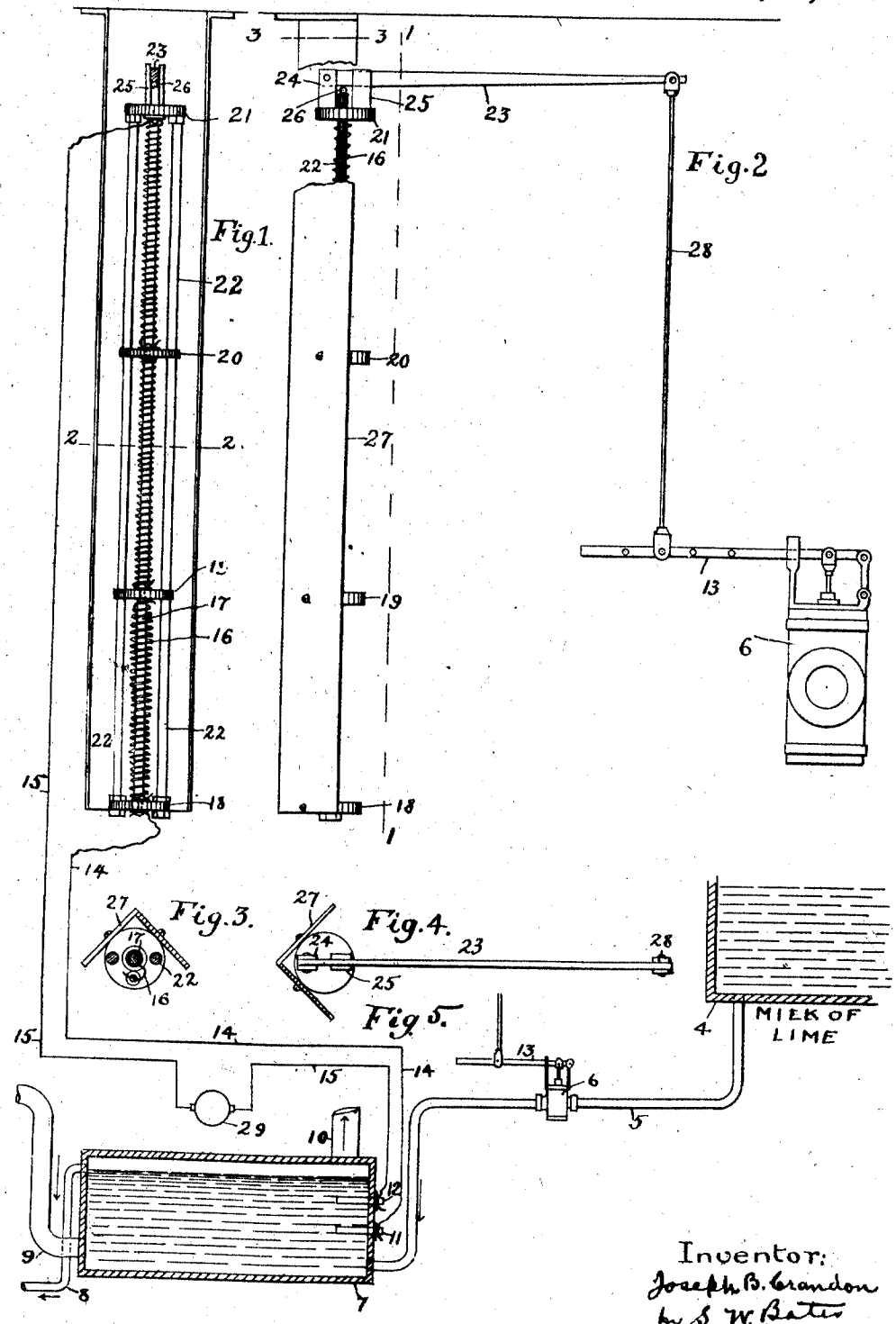
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APPARATUS FOR REGULATING THE ACIDITY OF SULFITE LIQUOR AND OTHER LIKE PURPOSES.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR REGULATING THE ACIDITY OF SULFITE LIQUOR AND OTHER LIKE PURPOSES.

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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 Apparatus for Regulating the Acidity of Sulfite Liquor and other like Purposes, of which the following is a specification.

My invention relates primarily to the regulation and indication of the acidity of sulfite liquor used in the sulfite process of making paper pulp although it is capable of being used for a great variety of analogous purposes.

