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ACID RECLAIMING APPARATUS FOR SULFITE MILLS.

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1,183,152. Patented May 16, 1916.

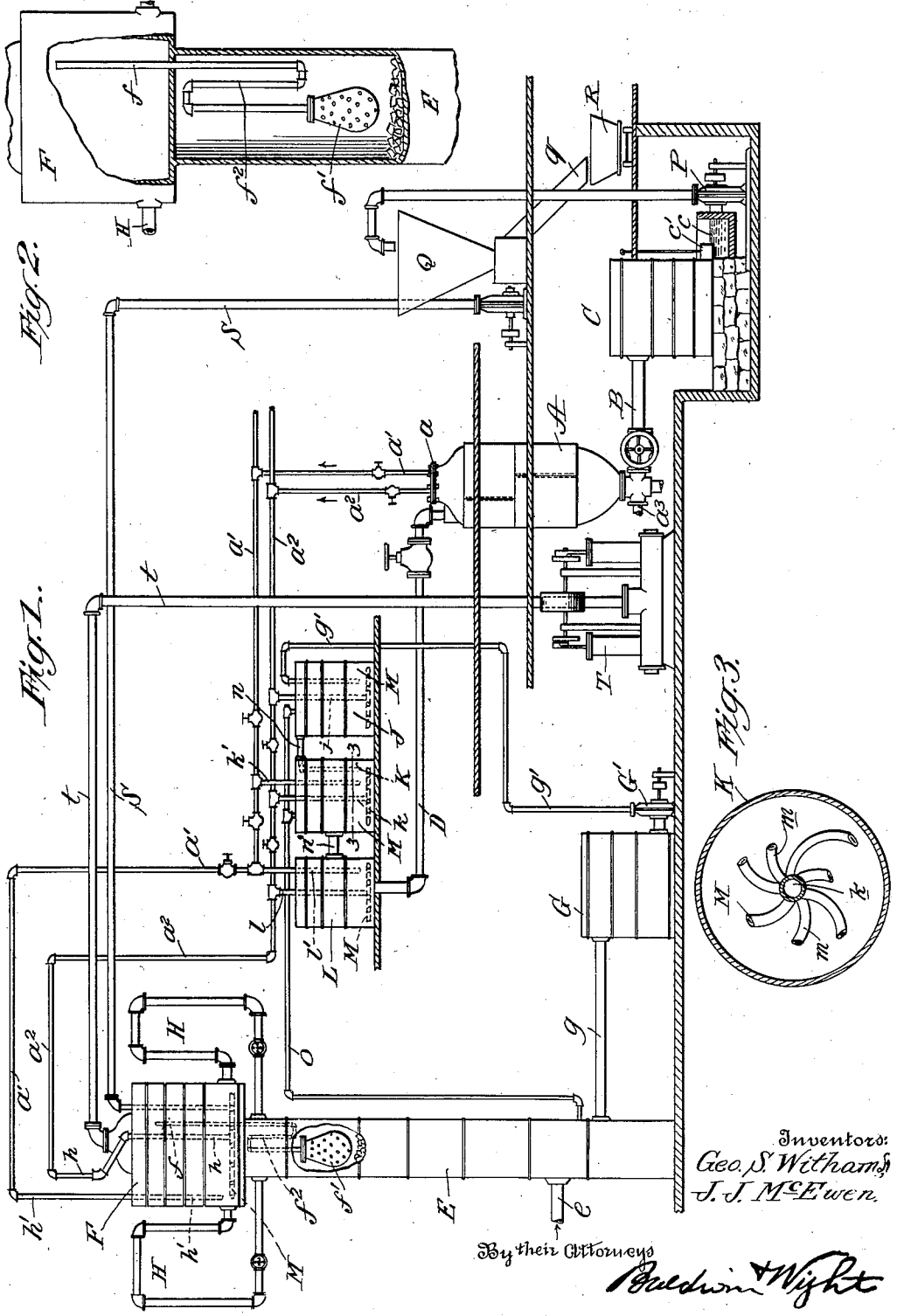


Fig. 2.

Fig. 1.

Fig. 3.

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UNITED STATES PATENT OFFICE.

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ACID-RECLAIMING APPARATUS FOR SULFITE-MILLS.

1,183,152. Specification of Letters Patent. Patented May 16, 1916.

Application filed December 11, 1915. Serial No. 66,391.

To all whom it may concern:

Be it known that we, GEORGE S. WITHAM, Sr., of Hudson Falls, in the county of Washington and State of New York, and JAMES J. McEWEN, of Fort Edward, in the county of Washington and State of New York, both citizens of the United States, have invented certain new and useful Improvements in Acid-Reclaiming Apparatus for Sulfite-Mills, of which the following is a specification.

