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W. D. MOUNT

CAUSTICIZING UNIT

Filed Oct. 16, 1922

Fig. 1.

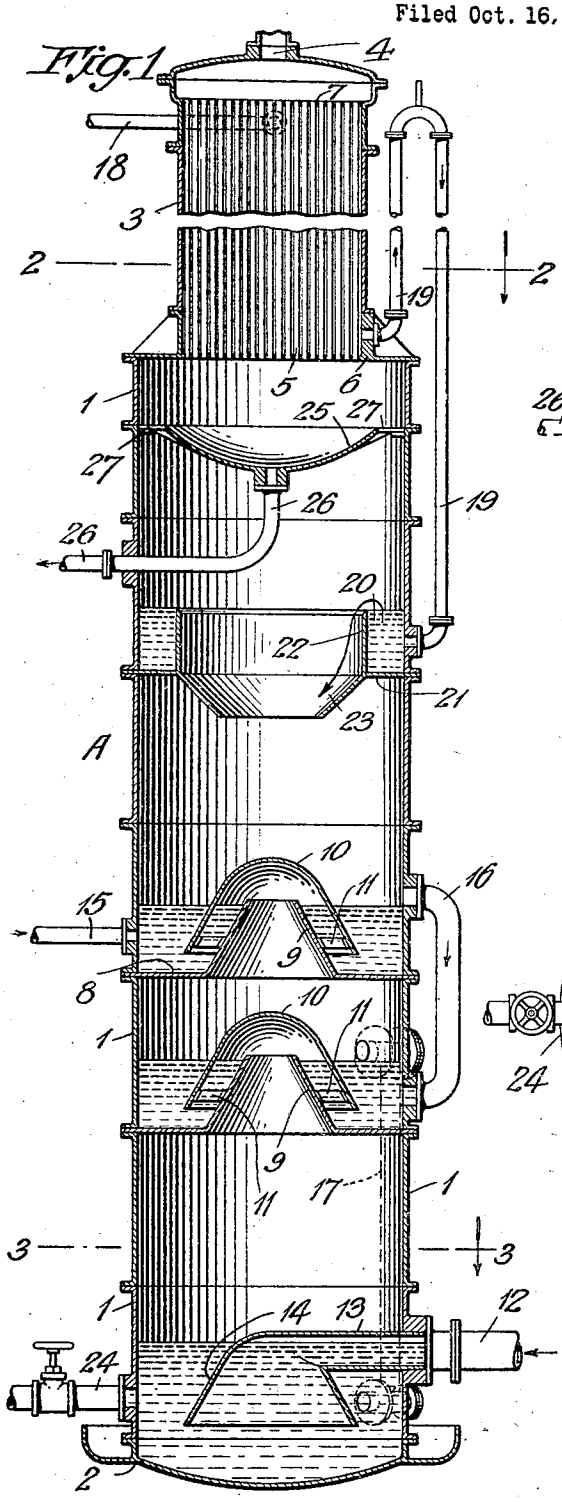



Fig. 2.

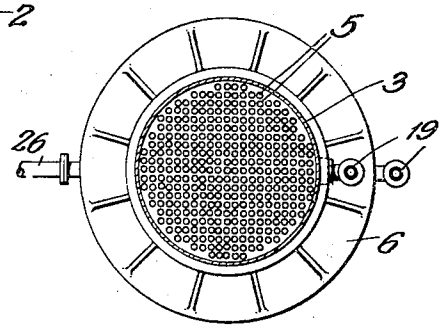
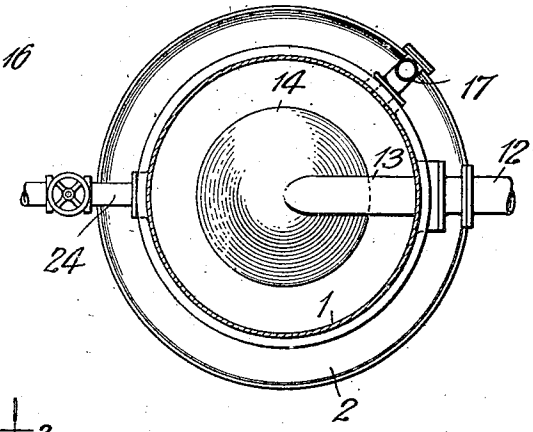



Fig. 3.




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# UNITED STATES PATENT OFFICE.

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## CAUSTICIZING UNIT.

