

1,097,782.

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APPARATUS FOR MAKING SULFITE LIQUOR.

1,097,782.

Specification of Letters Patent.

Patented May 26, 1914.

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To all whom it may concern:

Be it known that I, ROBERT B. WOLF, a citizen of the United States, residing at Berlin, county of Coos, and State of New Hampshire, have invented certain new and useful Improvements in Apparatus for Making Sulfite Liquor, of which the following is a specification.

The manufacture of wood pulp for paper making, and particularly the preparation of such pulp by a sulfite process, requires the production of an acid possessed of certain characteristics upon which the quality of the pulp and, ultimately, of the paper itself depends.

In all successful sulfite systems it has been found necessary to introduce an element into the acid which shall combine with the pyroligneous acids and other organic compounds (agencies) created and formed by the action of the acid and heat on the woody matters during digestion. This element is usually an acid base formed by the introduction of lime or magnesium into the water of the acid system.

In the ordinary methods of making acid heretofore in use it has been impossible to obtain an acid rich enough in free sulfurous acid without having too much base present.

In order to simplify explanation and discussion of previous conditions and desires, I will take up the proposition in relation to, and in the terms of a sulfite manufacture employing a calcium base in its acid. This will make more clear the setting forth of my present invention as I shall describe, as an illustrative example of it, a system in which lime is employed for this same purpose.

Prior to my invention it had been impossible to secure a strong acid or even an acid of any considerable strength without having formed in it an excess of bisulfite which not only caused troublesome deposits in the system, but left lime in the pulp. Difficulty was also experienced in securing a clean acid, owing to the tendency of the calcium and sulfur to come through as monosulfite, which is substantially insoluble, instead of as soluble bisulfite. The acid was, therefore, unsatisfactory and was produced at an excessive consumption of lime and sulfur. These difficulties were due in

part to shallowness of the liquid in the absorption system, necessary on account of the vacuum system used to draw the gas through the liquid, and in part to the decreased activity of the water and gas in the system under the vacuum and further to the delay of the bisulfite formation on account of the lingering tendency of the monosulfite formation, which, being more stable (due to its insolubility) tended to persist late in the formation of the acid, thus preventing the formation of that amount of free acid necessary to proper strength.

To the end, therefore, of overcoming these various difficulties I devised my present invention. In this I have provided for the burning of the sulfur under a partial vacuum or at least an atmospheric pressure, drawing it through the cooler also under a partial vacuum and then forcing it in excess through the absorption system under pressure sufficient to cause it to penetrate depths ample to secure complete reactions and great strength of acid. I have further provided means for preserving the blower, by which I secure my gas circulation, against the attack of the gas and at the same time partly convert some of the calcium hydrate into monosulfite. I further provide means for the utilization of the excess gas expelled from the acid by a system which reduces it to sulfurous acid and calcium bisulfite, which, together with the monosulfite initially secured is employed, as I will further describe, in the absorption system itself.

In the specification which follows I will more fully enlarge and discuss the devices of the system which is to serve as an illustration of my invention, and in the drawings I have shown a diagrammatic elevation of such a system.

Throughout specification and drawings like reference numerals are employed to indicate corresponding parts.

1 is a burner in which sulfur dioxid is formed and from it led by a pipe 2 it passes to a cooler 3.

4 is a blower connected on its exhaust side by a pipe 5 to the cooler 3.

6 are a pair of impellers rotated by their shafts 7. Above the impellers 6 is located a jet or jets 8 through which lime water is sprayed into the blower casing. This cal-

cium hydrate with the sulfur dioxid forms on the impellers and casing of the blower a coating of monosulfite 9 and possibly sulfate of lime which protects them against the attacks of the acid of the gas.

10 is an inclined catch pipe open below the center of the blower 4 on its delivery side so as to receive the falling crystals of calcium monosulfite as they drop from the blower with the shower. At its bottom the pipe 10 joins an upright pipe 11 forming a U tube. In the pipe 10 the liquid will stand on a level determined by the pressure it sustains from the blower and counterbalanced by the hydrostatic head in pipe 11. The pipe 11 has within it an agitator 12 driven by an indicated pulley 13. This prevents the choking of the pipe by the monosulfite crystals which are insoluble.