This invention relates to certain improvements in apparatus employed for the manufacture of wood pulp by the well known sulfite process, in which the wood in suitably sub-divided form is "cooked" in a digester while mixed with sulfite liquor under heat and pressure produced by steam admitted to the digester. In such a system it is usual to relieve the pressure in the digester at frequent intervals in order to reduce it and to admit more of the heating agent, and it is the practice after the cooking operation is complete to pass the contents of the digester to what is called a "blow-pit".

Ordinarily the gases and liquor discharged from the top of the digester when relieving it of pressure are wasted, although various ways of utilizing or reclaiming them have been proposed, and it is customary to discharge the liquor passing with the treated fiber from the digester to the blow-pit, and to entirely discard said liquor.

According to our invention, we provide means whereby all the gases and liquor withdrawn from the digester through the relief valves is saved and combined with the sulfite liquor for charging the digester. We also provide means whereby the liquor withdrawn from the digester with the cooked fiber is combined with the fresh sulfite liquor while the latter is being formed for use in the digester.

In carrying out our invention, we provide means, preferably in the form of a vertical tube or tower, for combining sulfur dioxid (SO_2) with an alkaline liquor such as lime water, and we provide means for mixing the sulfite liquor thus formed with the gases and liquor withdrawn from the top of the digester and also with the liquor withdrawn from the bottom thereof in such manner as to provide a sulfite liquor suitable for use in the digester.

More specifically the preferred apparatus comprises a tower containing lime stone and to which sulfur dioxid from a sulfur burner is admitted near the bottom and to which liquid, such as water, is supplied at the top. The acid liquor formed is conveyed to a tank which also receives the gas withdrawn from the top of the digester, and from this tank the acid liquor thus enriched overflows to another tank which receives the liquor withdrawn from the top of the digester. From this latter tank the enriched liquor passes to a third or storage tank, which supplies the digester with the enriched sulfite liquor.

When the digester is "blown" or emptied, its contents pass to the blow-pit and after most of the fiber has been separated from the liquor the latter is conveyed to an apparatus which separates the remaining fibers from the liquor, the former being carried away by suitable trucks and the latter being conveyed to a tank above the tower, from which tank the liquor descends into the tower and passes downwardly through the limestone therein. The tank is connected with the tower by a conduit which conveys the unabsorbed gases which reach the top of the tower to the tank above it, where they are to a large extent absorbed by the liquor therein. In this way we are enabled to use a relatively short tower as the gas which first enters the bottom of the tower is, to a large extent, absorbed before reaching the top thereof and such gases as do reach the upper end of the tower are conveyed to the tower supply tank and are absorbed by the liquid therein and descend with such liquid into the tower and act upon the lime stone therein. In this way practically all of the gases entering the tower are completely absorbed.

We provide the several tanks with means of novel construction which cause the gases and liquors withdrawn from the digester to be thoroughly intermingled in such manner that the gases are thoroughly mixed and absorbed and there is no loss of gas in the process.

In our reclaiming system the gases are made to traverse gas-tight tanks and conduits so that no gases or vapors are lost but are all absorbed and enter into combination with other constituents of the liquor, while the liquor passing from both the top and bottom of the digester is conveyed to

suitable parts of the apparatus where it is combined with the sulfite liquor for charging the digester. In this way there is no loss of the chemical agents employed as they are all reclaimed and used in the process so that a very large saving in the consumption of sulfur is effected.

Experience has demonstrated that by the use of our apparatus the quality of the pulp is improved and there is a very large saving in the cost of operation. Usually sulfite mills as at present operated consume from 275 to 350 pounds of sulfur to each ton of sulfite, while we only use from 200 to 215 pounds of sulfur to the ton.

In the accompanying drawings, we have shown our acid reclaiming system applied to a single digester, but it will be understood that it may be embodied in a plant or system in which a plurality of digesters are used.

Figure 1 shows diagrammatically apparatus embodying our invention. Fig. 2 is a detail view on an enlarged scale of parts of the tower and the tower supply tank. Fig. 3 shows a section on the line 3—3 of Fig. 1, and illustrates on an enlarged scale one of the mixers which we employ.

The digester A is, as usual, equipped with a removable top a, a relief pipe a' for liquor and a relief pipe a^2 for gas. Steam may be admitted at a^3 as usual, and the digester may be emptied through a pipe B leading to a blow-pit C. The digester is supplied with sulfite liquor through a pipe D.