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This invention relates to the art of causticizing, and particularly to improved apparatus by which the operation may be carried on continuously. In such an operation the reacting chemicals are introduced, heated, and agitated such as by forcing a heated gas through the mixture of chemicals. In causticizing apparatus commonly heretofore in use, the causticizing operation is carried out in tanks usually equipped with a mechanical mixer or agitator. The lime is placed in cages within the tanks and immersed in the green liquor contained therein and which came from the dissolving or leaching tanks. Steam is admitted to the liquor in the causticizing tanks to add heat to the solution and also supplement to some extent the mixing and agitation of the liquor, which is caused by the mechanical agitator or mixer. In order to obtain the maximum efficiency in the chemical reaction, it is essential that the proper proportions of liquor strength and lime be used and maintained. In the prior devices the efficiency of the operation has not been high nor the results uniform because it has been impossible to obtain a perfect mixture of the lime and liquor in the proper proportions, and the steam consumption is relatively high.

An object of this invention is to provide a continuously operating causticizing unit which can be operated more efficiently and economically than prior units; which for a corresponding capacity is considerably smaller in size; which can be operated for considerably longer intervals without trouble from accumulations of the precipitated carbonate; and which is comparatively simple and inexpensive in construction.

Another object is to provide improved apparatus for the causticizing operation, with which the operation may be carried on continuously and more efficiently and economically than heretofore, and which will require minimum floor space and operating attention for maximum output.

Other objects and advantages will be apparent from the following description of an embodiment of the invention and the novel features will be hereinafter particularly pointed out in claims.

In the accompanying drawings:

Fig. 1 is a sectional elevation through a unit constructed in accordance with this invention;

Fig. 2 is a transverse section through the same taken substantially along the line 2—2 of Figure 1; and

Fig. 3 is a section through the same taken substantially along the line 3—3 of Figure 1.

In the illustrated embodiment of the invention, a vertical tower or casing A is built of superimposed cylindrical sections 1 which are mounted upon a suitable pan or plate 2. A casing 3 is superimposed upon and closes the top of the tower or casing A and has a vent 4 at its upper end. A plurality of pipes 5 pass lengthwise through the casing and are mounted in and pass through the lower wall 6 and a transverse partition 7 at the upper end portion of the casing 3, so that communication between the interior of the casing A and the vent 4 is through the pipes 5 of the casing 3.

Between a number of the adjoining lower sections 1 of the casing A, a plurality of plates or partition walls 8 are clamped so as to extend transversely into the interior of the casing A. Each wall 8 is centrally apertured, and adjoining the aperture, is flanged upwardly as at 9, so as to form between it and a casing section an annular reaction pan. A dome or inverted shell 10 is mounted over each flange 9 so that the lower edge of the dome or shell will extend down into the annular pan between the upper end of the flange and the bottom or transverse portion of the wall. The dome or shell may be secured in spaced relation to the flange 9 in any suitable manner such as by brackets 11 connecting the dome to the flange 9.

In the bottom portion of the casing A a conduit 12 has an extension 13 into the interior of the casing which terminates in a downwardly flaring bell 14. One of the reacting chemicals, such as lime in the form of milk of lime, is introduced by a pipe 15 into the uppermost annular pan formed by a partition 8. An overflow pipe 16 conducts the reacting mixture from the uppermost annular reacting pan into the next lower pan before it overflows through the central passage formed by the flange 9. A similar overflow 17 removes the reacting mixture from this next lower reaction pan into the pan formed by the closed bottom of the casing A just before it overflows through the central aperture.

A pipe 18 conducts one of the chemicals, such as a solution of the carbonate of soda, into the upper end of the casing 3 between the partition wall 7 and the lower wall 6 and

surrounding the pipes 5. An outlet pipe 19 opens into the chamber of the casing 3 surrounding the pipes 5 at a point near the lower end thereof and rises to a height equal to that of the chamber surrounding the pipes 5 and then passes downwardly and discharges into an annular pan 20 formed around the interior of the casing A at a short distance above the uppermost reaction pan. The annular pan 20 may be conveniently formed by a partition plate 21 which is interposed between two of the casing sections 1 and has an upturned annular flange 22 which, with the inner peripheral wall of a casing section, forms the side walls of the annular pan 20. A flange 23 extends from the inner periphery of the flange or wall 22 convergingly and downwardly so that the solution of sodium carbonate in the annular pan 20 in overflowing over the upper edge of the wall 22 will be deflected as a peripherally continuous conical sheet upon the dome 10 of the uppermost reaction pan.

The mixture in which the reaction is complete is removed from the lowermost pan in the bottom of the unit through a suitable pipe 24, and reduced to a marketable condition in the usual manner.

A tray or pan 25 is supported across the interior of the casing A below the lower ends of the pipes 5. A pipe 26 connects with the bottom of the pan or tray 25 and passes through a wall of the casing A. The tray 25 is smaller in diameter than the interior of the casing A and is supported at its periphery from the casing by spider arms 27 so that there will be a passage between opposite faces of the pan or tray 25 around the periphery thereof through which the hot gas such as steam and air may pass to the pipes 5.

