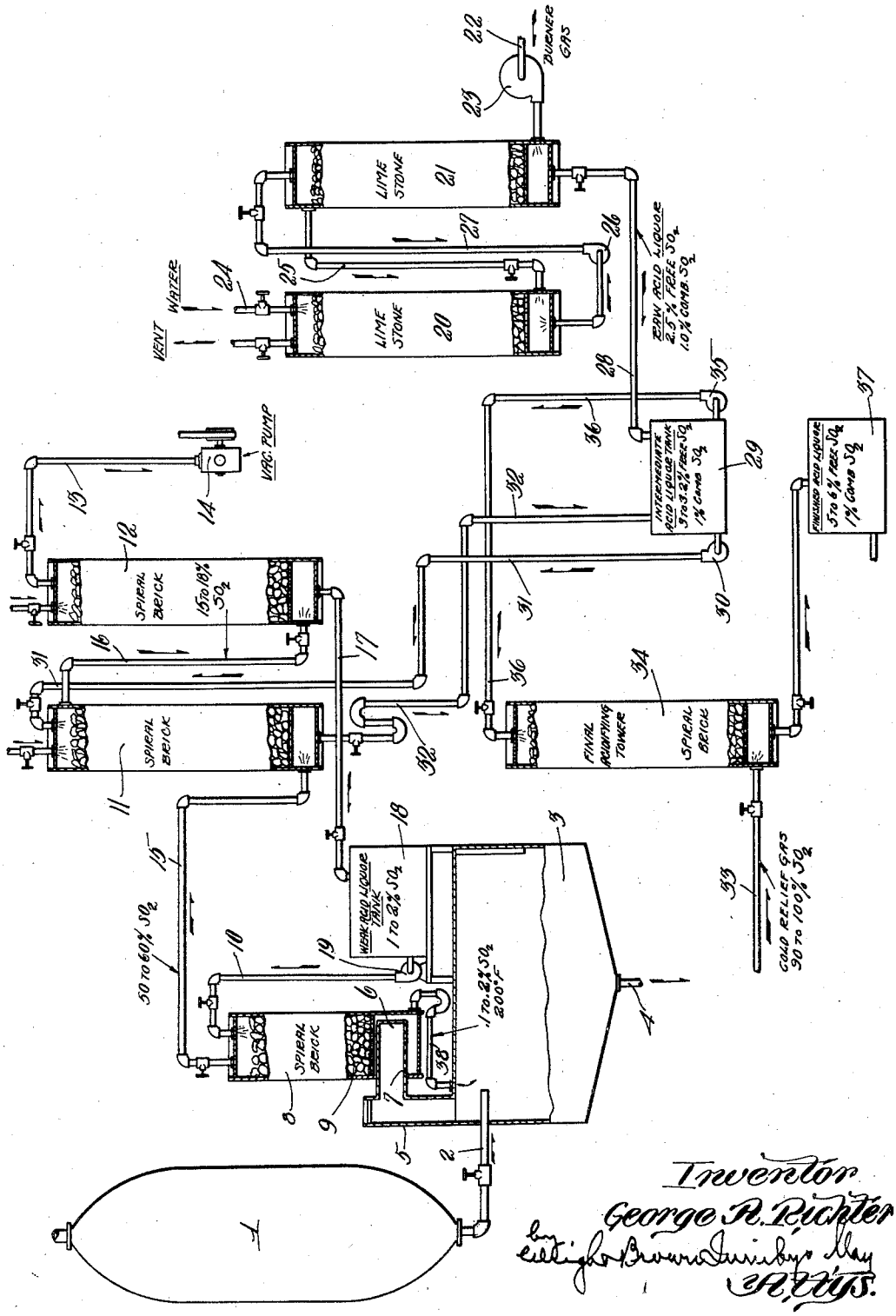
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G. A. RICHTER

RECOVERY OF WASTE GASES IN THE PRODUCTION OF SULPHITE PULP

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Inventor
George A. Richter
by Cushman, Darby & Cushman
Attys.