E indicates a tower for containing limestone. Sulfur dioxid from a sulfur burner is admitted to the lower portion of the tower through a pipe e. This tower may be of usual construction, but is not so high as those ordinarily used. Instead of making the tower 120 feet high as is often the case, we preferably make it half as high, say 60 feet. On top of the tower there is a tank F to which water may be supplied in any suitable way. This tank is closed gas-tight and communicates with the tower through a pipe f provided with an enlarged perforated discharge end f' and with a looped portion f^2 providing a column forming a trap or seal. It will be observed that the pipe f extends to near the top of the tank and the liquid overflows through this pipe and passes down through the limestone in the tower. The sulfite liquor thus formed passes through a pipe g to a tank G. Any gas which after having passed upwardly through the tower is unabsorbed by the liquid, passes through the pipes H to the lower portion of the tank F and is practically all absorbed by the liquid therein.

We preferably employ three mixing tanks J, K, L. These are closed at the top, being gas-tight throughout. The gas relief pipe a^2 extends to the tanks J and K and is provided with branches j, k extending to the bottom thereof through the closed tops, and said pipe a^2 is preferably extended, as shown, and provided with a branch pipe h extending into the tank F. The liquor pipe a' is provided with branch pipes k', l' extending into the tanks K and L and also with a branch pipe h' extending into the tank F, the arrangement being such that when the valves of the pipes a, a', are opened, the gas and liquor withdrawn from the digester may pass into the mixing tanks. We would say, however, that it is not absolutely necessary that the gas and liquor should pass into all the tanks mentioned. We prefer to have the gas pass into the tank J and the liquor into the tank K, but improved results are obtained by having the gas and liquor pass into the several tanks, as indicated in the drawings.

In order to obtain the best results it is important that the gases or bubbles admitted to the mixing tanks should be delivered thereto in a sub-divided condition in order that they may be completely absorbed, and for this purpose we employ a mixer M which is preferably constructed in the manner indicated in Fig. 3. Each of the pipes j, k and h shown in the drawings may be provided with such a mixer and we may also provide the gas pipe a^2 with a branch pipe l extending into the tank L and this pipe may also be provided with a mixer. Such mixer, as shown, comprises a series of hollow arms m communicating with the supply pipe. These arms are preferably curved, as shown, and are arranged radially with reference to the vertical axis of the supply pipe. They are of different lengths as shown, as by this arrangement the gas in the form of bubbles is made to enter the tank at different radial distances from the central axis of the tank. The mixer is stationary, but as the acid or gas leaves the arms m a circular motion is given to it and as the arms are of different lengths a pressure is exerted at a different radial distance from the central vertical axis of the supply pipe. This produces a whirling motion of the liquor which is found to be most efficient in the process. The liquor entering the tank J overflows through a pipe n to the tank K and from the tank K the liquor passes through a connection n' to the tank L which supplies the digester. When the apparatus is properly working the gases are completely absorbed, but as a precaution we provide a pipe O, connecting with the tanks J, K and L and leading to the lower portion of the tower E, to convey thereto any gases that may not be absorbed in the tanks. The acid liquor which passes from the bottom of the tower is first received by a tank G, from which it is taken to a pump G' and elevated through a pipe g' to the tank J and in the

tanks J, K and L it mixes with and is enriched by the gases and liquor withdrawn from the top of the digester, and as before stated, the liquor thus enriched is drawn from the supply tank L and conveyed to the digester as needed.

When the digester is "blown" its contents are conveyed to a blow-pit C, which may be of usual construction. The contents of the blow-pit may be transferred at suitable intervals to a box or trough c by way of a gate c'. Most of the fibers are here separated from the liquor and from this trough c the remaining fibers and liquor are elevated by means of a pump P to a separator Q which may be of any suitable construction. From the separator the fiber passes by means of a chute q to any suitable receptacle, such as a truck R. The liquor thus separated from the fiber is conveyed by a pipe S to the tank F where it is mixed with the liquor in said tank and passed through the system in the manner before described. In order to promote the mixing of gas with the liquor in the tank F we employ a vacuum pump T, of well known construction, which is connected by a pipe t with the top of the tank F. It will be understood that this tank is closed gas-tight but is connected with the vacuum pump for the purpose of producing such relief of pressure as to cause the gases to readily ascend in the tower and in the tank and convey off the unabsorbed gases. The pipe f serves to convey liquor from the tank F to the tower. The loop f^2 in said pipe provides a liquid column which forms a trap or seal high enough to overcome any partial vacuum produced in the tank and thus prevent any gas from passing from the tower through said pipe to the tank. The partial vacuum produced in the tank F prevents liquor from rising in the pipes H and causes gas to be drawn through said pipes from the tower to the tank.

It will be understood that the valve of the gas pipe a^2 is closed while the digester is being relieved of liquor. When the liquor has all been blown off the valve of the liquor pipe is closed and the valve of the gas pipe opened to relieve the pressure and permit the remaining gases to pass to the mixing tanks.