In the manufacture of caustic soda with such a unit, the sodium carbonate, which may be a solution of soda-ash, is introduced by the pipe 18 into the interior of the casing 3 surrounding the pipes 5. This solution passes downwardly through the casing 3 and out through the pipe 19, rising to a height substantially equal to the height of the chamber in the casing 3 and then downwardly into the annular pan 20. The rise of the pipe 19 serves to keep the chamber in the casing 3 surrounding the pipes 5 filled at all times to a height substantially equal to that of the upper end of the pipe 19.

From the annular pan 20, the solution of sodium carbonate overflows and falls as a peripherally continuous, inverted, conical sheet upon the dome 10 of the uppermost reaction pan. At the same time, lime, such as milk of lime, is conducted into the uppermost reaction pan by the pipe 15. The mixture overflows through the pipe 16 into the next lower reaction pan and then overflows therefrom through the pipe 17 into the reaction pan in the bottom of the casing of the unit.

At the same time, air or steam, preferably a mixture of both, is forced through the pipes 12 and 13 into the inverted bell 14, the lower edge of which is below the normal upper level of the liquid in the bottom pan. The steam and air will escape from the bell 14 around the lower edge thereof and bubble up through the liquid in the lower pan and pass upwardly through the central passage formed by the flange 9 of the next higher reaction pan into the interior of the dome 10 of that pan. The steam or air then passes downwardly through the annular reaction pan in the space between the dome and the flange 9 and escapes along the lower edge of the dome 10 and bubbles up through the contained reacting solutions. The steam and air escaping from this reaction pan pass upwardly through the passage formed by the flange 9 in the next higher reaction pan into the chamber in the dome 10 of that pan. The air and steam then pass downwardly into the interior of that pan in the space between the flange and the casing wall thereof and bubble up through the reacting liquid in that pan.

The escaping steam and air then pass through the descending sheet of sodium carbonate solution and through the aperture in the flange 23, and continue upwardly around the periphery of the tray 25. The steam and air then pass upwardly through the pipes 5 to the vent 4. The steam and air being successively bubbled through the reacting solutions, will both agitate and heat the same and insure a complete mixing and reaction of the sodium carbonate and lime. The heat also expedites the reaction between the lime and sodium carbonate.

When soda-ash is utilized as the source of the sodium carbonate it may contain a small proportion of sodium sulphide, and the air converts this sodium sulphide into sodium thiosulphate and sulphate as expressed in the equation:

$$2Na_2S + H_2O + 4O = 2NaOH + Na_2S_2O_3.$$

The thiosulphate is afterwards destroyed by oxidizing it to the sulphate. Any precipitates which may be formed will be carried in suspension from pan to pan into the lowermost pan, from which the solution of caustic soda and suspended precipitate are removed through the pipe 24. The precipitate is then separated from the solution of caustic soda in any suitable manner and the caustic soda is concentrated. The steam and the moisture carried by the escaping air in passing through the pipes 5 to the vent 4 will be condensed by a heat interchange through the pipes 5 with the ingoing sodium carbonate solution. The condensed steam and moisture will then drop into the pan or tray 25 and be conducted out of the unit through the pipe 26. In this manner the condensed steam and moisture will not dilute the reacting solutions.

In view of the fact that the solution

of sodium carbonate passes downwardly through the casing 3 and around the pipes 5 in a direction counter to the direction of travel of the steam and air through the pipes 5, a maximum possible heat interchange will be effected, the carbonate solution being heated as the steam and moisture are cooled, with the result that practically no steam or moisture will escape through the vent 4. The conical sheet of the sodium carbonate solution which is produced by the action of the flange 23 upon the overflow from the pan 20 will limit spattering of the reacting liquids in the uppermost annular reaction pan. With this construction the number and size of reaction pans can be very greatly reduced such as from nine to two or three, without lessening the capacity of the unit, and a more economical and efficient operation is secured.

It will be understood that if desired, the lime could be introduced through the pipe 18 and the sodium carbonate introduced through the pipe 15 without departing from the principle and scope of the invention, although more satisfactory results are obtained in introducing the carbonate through the pipe 18. The unit, while particularly adapted for and advantageous in the production of caustic soda, could obviously be utilized in effecting the reaction between other chemicals where similar conditions are encountered.