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GEORGE A. RICHTER, OF BERLIN, NEW HAMPSHIRE, ASSIGNOR TO BROWN COMPANY, OF BERLIN, NEW HAMPSHIRE, A CORPORATION OF MAINE.

RECOVERY OF WASTE GASES IN THE PRODUCTION OF SULPHITE PULP.

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This invention has for its object an improved method of recovering sulphur dioxide gas from the vapors and gases which are liberated with the discharge of the contents of a sulphite digester, following the completion of the cooking operation by which wood chips are digested in an acid sulphite liquor, and the utilization of the recovered SO_2 gas in the production of fresh cooking liquor having a high percentage of free sulphur dioxide gas.

In the normal operation of cooking wood chips for the production of sulphite pulp, it is customary to cook the chips in a closed digester under proper conditions of heat and pressure until the cellulose fibers are free from the ligneous or encrusting components of the wood, and then to discharge the contents of the digester into a blow pit wherein the pulp or cellulose fibers are separated from the waste cooking liquor. With the liberation of the liquid content of the digester which has previously been subjected to high pressure and temperature, the stream issuing from the blow pipe is approximately at or slightly below the boiling point so that much of the contained water vaporizes and has mixed therewith a relatively large percentage of free SO_2.

In accordance with the present invention, the mixed vapors and gases from the blow pit are caused to pass through a condensing tower provided with inert interstitial material and into direct contact with water which is sprayed or delivered to the top of the tower so as to pass the gas as the liquid travels downwardly through the interstitial material.

It has heretofore been customary to utilize for this purpose fresh water at seasonable temperatures. The water condenses the vapor and cools the gas, which as it leaves the condenser tower, comprises approximately 40% to 50% by volume of SO_2, which it is the purpose of the present process to recover and utilize most effectively in the production of an acid sulphite liquor containing a high proportion of free SO_2.

On the accompanying drawing, I have illustrated more or less diagrammatically and conventionally the instrumentalities which may be employed in carrying out the process which will be subsequently described.

Before proceeding to a description of the apparatus, it may be stated that ordinarily in the production of an acid sulphite liquor, sulphur or sulphur-bearing material is burned for the production of SO_2, and the "burner gases" so-called, resulting from this combustion are caused to pass through one or more lime towers in series, through which water is passed for the formation of what may be termed a raw acid liquor. This raw acid liquor ordinarily contains about 1.0% combined SO_2 and 2.5% free SO_2. The raw acid liquor thus produced must be strengthened by the addition of free SO_2 to bring it to a point at which it contains approximately 5% to 6% free SO_2 and thus be ready for use in the digesters for the liberation of fiber and the production of sulphite pulp.

Referring to the accompanying drawing,— 1 indicates a sulphite digester of the usual type in which wood chips (spruce for example) are cooked in an acid sulphite liquor,— usually calcium bisulphite. Upon the completion of the cooking operation, the cooked chips and the liquid content of the digester together with such free gas as may be therein are discharged through a blow pipe 2 into a blow pit 3 from which the waste liquor which is separated from the pulp is withdrawn through a pipe indicated at 4. A stack 5 leads from the top of the blow pit which is otherwise closed and is provided with a laterally projecting portion 6 provided with ports 7 on its lower side through which the vapors and mixed gases are emitted. This laterally projecting portion of the stack extends into the lower end of a tower indicated at 8 which is provided with spiral brick or other inert interstitial material as indicated at 9. A stream of liquid to be described is delivered through a pipe 10 to the top of the tower and is sprayed downwardly therein so as to pass downwardly through the inert interstitial material in multitudinous streams in counter-current flow to the gases and vapors which rise upwardly through the tower. The condenser tower is subjected to a partial vacuum to ensure the flow of vapor and gas upwardly thereinto. At 11 and 12 are indicated two towers each of which is provided with a mass of inert interstitial material such as spiral brick, the upper portion of tower 12 being connected by pipe 13 with a vacuum pump indicated conventionally at 14. A pipe or conduit 15 leading from the top of the condenser tower 8 is connected to the lower end of tower 11, and similarly a pipe or conduit 16 extends from the top of tower 11 to the lower part of tower 12. The partial vacuum created by