The sulfite liquor above referred to is made in one of the common processes by passing milk of lime through a series of tanks and drawing or forcing sulfurous acid gas through the lime water as it passes through the tanks. The sulfurous acid unites with the lime to form bisulfite of lime with a certain proportion of free acid which remains in the solution uncombined. The sulfurous acid gas which is passed through the lime water comes from the burners where sulfur is burned and varies considerably in quantity and concentration and consequently the acid content of the sulfite liquor varies.

At present the method of securing uniformity of the acid content of the liquor is to make frequent chemical analyses of the liquor and to open or close the feed valve which regulates the supply of milk of lime at the head of the system of tanks as the acid content shows more or less strength.

Another system of making the sulfite liquor is to allow water to run down over lumps of unslaked lime placed in a tower, the gas being introduced at the bottom and allowed to pass upward through the lime rock and water. The sulfurous acid gas meeting the water holding lime in solution unites with the lime to form the bisulfite of lime and the resulting solution is collected in a tank at the foot of the tower. In this process the strength of the acid is regulated by letting in more or less water at the top of the tower.

The object of my invention is to determine and regulate the acidity of the sulfite liquor through an apparatus controlled by a current of electricity which is made to pass through the liquor while the latter is in the process of making. I have found that when a current of electricity is passed through the liquor the resistance to the passage of the current varies in proportion to the acid content of the bisulfite liquor, the greater the proportion of acid the greater the conductivity of the liquor and my apparatus is founded on this principle. The apparatus may indicate by a movable member the relative quantity of acid in the sulfite liquor or the same movable member may be used to automatically regulate the supply valve to admit more or less lime water or clear water according to the system to which it is applied.

According to my present invention, I pass a current of electricity, through the solution and introduce into the circuit an electric heating device including an expansion member which expands more or less according to the quantity of current which passes through the device. The relatively slight motion produced in the expansion member may be transformed by means of levers or their equivalents into a motion of considerable amplitude and power so that the supply valve may be directly operated by it.

This same apparatus or apparatus based on the same principle may be used for testing the concentration of any chemical solution where the electrical resistance of the chemical varies according to the concentration of the chemical or may be used to regulate the concentration of a chemical solution where a liquid and a gas or two liquids are being united in a continuous process governed by one or more inlet valves or their equivalents, as in the manufacture of bleach where chlorin gas is united to lime forming chlorid of lime and in other like operations.

In the accompanying drawing I have illustrated one form of my invention as applied to the tank system of making bisulfite of lime.

In the drawing,

Figure 1 shows an elevation of my electric heating device partly in section on line 1—1 of Fig. 2 connected with a diagrammatic representation of a liquor making system.

Fig. 2 is an elevation of the heating device taken at right angles to that shown in Fig. 1,

Fig. 3 is a section on the line 2—2 of Fig. 1.

Fig. 4 is a section taken on the line 3—3 of Fig. 2 and

Fig. 5 is a view of the tank and its connections.

Referring to the drawings, 4 represents the supply tank of milk of lime from which the supply pipe 5 leads to the tank 7 which may be one of the tanks of the series as they are usually arranged in series, one above the other, so that the liquor will flow by gravity from one to the other. The flow of milk of lime from the supply tank is regulated by a supply valve 6 which is preferably a gate valve operated by a lever 13. The liquor as it flows through the tank 7 overflows through a pipe 8 to the next lower tank in the series. The sulfurous gas is drawn or forced in through a pipe 9 which is connected with the sulfur burners. The gas passes up through the liquor and out through the exhaust pipe 10. The gas as it bubbles through the liquor unites with the milk of lime to form the bisulfite of lime with a portion of the gas held in the solution as free acid.

Means are provided to pass a current of electricity through the liquor and as here shown I provide two electrodes 11 and 12 which are introduced through the side of the tank. These electrodes 11 and 12 are connected by wires 14 and 15 with a heating wire of an electric heating device having an expansion member, the expansion and contraction of which is made to indicate the acid content of the liquor and to regulate the supply of lime water passing through the valve 6. My electric heating device as here shown is composed of an expansion rod 17 around which is coiled the heating wire 16. The rod 17 is preferably of brass or some metal having relatively great expansibility and the heating wire is of iron or steel or wire having considerable resistance to the passage of the electric current.