It will be understood that various changes in the details and arrangements of parts herein described and illustrated for the purpose of explaining the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim:

1. In a causticizing unit, a casing, connections thereto by which one chemical may be passed through the casing, means for admitting the second chemical to the moving body of the first chemical, means for bubbling a hot gas through the moving mixture of chemicals to heat and agitate the mixture, and a heat interchange unit through one part of which the exhaust gas passes and through the other part of which one of the ingoing chemicals passes out of direct contact with the exhaust gas so as to be heated preliminarily thereby.

2. In a causticizing unit, a casing, connections thereto by which one chemical may be passed through the casing, means for admitting the second chemical to the moving body of the first chemical, means for bubbling a hot gas through the moving mixture of chemicals to heat and agitate the mixture, a heat interchange unit through one part of which the exhaust gas passes and through the other part of which one of the ingoing chemicals passes out of direct contact with the exhaust gas so as to be heated preliminarily thereby, and means for preventing condensate from the exhaust gas in the interchange unit from mixing with the re-acting chemicals.

3. In a causticizing unit, a casing, connections thereto by which one chemical may be passed through the casing, means for admitting the second chemical to the moving body of the first chemical, means for bubbling a hot gas through the moving mixture of chemicals to heat and agitate the mixture, and means for effecting an indirect heat interchange between the exhaust gas and one of the ingoing chemicals to preliminarily heat the latter by the otherwise wasted heat of the exhaust gas.

4. In a causticizing unit, a casing, connections thereto by which one chemical may be passed through the casing, means for admitting the second chemical to the moving body of the first chemical, means for bubbling a hot gas through the moving mixture of chemicals to heat and agitate the mixture, means for effecting an indirect heat interchange between the exhaust gas and one of the ingoing chemicals to preliminarily heat the latter by the otherwise wasted heat of the exhaust gas, and means for preventing return of the condensate from the exhaust gas in the heat interchange means to the re-acting chemicals.

5. In a causticizing unit, a vertical tower casing, means for passing openly therethrough a solution of one of the chemicals, means for adding the other chemical to the first chemical, means for bubbling a hot gas through the moving mixture to heat and agitate the same, a second casing through which one of the ingoing chemicals is passed before mixing with the other chemical, pipes passing through the second casing, through which pipes the exhaust gas passes, and means for collecting the condensate occurring in said pipes to prevent its return to and resulting dilution of the mixture.

6. In a causticizing unit, a vertical tower casing, means for passing openly therethrough a solution of one of the chemicals, a second casing at the top of the tower casing, means for admitting the other of the chemicals to the upper end of the casing, pipes passing through the second casing, means for removing the said other of the chemicals from the second casing at a point adjacent the lower end thereof, carrying it upwardly for a distance sufficient to maintain a desired level of the chemical in the second casing, and for then discharging it into the chemical passing through the casing, and means for bubbling a hot gas through the moving mixture to heat and agitate the same, the exhaust gas passing upwardly through the pipes in the second casing to heat the ingoing chemical.

7. In a causticizing unit, a vertical tower casing, means for passing openly therethrough a solution of one of the chemicals, a second casing at the top of the tower casing, means for admitting the other of the chemicals to the upper end of the casing, pipes pass-

ing through the second casing, means for removing the said other of the chemicals from the second casing at a point adjacent the lower end thereof, carrying it upwardly for a distance sufficient to maintain a desired level of the chemical in the second casing, and for then discharging it into the chemical passing through the casing, means for bubbling a hot gas through the moving mixture to heat and agitate the same, the exhaust gas passing upwardly through the pipes in the second casing to heat the ingoing chemical, and a pan supported below the pipes for collecting condensate from the exhaust gas in the pipes so as to prevent its return into the mixture to dilute the same.

8. In a causticizing unit, a casing, means for passing openly therethrough a solution of one of the chemicals, means for bubbling therethrough a hot gas to heat and agitate the same, a device supported above the body of the chemical in the casing with a funnel shaped passage therein through which the exhaust gas passes and through which the other reacting chemical is admitted as a circular sheet to the said one chemical, the sheet preventing spattering of the reacting mixture above said device.

9. In a causticizing unit, a casing, a partition wall extending horizontally across the interior of the casing and having a passage upwardly therethrough with the partition wall flanged upwardly to provide a pan extending peripherally around the interior of the casing, a dome shell fitting over the flange with its lower edge intermediate the top and bottom of the pan, means for passing one of the reacting chemicals through the pan, a partition with a downwardly converging passage therein supported above the said dome shell, means for forcing a hot gas upwardly through the first passage beneath the dome shell to cause it to bubble through the chemical in the pan for heating and agitating the same, and means for directing the other chemical as a peripheral sheet through the converging passage upon the dome to prevent spattering of the reacting chemically upwardly above the upper partition.

In witness whereof, I hereunto subscribe my signature.

WILLIAM D. MOUNT.