the pump 14 extends back into the condenser tower 8 as will be readily appreciated. These two towers 11 and 12 constitute means for recovering the SO_2 which passes from the blow pit upwardly through the condenser 8.

In accordance with the present invention, water at seasonable temperatures is delivered to the top of the second recovery tower 12, and in passing downwardly through the interstitial material absorbs such SO_2 from the blow pit mixed gases as were not absorbed in tower 11. The weakly acidulated water which is delivered from the bottom of tower 12 is conducted by a pipe 17 to a large tank indicated at 18 located in convenient proximity to the condenser 8. It is this acidulated water in what I may call the weak acid liquor tank 18 which is utilized for condensing the vapors and cooling the gases in the condenser. A pump 19 withdraws the weak acid liquor from the tank 18 and forces it through pipe 10 to the top of the condenser tower 8.

Omitting for the moment further reference to the tower 11, attention is directed to the two lime towers which are indicated at 20 and 21, and which are utilized in producing what I term the raw acid liquor. Burner gases, i. e. the products of combustion resulting from the burning of sulphur or sulphur-bearing material, after being properly cooled are delivered by a pipe 22 to a fan or blower 23 by which they are delivered to the bottom of tower 21. This tower, like tower 20, is partially filled with limestone, dolomite or other calcium-bearing material. Water at seasonable temperatures is delivered to the top of lime tower 20 through a pipe 24, and in passing downwardly therethrough meets a current of gas supplied to the bottom of tower 20 by a pipe 25 leading from the top of tower 21. The liquor from the bottom of tower 20 is pumped by a pump 26 through pipe 27 to the top of tower 21, where, in passing through the limestone or dolomite, it comes in contact therewith and also with the fresh burner gases to the lower end of tower 21. The acid liquor from the bottom of lime tower 21 is conducted by a pipe 28 to what I have termed for convenience of phraseology or designation the "intermediate acid liquor tank" 29. It is from this tank that the raw acid liquor is caused to circulate through the blow pit gas recovery tower 11 to increase its strength in free SO_2. To this end the acid liquor is withdrawn from intermediate acid liquor tank 29 by a pump 30 and forced through pipe 31 to the top of tower 11, and, after being passed through the interstitial material therein, the liquor is conducted back to the tank 29 by a sealed pipe 32. Although the acid liquor in the intermediate acid liquor tank 29 has its proportion of free SO_2 increased, its strength must be further increased so that it may be utilized to the greatest advantage as a cooking liquor. For the further fortification or strengthening of the intermediate acid liquor, a substantially pure SO_2 gas is required, and this is supplied by relief gases which are relieved from time to time from the digesters during the cooking operation. This relief gas is supplied through a pipe or conduit indicated at 33 and it is delivered to the lower end of what for convenience I term the "final acidifying tower" 34. This tower is partially filled with inert interstitial material, such for example as spiral bricks. The intermediate acid liquor from the tank 29 is pumped to the top of this tower by pump 35 and pipe 36. The final or finished acid liquor is delivered from the bottom of tower 34 to a tank indicated at 37 which for convenience of designation I term the "finished acid liquor tank".

Thus it will be seen from the foregoing description that the finished acid liquor is acidified by burner gas, by gas recovered from the blow pit, and by cold relief gas.