14 is a supply for the trap to afford an increased circulation in addition to the shower of liquid therethrough and cause the liquid in the pipe 11 to overflow into a spill 15 from which it runs through a pipe 16 to carry the monosulfite to the lime tank 17.

At one side of the delivery end of the blower the gas conductor 18 branches, and, rising above the top level of the acid system 20, enters it at the bottom and terminates centrally of it in a capped discharge nozzle 19.

The absorption system 20 preferably consists of a plurality of tanks, although only one might be used. I have shown three: 21, 22, and 23 superimposed. This is what is known as the Burgess three tank system shown in Letters Patent No. 649,041. These tanks have central openings between them as shown at 24 and 25 through which the gas may progress into the next tank.

26 are hollow stirring arms or blades through which the gas passes on a shaft 27 which vertically passes through the centers of the tanks and is rotated by the pulley 28 to agitate the liquid and the gas.

The liquid is lifted from the tank 17 by a pump 29 through a pipe 30, to which the pipe 14 to feed the pipe 11 connects. The pipe 30 leads to the bottom of the upper tank 23, filling it until it overflows through the pipe 31 to the bottom of tank 22. In this tank it again rises to the level of a pipe 32, which conducts it to the bottom of the tank 21 from which it is drawn by a pipe 33, bent to form a seal against the gas pressure and vented at 33' to prevent siphoning. This delivers it as finished acid.

The excess gas of the system 20 is led through a pipe 34 to the bottom of a tower 35 filled with limestone indicated as 36 and supported on a grating 37. 38 is a similar tower filled with lime stone supported in the same manner. A water supply 39 enters the top of the tower 38 and a pump 40 lifts it from the tank 41 in the bottom of the tower

38 through the pipe 41' to the top of the tower 35 through which it again falls as a shower to the tank 42 from which it is drained through a trap 43 and through a pipe 44 to the lime tank 17. From the top of the tower 35 a pipe 45 leads to below the grate bars of the tower 38.

46 is a vent at the top of the tower 38 for the escape of such gases as may pass through the final treatment of the tower 38. Although I have shown two towers, one or more may be used according to the needs of the system.

Tracing the action of the various parts of my system there is drawn from the burners 1, sulfur dioxid, which has been burned under slightly less than atmospheric pressure. This is cooled at 3 and then drawn into the blower 4 in which it is mixed with a spray of lime water injected just above the rotary impellers. This forms in the blower calcium monosulfite and some calcium sulfate owing to a small percentage of SO_3 present in the gas, a part of which deposits in a fine coating on the impellers and casing and protects them from the acid attack which otherwise would quickly destroy them. The remainder of the monosulfite thus formed drops into the inclined pipe 10 and is carried through by the agitated flow from the spray 8 and the pipe 14, to the spill 15 from which it passes to the tank 17. The gas is then forced by the blower through the three depths of liquid in the tanks 21, 22, and 23, where it is brought into contact with the liquid from the tank 17. When introduced into the top tank 23 the liquid contains, in aqueous solution and suspension calcium monosulfite, possibly a slight amount of bisulfite, possibly a little sulfurous acid and calcium hydrate at times, though sulfurous acid and calcium bisulfite cannot exist in the presence of calcium hydrate.

The gas which contains sulfurous acid is continually passing through the opening 25 and the agitator arms 26 and further converts more of the calcium hydrate into monosulfite so that the liquid which overflows into tank 22, through the pipe 31 contains only a very small portion of calcium monosulfite, or possibly none at all. In the tank 22 this solution is further acted upon by the SO_2 gas which is continually passing through the opening 24 in its bottom and the agitator arms 26 so that the liquid as it finally overflows into tank 21, through pipe 32, contains practically no monosulfite, this having all, or nearly all, been converted to the bisulfite in tank 22. Further than this, the water in which the lime was suspended has absorbed a considerable quantity of SO_2 which we will call the "free" sulfurous acid, so that the liquid or acid which finally reached this tank 21, through

the pipe 32, is practically a finished acid. It is, however, too high in its per cent. of calcium bisulfite as compared with the total amount of sulfurous acid in solution. This is, however, corrected by the further contact of the acid with the gas coming through the pipe 18 and the agitator arms 26 so that when it finally overflows through the pipe 33 the acid is of a suitable composition for conveying to the reclaimer tanks, from which it is finally conveyed to the digesters for cooking purposes. As this has been accomplished under pressure and with excess gas, there is apt to be a discharge of sulfur dioxide at the top of tank 23. This excess gas is therefore conducted to the towers 35 and 38 in which the gas rises through lime stone in a shower of water. This forms sulfurous acid and from it calcium mono-sulfite forms on the limestone. This monosulfite in turn being raised to the bisulfite which dissolves and passes with a portion of the sulfurous acid and water into lime tank 17.

