

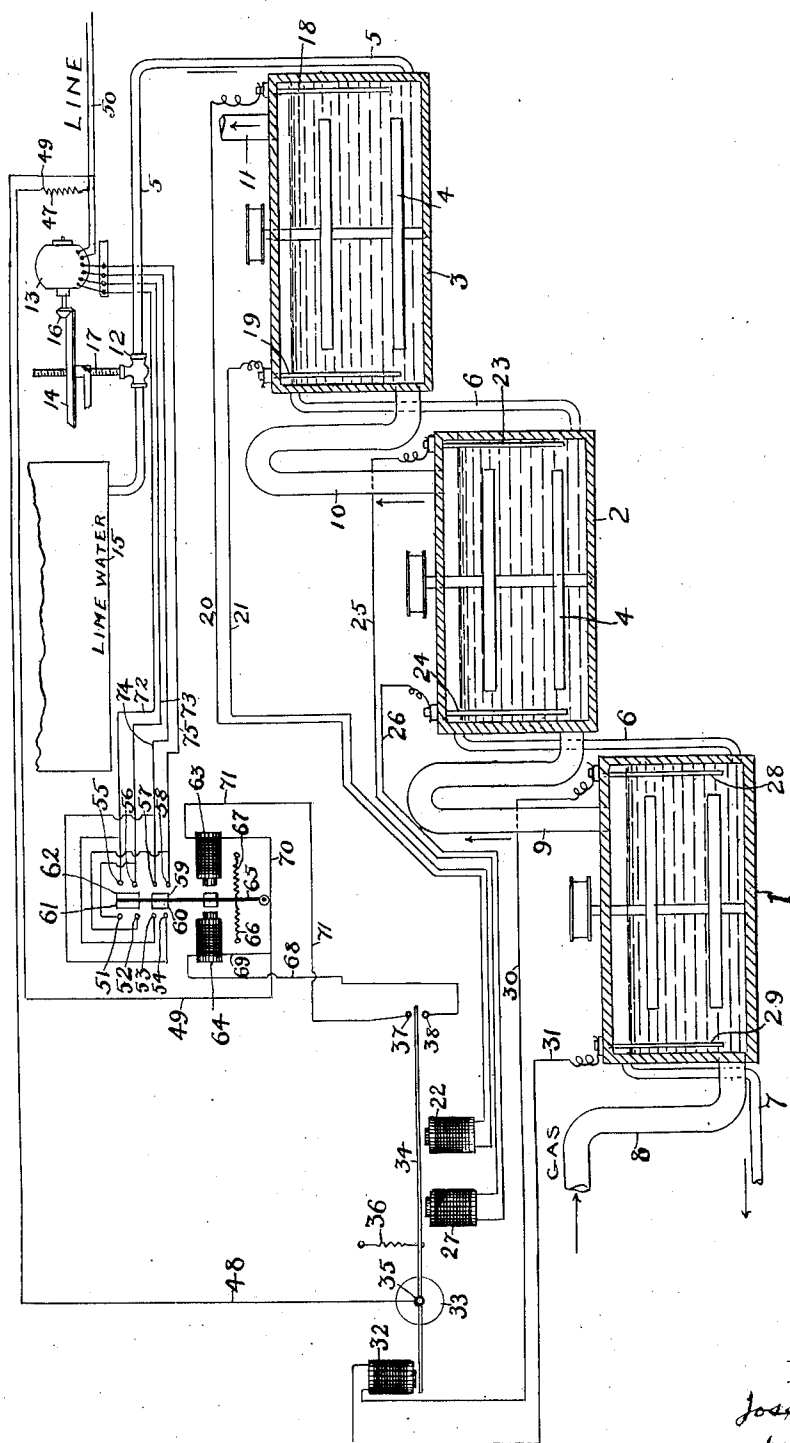
J. B. CRANDON.

PROCESS FOR REGULATING THE ACIDITY OF SULFITE LIQUOR.

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UNITED STATES PATENT OFFICE.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, JOSEPH B. CRANDON, a citizen of the United States, residing at Portland, in the county of Cumberland and State of Maine, have invented certain new and useful Improvements in Processes for Regulating the Acidity of Sulfite Liquor, of which the following is a specification.