Assuming that the digester 1 is of fairly large size, about 10,000 to 16,000 gallons of water are required for the condenser 8, depending upon the temperature of the condenser water, to condense the vapors and to cool the gases which have been delivered from the digester upon the completion of the cook. The supply of condensing water form weak acid liquor tank 18 to the top of the condenser is so regulated ordinarily that this water leaves the lower end of the condenser at a temperature ranging from 190° to 200° F. and is delivered by a trapped pipe 38 into the blow pit so as to impinge upon the stream being delivered into the blow pit through the blow pipe 2. As the condensing water and the condensate are heated by the hot stream of chips and liquor emerging from the blow pipe, they are freed from SO_2 which was absorbed thereby, and this SO_2 passes upwardly with the other vapors and gases through the stack 5 back into the condenser. Such SO_2 as is not absorbed by the condensing water passes through the pipe 15 into the tower 11, and it comprises 50% to 60% of SO_2 by volume of the mixed gases, affording therefore a strong acid gas which may be utilized in strengthening the intermediate acid liquor which was delivered to the tank 29 from the lime towers 20, 21. The cold blow pit gases, which have been unabsorbed in the tower 11, now pass to tower 12 where they meet a stream of fresh water at atmospheric temperatures and are absorbed thereby. The gas leaving tower 11 contains ordinarily 15% to 18% of SO_2 by volume, and the tail gases drawn from the tower 12 by the vacuum pump 14 contain substantially no SO_2. The weakly acidulated water from the bottom of tower 12 contains approximately 1% to 2% of SO_2 and is cold so that it may be well utilized for the condenser tower 8. In passing through this tower, 8, it is heated by

the rising steam and vapors so that its contained SO_2 is driven therefrom and passes through pipe 15 to tower 11 with the other SO_2 gas delivered from the blow pit. The condensing water and condensate leaving the bottom of condenser 12 contains ordinarily about 0.1% to 0.2% SO_2, but most of this SO_2 is discharged therefrom when the water meets the hot stream of digester contents emerging through the blow pipe 2. As a result of this arrangement of instrumentalities, the volume and concentration of SO_2 in the gases leaving the condenser 8 are increased and the gas which was absorbed in the weak recovery tower 12 is liberated therefrom without the use of extraneous heat additional to that supplied by the digester contents. Furthermore the increased volume and concentration of cool blow pit gases allow a correspondingly high fortification or increase in strength of the raw acid liquor delivered from the lime towers to the intermediate acid liquor tank 29.

The sulphur burner gases contain ordinarily about 16% SO_2, and the raw acid sulphite liquor leaving tower 21 contains about 2.5% free SO_2 and 1.0% combined SO_2 as it is delivered to the tank 29. By circulating this liquor through the first recovery tower 11, where it is brought into contact with a gas containing 50% to 60% SO_2, it is converted to what I have termed an "intermediate acid liquor" containing 3.0% to 3.2% free SO_2 and 1.0% combined SO_2. Then this intermediate acid liquor is brought into contact with a gas which is substantially pure SO_2, namely the cold relief gas which comprises 90% to 100% SO_2 by passing it through tower 34 and is then converted to a final acid liquor containing 5% to 6% free SO_2 and 1% combined SO_2. In this way the sulphite liquor is subjected to increasingly stronger or more concentrated gas, and by a series of these steps is converted into its final form. Substantially no gas is wasted and all but a trace of the blow pit gases are recovered.

The advantages gained by the operation hereinbefore described may be increased or exaggerated by diverting a portion of the sulphur-burner gases through tower 12 (with the gases from recovery tower 11) for the purpose of increasing the acid strength of the weak liquor delivered therefrom to a point where it contains up to 2% SO_2. This, consequently, increases the strength in SO_2 of the gases leaving the blow pit condenser 8 sufficiently to increase the acid strength of the intermediate liquor leaving the recovery tower 11 from 3.0%–3.2% to 3.8%–4.2% free SO_2.

