Sept. 20, 1938. C. K. TEXTOR 2,130,402

APPARATUS FOR CHLORINATING PULP

Filed Dec. 11, 1935

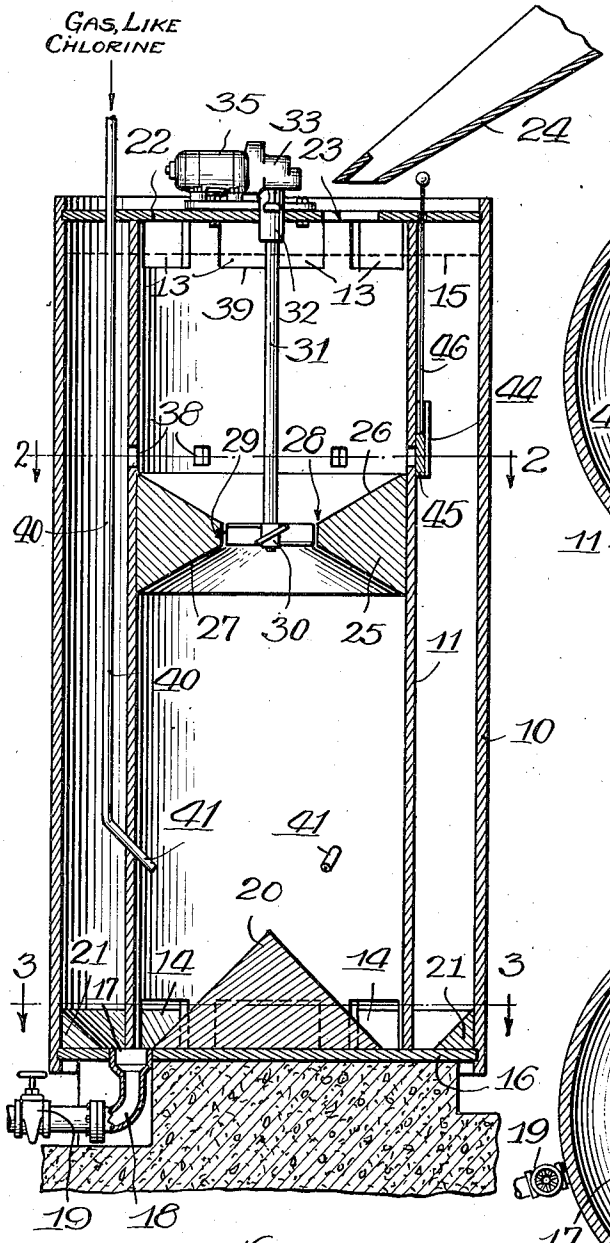


Fig. 1

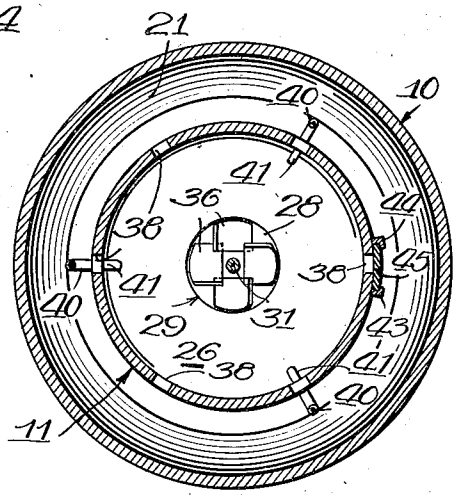
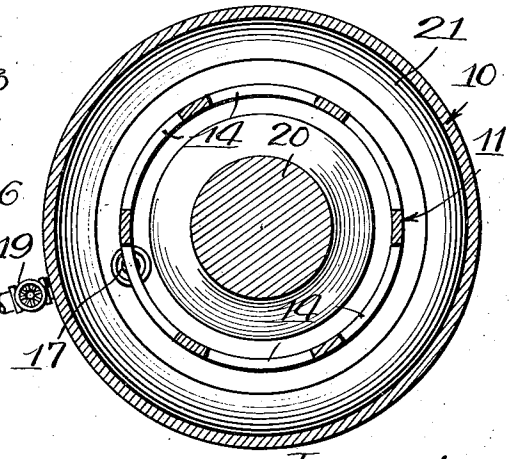


Fig. 2

Fig. 3



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Patented Sept. 20, 1938

2,130,402

UNITED STATES PATENT OFFICE

2,130,402

APPARATUS FOR CHLORINATING PULP

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Application December 11, 1935, Serial No. 53,886

2 Claims. (Cl. 261—93)

The present invention relates to apparatus in which gas is introduced into a liquid for an absorption or reaction with the liquid or material suspended therein. In particular it relates to method and apparatus for treating cellulosic pulp with chlorine, to effect bleaching thereof, as is commonly practiced in paper mills.