My invention among other things relates to the manufacture of paper pulp and particularly to what is known as the sulfite process wherein the wood in the form of chips is subjected in a digester to the action of heat and pressure in the presence of bisulfite of lime, magnesia, or other base.

The sulfite liquor used in the digester is commonly formed by bringing sulfurous acid gas into contact with caustic lime either by passing the gas through a body of unslaked lime in the form of lumps of unburned lime as dolomite held in towers or through lime water or calcium hydrate. By this process the sulfurous acid is converted into a solution of bisulfite of calcium, which is the sulfite liquor desired in the chemical treatment of wood, for the purpose of converting it into cellulose.

In the carrying out of this last mentioned process the gas is drawn from the burners and forced through a series of tanks through which lime water is constantly passing, the sulfite of calcium solution being finally discharged into a storage tank from which it is drawn into the digester to be mixed with the wood chips.

In the preparation of the liquor it is desirable that it should always be of the same degree of concentration and that it should have the same amount of free acid since it is this acid both free and combined with lime to form the bisulfite which acts on the wood fiber. The gas as it comes from the burner varies in strength to a very considerable extent and consequently when combined with the lime water the resulting bisulfite varies in the same manner. It is desirable to always have the acid in the liquor at a standard strength. Hitherto the only way of getting uniform results in the quality of the liquor was to make frequent chemical tests and regulate the flow of the milk of lime accordingly. One of the important objects of my invention is to automatically regulate

the strength of the acid so that it will come from the liquor tanks or towers with the same degree of strength or acidity.

Another object of the invention is to eliminate the necessity of chemical analysis of the solution in the process of manufacture, which solution is capable of acting as an electrolyte by generating a current in the solution and indicating by suitable apparatus the strength of the current and the consequent strength of the solution.

My invention is founded on the fact that the sulfite liquor in the process of making may be used as an electrolyte in an electric battery and the amount of electric current thus generated will vary as the acidity of the acid varies. By providing means for indicating when this electric current is above or below normal the acidity of the liquor will be indicated. This meter or indicating device may be used with a moving arm or other like element the position of which may be read directly by means of a suitable scale or which may be made to act as a relay switch to throw on or off an electric circuit or circuits which will act to admit more or less of the neutralizing lime water or other modifying substance into the system.

As I apply the invention to the liquor-making system wherein the sulfurous acid gas is drawn through tanks containing a moving body of lime water, a battery element is formed in one of the tanks or pipes or in any suitable place using the liquor as an electrolyte, and the current thus produced passing through an electro-magnet moves an arm which acts as a relay switch to control the circuits to a reversing motor. The motor acts to open and close a valve which admits lime water to the tank.

If the liquor is too strong of acid the current produced will cause the switch to close the circuit which runs the motor in a direction to open the valve, admitting lime water to the tank and increasing the supply. If the current is too weak the supply of lime water is decreased in a like manner. Thus the outflow of the sulfite liquor at the outlet of the system always tends to become standardized according to the adjustment of the controlling relay switch.

My invention will be readily understood

when considered in connection with the accompanying drawing in which I have illustrated it diagrammatically as applied to a form of a liquor making apparatus in common use.

In the drawing 1, 2, and 3 represent a series of closed tanks arranged one above the level of another, each provided with stirrers 4. Milk of lime is fed from a lime water tank 15 into the upper tank 3 by a pipe 5, over-flowing by pipes 6, 6, into the two lower tanks 1 and 2 and finally being discharged through a discharge pipe 7 by which it passes to a storage tank (not shown). The sulfurous acid gas is pumped from the burners and enters the system at the bottom of the lower tank through a flue 8, bubbles up through the liquor in the lower tank and passes through flue 9 to the bottom of the second tank 2, thence passing through the liquor in the tank 2 and the flue 10 to the upper tank 3, and thence out through the exhaust flue 11. During the passage of the gas through the tanks it is gradually absorbed by the liquor. Any excess of gas not absorbed will pass off through the exhaust pipe 11. The aim of my invention in this instance is to regulate the flow of lime water through the supply pipe 5 according to the acidity of the liquor and by causing the absorption of all the gas or its neutralization prevent the escape of gas and produce a liquor of uniform acidity.