The rod 17 is of considerable length and is fixed in a frame made up of a series of disks 18, 19, 20 and 21 connected by tie rods 22 made preferably of iron or steel or metal less expansible by heat than the material of which the rod 17 is made. The rods 22 are secured to the bottom disk 18 and to the upper disk 21 by nuts while the rod 17 is secured firmly to the bottom disk by being driven into a hole extending through the disk or it may be soldered or otherwise secured to the disk. The upper end of the rod 17 extends through a central opening in the upper disk 21 to a point above the disk. As the rod 17 is heated more or less by the heat of the heating wires 15 it expands more or less and its upper end rises and falls according to the heat of the rod. The slight motion of the upper end of the rod 17 is converted into a much greater motion capable of indicating the strength of the solution or of doing work by means of a lever or its equivalent so fulcrumed as to magnify the motion of the end of the rod 17.

As here shown, I make use of a relatively long lever 23 pivoted on the disk 21 by a stud 24 and guided by a guide 25 which insures the continual alinement of the lever 23. The under side of the lever 23 bears or rests on the upper end of the rod 17 an anti-friction device as a bearing ball being interposed between the upper end of the rod 17 and the lever 23.

The frame containing the expansion rod is held in place by a casing made of a strip of angle iron 27 which is here shown as being secured to some overhead support and also secured by screws to the several disks. The pivoting point of the lever 23 and the contact point with the rod are close together while the long arm of the lever extends out a considerable distance. As the rod 17 expands more or less the outer end of the rod vibrates vertically and in connection with a suitable scale would serve to indicate the degree of concentration of the solution. It may also be employed to open and close the valve 6 by connecting the valve lever 13 which controls the valve with the lever 23 by a connecting rod 28 so that the rise and fall of the end of the arm 23 will open or close the valve as the case may be.

For the purpose of operating my device I make use of a standard electric current which is made to pass through the liquid solution and through my electric heating device. For this purpose I show herein a generator 29 arranged in the circuit, but it will be understood that this current may be taken from any outside current or otherwise supplied.

In the making of bisulfite of lime, as the acidity increases the conductivity of the liquor increases so that as the free acid increases the current through the wire 16 will increase and the rod 17 increases in length throwing up the arm 23 and partially opening the valve. This lets more lime water flow into the tank, neutralizing the acid and reducing the quantity of free acid. When the acidity falls the opposite effect takes place and the valve is partially closed, shutting off the flow of lime water and causing the valve to close.

It will be seen that this apparatus is adapted to be used either in indicating or regulating the concentration of any chemical solution where the electrical conductivity of the solution varies with the degree of concentration.

The apparatus is adapted to be used in any process where a product of uniform character is being made by combining two or more substances and where the degree of concentration is governed by the resistance of a standard electric circuit.

I claim:

1. In an apparatus for determining the concentration of a chemical solution, a re-

ceptacle for said solution, means for passing a current of electricity through the solution, an electric heating device through which said current passes having an expansion member and a movable element moved by the expansion of said member.

2. In an apparatus for determining the concentration of a chemical solution, a receptacle for said solution, means for passing a current of electricity through the solution and an electric heating device through which said current passes having an expansion member and a lever arm connecting with said expansion member for receiving motion from the same.

3. In an apparatus for regulating the concentration of a chemical solution, the combination of an elongated expansion rod, a heating wire surrounding said rod, means for passing a current of electricity through the solution and through said heating wire, a lever arm connected with said rod and arranged to be moved by the longitudinal motion of the same under the influence of the change of temperature.

4. In an apparatus for regulating the concentration of a chemical solution and other like purposes, the combination of a tank for said liquor, a supply valve for said tank, a pair of electrodes immersed in the liquor, an electric heating device having an expansion member, an electric circuit including said electrodes and said electric heating device, a lever connecting with the end of said expansion member, a connecting rod connecting said lever with said valve for controlling the valve.

5. In an apparatus for regulating the concentration of a chemical solution and other like purposes, the combination of a tank through which said liquor passes, a supply valve for said tank, a pair of electrodes immersed in the liquor, an electric heating device having an expansion rod, an electric circuit including said electrodes and said electric heating device, a lever arm pivoted adjacent to said expansion rod, a bearing ball interposed between the end of said rod and said arm, a valve lever for controlling operation of said valve, and a connecting rod for connecting said valve lever and said lever arm.

JOSEPH B. CRANDON.