner ends being closed, means for supporting the upper ends of said heating tubes against lateral movement, said means consisting of a spider comprising a ring fitted to the interior of the shell or casing, thimbles and arms which connect said ring with said thimbles, projections on the upper ends of said heating tubes which engage said thimbles and lugs on the inner surface of the shell or casing of the evaporator which hold said spider in engagement with said projections.

In testimony, that I claim the foregoing as my invention, I affix my signature in presence of two subscribing witnesses, this 4th day of March, A. D. 1908.

OTTO MANTIUS.

Witnesses:
K. A. COSTELLO,
M. V. MCGRATH.