The battery element may be formed at the upper tank of the system and the solution tested and regulated at that point or it may be tested by forming battery elements at all the tanks and combining the currents thus produced as herein shown or the test may be applied at any desired point.

The flow of lime water from the tank 15 through the pipe 5 is controlled by a valve 12, opened and closed by a reversing electric motor 13.

The motor has a bevel gear 16 engaging a gear 14 screw threaded to take the screw threaded spindle of the valve 12. Thus the valve is opened or closed by the rotation of the motor in one direction or the other.

The regulation of the valve is effected by the electric current generated by the bisulfite in the liquor-making tanks.

A battery is formed with an anode and cathode and with the liquor as the electrolyte, the current thus generated which is directly proportional to the free acid in the liquor is passed through an indicating device where it indicates the strength of the acid. As here shown an anode 18, and a cathode 19 are immersed in the upper tank 3 where the lime water is first admitted. The anode and cathode are connected by wires 20 and 21, each wire being connected to the terminal of an electro-magnet.

The anode, cathode and the acid consti-

tute a battery element which generates a current of dynamic electricity and which flows through the wires 21 and 20 when the circuit is completed.

The strength of the circuit will be substantially proportional to the acidity of the liquor. An indicating device is employed to indicate the strength of the current and as herein shown the wires 19 and 20 are connected through an electro-magnet 22.

As here shown, a similar anode 23 and cathode 24 are immersed in the tank 2 and connected by wires 25 and 26 passing through an electro-magnet 27. In like manner an anode 28 and a cathode 29 are inserted in tank 1 and united by wires 30 and 31, which pass through an electro-magnet 32. An indicating device is provided in which the power of the generated current will be indicated. As here shown I measure the current of the three magnets 22, 27, and 32 which are combined to impart motion to a movable part to thus indicate substantially the total of all the three currents produced by the electricity produced in the three tanks and thereby indicate the acidity of the sulfite liquor.

As here shown I provide an instrument 33 having an arm pivoted at a point 35 between its ends. The arm is made of steel or iron which will be attracted by the magnets. Two of the magnets 22 and 27 are located adjacent to one side of the arm and the magnet 32 is located at the opposite side of the arm and the opposite side of the pivot 35 and adjacent to the arm. As a result of this arrangement when the currents pass through the magnets all three tend to deflect the arm and turn it on its pivot in one direction. A suitable spring, or other, like instrumentality 36 is provided tending to swing the arm in the opposite direction from that in which it is moved by the magnets.

The swing of the arm 34 more or less from its normal position will indicate the strength of the current passing through the several magnets. Using the movement of this arm as an indication of the acidity of the sulfite liquor the same may be neutralized in the usual manner by opening or closing the valve which supplies lime water to the liquor. In the preferred form of my apparatus, I make use of the indicating instrument as a relay switch to operate the motor to open or close the valve 12 according as more or less than the regular flow of lime water is required.

For the purpose I provide a pair of contact points 37 and 38, one on each side of the end of the arm 34 and in the range of its motion. Each of the contact points 37 and 38 is in a circuit which includes two lines 48 and 49 forming a branch of the circuit 50 which supplies power to the mo-

tor 13. A resistance 47 is inserted in the line 49 for the purpose of reducing the current of the circuit and bringing it down to a point where the contact points and magnets hereinafter described will not be injured.

The strength of the spring 36 is such that when the solution is at the standard the effect of the spring and the magnets will exactly counterbalance each other and the end of the arm will not contact with either of the contact points 37 or 38.

A reversing switch is provided and so connected with the indicating device that when the current generated in the tanks rises above the normal indicating an excess of acid, the motor will be run in a direction to open the valve 12 to admit more lime water and when the current is below normal the valve will be closed cutting down the supply of lime water.

The reversing switch of which I make use is composed of a pivoted and insulated arm 65 held in a central position by balancing springs 66 and 67. On each side of the arm 65 there is located a magnet 63 and 64. A suitable armature on the arm 65 is located between the two magnets in such a position as to cause the arm to vibrate from side to side as it is attracted to one or the other of the magnets 63 or 64.

One end of the magnet 64 is connected with the contact point 38 by a wire 68 and one end of the magnet 63 is connected with the contact point 37 by a wire 71. Each of these magnets is also connected by its opposite end with the feed wire 49 by wires 69 and 70.