It may be reiterated that, by the method herein described, there is a saving of heat in recovering SO_2 from the blow pit (in that SO_2 absorbed by the cooling water is liberated by the heat of the digester contents), an increased SO_2 concentration in the chilled gases leaving the blow pit condenser is secured, substantially all of the SO_2 from the blow pit is recovered except such minute amounts as are absorbed by and wasted with the waste liquor from the blow pit, and an acid sulphite cooking liquor having from 5% to 6% free SO_2 is produced at relatively low expense and with a marked economy in its production.

What I claim is:—

1. A process of recovering SO_2 from hot blow pit vapors and gases, which comprises conducting such vapors and gases through a confined mass of inert interstitial material in countercurrent flow to a cold acidulated water thereby condensing such vapors and cooling such gases, conducting the cooled gases through a mass of inert interstitial material in contact with water, to cause SO_2 to be absorbed thereby, and supplying such acidulated water to the first-mentioned mass of interstitial material for the condensation and cooling of blow-pit vapors and gases and liberation of the SO_2 contained in such acidulated water.

2. A process of recovering SO_2 from blow-pit vapors and gases and utilizing the same in the production of bisulphite cooking liquor, which comprises conducting such vapors and gases through inert interstitial material, wherein the vapors are condensed, passing the chilled gases through a mass of inert interstitial material into contact with a bisulphite liquor to increase the acid strength of such liquor, passing the resulting tail gases through a mass of interstitial material in contact with water for the acidulation of such water by the remaining SO_2, and passing the acidulated water through the first-mentioned material to condense and cool the said blow-pit gases and vapors passing therethrough and to liberate the SO_2 gas previously absorbed in such water.

3. A process of recovering SO_2 from blow-pit vapors and gases and utilizing the same in the production of bisulphite cooking liquor rich in free SO_2, which comprises producing a raw acid sulphite liquor by conducting water and sulphur burner gases in contact with calcium-bearing material; conducting blow-pit vapors and gases through an inert surface material and condensing such vapors and chilling the gases; circulating said raw acid liquor through inert interstitial material and conducting such chilled blow-pit gases through said last-mentioned material in contact with such raw acid liquor to increase the acid strength of such liquid; passing the unabsorbed tail gases in contact with water through inert interstitial material for the absorption of the remaining SO_2 and the acidulation of such water; and passing such acidulated water through the first-mentioned inert material in contact with the blow-pit vapors and gases and in counter-

current flow thereto to condense such vapors, chill such gases, and liberate the gas previously absorbed by such water.

4. A process of recovering SO_2 from blow-pit vapors and gases and utilizing the same in the production of bisulphite cooking liquor rich in free SO_2, which comprises producing a raw acid sulphite liquor, condensing and chilling the said blow-pit vapors and gases by SO_2 acidulated water and simultaneously liberating the SO_2 from such acidulated water; causing said raw acid liquor to absorb a portion of the SO_2 from the chilled blow-pit gases; and effecting the acidulation of said water by the absorption therein of SO_2 remaining in said chilled blow pit gases.

5. A process of recovering SO_2 from blow-pit vapors and gases and utilizing the same in the production of bisulphite cooking liquor rich in free SO_2, which comprises producing a raw acid sulphite liquor, condensing and chilling the said blow-pit vapors and gases by SO_2 acidulated water and simultaneously liberating the SO_2 from such acidulated water; causing said raw acid liquor to absorb a portion of the SO_2 from the chilled blow-pit gases; then bringing such acid liquor to ultimate acid strength by contact with substantially pure SO_2 gas; and effecting the acidulation of said water by the absorption therein of SO_2 remaining in said chilled blow-pit gases.

6. A process of producing a sulphite cooking liquor having a high proportion of free SO_2, which comprises first producing a raw acid sulphite liquor, circulating such liquor through inert surface material in contact with chilled blow-pit gases to increase the proportion of free SO_2 therein; and then passing such liquor through inert material in contact with digester relief gases to produce a finished acid cooking liquor having a high proportion of SO_2.

In testimony whereof I have affixed my signature.

GEORGE A. RICHTER.