Some of the apparatus is merely illustrative in a conventional way but the details of construction are well known to those skilled in the art to which this invention relates. For the most part our invention is not limited to any specific form of apparatus but consists in subject matter hereinafter specified.

It will be understood that the lime required for the sulfite liquor is derived from the lime stone contained in the tower but if necessary lime, in the form of milk of lime, for instance, may be added to the pump box connected with the separator Q. Such additions are, however, rarely neccssary. Liquor is taken from the pump box and delivered to the tank F. The blow pit C is also a washing tank and water is supplied to this tank for the purpose of washing the fibers by a hose. The supply is not fixed but is used when required.

The separator extracts all solid matter from the liquor before said liquor passes to the lime tower. Fresh water is added to the pump box as often as required to compensate for the natural shrinkage in continuous operation. The fresh water added is sufficient to prevent the liquor from becoming thick or intensified. This operation can be carried on for an indefinite time. Whatever gums pass from the separator to the lime tower are deposited in the lime tower as a residue.

We claim as our invention:—

1. A reclaiming apparatus for sulfite mills, comprising a tower for mixing sulfur dioxid containing gases with an alkali, a mixing tank to which the acid liquor is conveyed from said tower, a digester, means for conveying gases and liquor withdrawn from the digester to said mixing tank, means for thoroughly mixing said last mentioned gases with the liquor, and means for conveying the enriched liquor to the digester.

2. A reclaiming apparatus for sulfite mills, comprising means for mixing sulfur dioxid containing gases with an alkali, a closed gas-tight mixing tank to which the acid liquor is conveyed from said mixing means, a digester, means for conveying gases withdrawn from the digester to said mixing tank, means for thoroughly intermingling said last mentioned gases with the liquor, and means for conveying the enriched liquor to the digester, means for discharging the contents of the digester, means for separating from the fibers discharged by the digester the liquid therein and means for conveying such separated liquid to the means for mixing sulfur dioxid containing gases with the alkali.

3. A reclaiming apparatus for sulfite mills, comprising means for mixing sulfur dioxid containing gases with an alkali, a mixing tank to which the acid liquor is conveyed from said mixing means, a digester, means for conveying gases withdrawn from the top of the digester to said mixing tank, a mixer through which said gases are delivered to the liquor in the mixing tank and which comprises a series of radially curved hollow arms of different lengths.

4. In a reclaiming apparatus for sulfite mills a mixing tank where gases withdrawn from a digester are mixed with sulfite liquor and which is provided with a mixer for the gases withdrawn from the digester consist-

ing of a series of radially curved hollow arms of different lengths.

5. In a reclaiming apparatus for sulfite mills, a tower, means for supplying sulfur dioxid containing gases to the lower portion thereof, a supply tank above the tower and connected therewith, means for producing a partial vacuum in the tank, connections between the upper portion of the tower and the lower portion of the tank for conveying gases from the top of the tower to the tank, a mixing tank to which the acid liquor is conveyed from said tower, a digester, means for conveying gases and liquor withdrawn from the digester to said mixing tank, means for thoroughly mixing said last-mentioned gases with the liquor, means for conveying the enriched liquor to the digester, and means for conveying gases not absorbed in the mixing tank to the lower portion of the tower.

6. In a reclaiming apparatus for sulfite mills a tower, means for supplying sulfur dioxid containing gases to the lower portion thereof, a supply tank above the tower and connected therewith, a digester, means for discharging the contents of the digester, means for separating from the fibers discharged by the digester the liquid therein, and means for conveying such separated liquid to the tank above the tower.

7. A reclaiming apparatus for sulfite mills, comprising means for mixing sulfur dioxid containing gases with an alkali, a series of mixing tanks, means for conveying the sulfur treated alkaline liquor to each of said mixing tanks, a digester, means for conveying gases and liquor withdrawn from the digester to said mixing tanks, a storage tank to which the enriched liquor is delivered, and connections between said storage tank and the digester.

8. A reclaiming apparatus for sulfite mills, comprising a tower, means for admitting sulfur dioxid containing gases to the lower portion thereof, a gas-tight tank above the tower for containing liquor, means for conveying said liquor to the upper portion of the tower, means for producing a partial vacuum in said tank, connections between the upper portion of the tower and the lower portion of the tank to convey gas from the tower to the tank, a digester, means for separating from the fibers discharged by the digester liquor mixed therewith, means for conveying such separated liquor to the tower-supply tank, mixing apparatus, means for conveying to said mixing apparatus acid liquor from the tower, and means for conveying to said mixing apparatus gases and liquor withdrawn from the top of the digester.

In testimony whereof, we have hereunto subscribed our names.

GEORGE S. WITHAM, SR.
JAMES J. McEWEN.

Witnesses:
GEORGE G. DURANT,
GEORGE W. LYON.