Thus when the arm 34 is drawn over against the contact point 38 by the pull of the magnets 22, 27, and 32 a circuit will be completed from the line 50 through line 49, 69, magnet 64, line 68 contact point 38, arm 34 and line 48 back to the line 50.

The arm 65 is then drawn to the magnet 64 and the switch is thrown to one side.

When the spring 36 draws the arm 34 away from the magnets 22 and 27 into contact with 37 a similar circuit is closed except that the magnet 64 is cut out and the magnet 63 included. The circuit passes from line 49, 70, magnet 63, line 71 to contact point 37.

The reversing switch proper is composed of eight contact points four on each side of the arm. On one side of the arm are contacts 55, 56, 57, and 58 connected to the motor by wires 72, 73, 74, and 75 respectively. Contact plates 62 and 59 on the swinging arm 65 connect the contact points 55, 56, 57 and 58 when the switch is thrown to the right by magnet 63.

Plates 61 and 60 connect the points 51, 52, 53, and 54 respectively when the switch is thrown in the opposite direction.

The point 51 is connected by a wire with line 73, point 52 with 75, point 53 with line 72 and point 54 with line 74.

Without going into the construction of the motor it will be well understood by an electrician that the result of the action of this switch as the arm 65 is thrown back and forth is to reverse the motor or when the arm 65 is in a central position, to stop the same.

It will be understood that any suitable measuring instrument may be used and particularly if it has a movable arm which may be made use of for a relay switch to effect the reversal of the motor.

A scale may be used in connection with the vibrating arm of the measuring instrument whereby the amount of deflection may be read showing the acidity of an acid solution or the strength of any other solution capable of acting as an electrolyte, and this may be read or automatically recorded in any well known manner.

Other means beside opening and closing a supply valve as here shown may be used for varying the supply of regulating substance which may be added to the liquor.

Instead of regulating the quantity of lime water admitted I may regulate the admission of gas and so modify the acidity of the solution.

While I have described my process as applied to the manufacture of bisulfite of lime it will be understood that it may be used with magnesia, soda, or any other base, or it may be used for testing and regulating any acid where a standard strength is required whether in paper making or in some other industry.

Although I have described the invention as applicable to manufacture of pulp, the use for which it was particularly designed, it is evident that it is applicable to any process where a liquid product composed of two or more substances combined and capable of acting as an electrolyte is to be standardized by the addition of an alkali, a stronger acid or by dilution of the solution or by the use of any modifying substance which may be added to modify the acidity of the solution or the concentration of any other solution.

In speaking of the system of tanks it will be understood that any number of tanks may be used in the series from one upward depending on conditions that exist in the particular mill.

It is evident that the process may be applied to the tower system where water is allowed to run down through the lime rock, the inflow of water being governed by the strength of the acid instead of the inflow of lime water as in the tank system. The invention may be used to indicate and record the degree of concentration by the use of a

suitable scale applied to the indicating arm as pointed out or a record may be made of the movement of said arm or of the strength of the generated current in any well known manner. Such records may be kept and may form a permanent record and the indicating instrument may be located at any convenient point where it may be always at hand to indicate the character of the solution. The need of making frequent chemical analyses of the sulfite liquor or other solution capable of acting as an electrolyte will thus be avoided and the solution may be kept of a standard quality or its concentration may be constantly known and recorded.

I claim:

1. The process of determining the acidity of the liquor for use in pulp digesters and other like purposes consisting of bringing said liquor into contact with an anode and cathode to form an electric battery and indicating the electric current thus produced.
2. The process of indicating the degree

of concentration of a liquid made up of a plurality of substances capable of acting as an electrolyte which consists of bringing into contact with said electrolyte an anode and a cathode to generate a current of electricity and indicating by a suitable instrument the strength of said current and the corresponding strength of the liquid.

3. The process of regulating the acidity of sulfite liquor which consists of bringing the liquor into contact with an anode and a cathode and adding to said liquor a modifying substance according to the current generated.

4. The process of making sulfite liquor which consists of passing sulfurous acid gas through hydrate of lime or other base, bringing the liquor into contact with an anode and a cathode to form an electric current and supplying hydrate to this liquor according to the electric current thus produced.

JOSEPH B. CRANDON.