The advantage of being able to pass an excess of gas through the top or last tank of the system is that it practically assures a finished acid which is entirely free from monosulfite. Further than this, the introducing of the acid made by the escaped gases from the carbonate of lime in this lime stone tower, into the lime tank, converts a portion of the calcium hydrate to the monosulfite so that the lime water which is pumped through the pump 29 to the top tank of the system contains already a large portion of monosulfite of lime, some of this having been formed, as previously mentioned, in the blower and the remaining portion as just described.

It is further to be borne in mind that under the vacuum system a ten-inch vacuum reduced the atmospheric pressure by 5 pounds, leaving only a ten pound pressure and an accordingly rarefied gas. By employing my system and using atmospheric pressure, my gas is under fifteen pounds pressure and I have therefore 50% more gas handled by the same power as well as having it in more efficient combining condition.

The process described herein forms the subject matter of my application No. 528,443, filed concurrently herewith.

Various modifications in the different parts of the system may of course be made. The form and construction of the blower may be modified and other types used. As has been suggested, the number of the acid tanks may be varied according to the needs and the use of towers for the excess gas may be regulated by the necessity of the system. These and other modifications may be made without departing from the spirit of my invention, if within the limits of the appended claims.

What I therefore claim and desire to secure by Letters Patent is:—

1. An apparatus for making sulfite liquor comprising means for producing sulfur dioxide gas, a cooler for said gas, an absorbing system comprising a plurality of absorbing tanks, a lime tank, means for transferring liquid from one tank to another in series, means located between the cooler and the absorption system for forcing an excess of gas through the absorption system under pressure in reverse relation to the flow of the liquid, means for agitating the liquid, means associated with the gas forcing means for supplying thereto a substance capable of being converted into a monosulfite, means for combining the excess gas from said absorption system to secure bisulfite and sulfurous acid, and means for conducting the sulfites and the acids from said gas forcing means and from said excess gas combining means to said lime tank.

2. An apparatus for making sulfite liquor comprising means for producing sulfur dioxide gas, a cooler for said gas, an absorption system, means for supplying lime water to said absorption system, means located between said gas producer and the absorption system for forcing the gas through the system, and means for introducing milk of lime into the gas forcing means and means for absorbing the sulfur dioxide from the excess of gas.

3. An apparatus for making sulfite liquor comprising means for producing sulfur dioxide gas, a cooler for said gas, an absorption system comprising a tank, means for supplying lime water to said absorption tank, a blower located between said gas producer and the absorption system and wholly in advance of said absorption system for forcing the gas through said tank under pressure in reverse relation to the flow of the liquid, and means for agitating said liquid.

4. An apparatus for making sulfite liquor comprising means for producing sulfur dioxide gas, a cooler for said gas, an absorption system, comprising a tank, means for supplying lime water to said tank, a blower located between the gas producer and the absorption system and wholly in advance of said absorption system for forcing gas through said tank under pressure in reverse relation to the flow of the liquid, means for agitating said liquid, and means associated with said blower for introducing an alkaline solution, and means for combining the excess of gas from said absorption system to secure bisulfite and sulfurous acid.

5. An apparatus for making sulfite liquor comprising means for producing sulfur dioxide gas, a cooler for said gas, an acid system comprising a plurality of absorbing tanks, a lime tank, means for supplying lime

water from said tank to the said absorbing
tank, means for transferring the liquid from
one absorbing tank to another in series,
means located between the gas producer and
5 the absorbing system and wholly in advance
of said absorption system for forcing an ex-
cess of gas through said system under pres-
sure in reverse relation to the flow of the

liquid, and means for agitating the said
liquid.

In testimony whereof, I have affixed my ¹⁰
signature in presence of two witnesses.

ROBERT B. WOLF.

Witnesses:

EDMUND SULLIVAN,
THOMAS W. ESTABROOK.