Apparatus has been specially provided for the purpose of chlorinating pulp, but in many respects it is defective. There is known apparatus which is in many respects similar to that herein described, but certain defects therein have been overcome in the present invention. Time efficiency in the process, apparatus cost and maintenance, and power costs are particular items in which older practice has been improved.

The older apparatus involves an outer circular tank and an inner concentric cylinder, open at both ends, with a propeller arranged to circulate a pulp slurry either upwardly or downwardly through the inner cylinder and back through the annular space. Such apparatus provides a propeller at the bottom of the inner cylinder, and the depth of apparatus necessitates a bearing below the liquid level. Where chlorine is employed the corrosive action is destructive of the bearing structure and surfaces, or else a very expensive bearing must be provided.

Another feature of disadvantage in prior art structures is the use thereof involving much power to cause a downward flow at a velocity which overcomes the tendency of chlorine bubbles to rise. Such high downward velocity necessitates a high upward velocity in the circuit, and this tends to carry rising bubbles more quickly to the top.

The present invention aims to provide a structure in which bearings are eliminated below the liquid level, and in which the velocity requirements of the moving stock are materially lessened, thus to conserve power in operation.

Another object of the invention is to permit circuitous flow of stock at a velocity upwardly which is very slow, and at a velocity downward which is not determined to overcome tendency of bubbles to rise.

Still another object of the invention is the provision of a slowly downwardly moving column of stock in which bubbles may rise, and the provision in the column of a constriction through which the velocity of the stock prevents the passage of rising gas, thus effecting a "velocity seal".

Various other and ancillary objects and advantages of the invention will appear from the description and explanation of the invention given hereinafter in reference to the practical use thereof in the exemplary apparatus illustrated in the accompanying drawing in which:

Fig. 1 represents a vertical section through the center of the apparatus.

Fig. 2 shows a horizontal cross-section on the line 2—2 of Fig. 1.

Fig. 3 shows a horizontal cross-section on the line 3—3 of Fig. 1.

It is to be understood that the illustrated example of the apparatus can be modified in numerous ways without departing from the invention herein described and claimed.

Generally the apparatus provides a liquid circuit with an upward passage-way and a downward passage-way. Practically, this is accomplished by placing in the middle of a vessel a tubular shell with both ends open below the liquid level in the vessel. Where gas is introduced, such as chlorine for bleaching paper pulp in suspension in the liquid, there are times in the process where gas may be introduced faster than it is used or absorbed by the liquid, with the consequent formation of bubbles or bodies of gas. These tend to rise and may be lost. For the entire downwardly moving column it has heretofore been proposed to use a high velocity to prevent gas bubbles rising therethrough. Increasing the downward velocity in any apparatus also increases the upward velocity, and such bubbles of gas as get into the upward column are more quickly carried to the top and may be lost. Hence slow upward velocity and high downward velocity are desirable for prior art apparatus, but these are quite antagonistic requirements in the apparatus employed heretofore.

The first step in improvement over the older practice is to decrease the velocities of both columns, giving less tendency to loss in the upward column. The decrease in velocity of the downward column may be carried so far as to permit gas to rise in it. However, as a safe-guard a velocity seal is provided in the downward column above the point of introducing the gas. By constricting the column at a narrow zone in an amount conditioned by the rate of flow in the column, the velocity can be made to bar the rise of gas and even hold below said constriction a pocket of the gas. As a further assurance for positive action of the seal, the circulating means is located in the constricted zone.

For convenience of construction it is best located in the shell. Where a rotary propeller is used, it is most practical to use a cylindrical shell, and for this reason the vessel itself is preferably cylindrical. A propeller will function to maintain general circulation irrespective of its location in the shell. However, the higher the propeller is located in the shell, the less it may whip, and it may more easily be supported from outside the vessel. In a like manner the smaller the propeller, the less power it takes, and the less it stirs the column. The constriction of the column is made circular and is placed high, thus to afford a small circular orifice in which to lo-

cate the propeller. Thus less power and less stirring results. The columns flow more generally vertically, up and down, with good mixing and agitation only at a small zone in the circuit, which provides the velocity seal. The work of the propeller is in effect only for agitation and that effort to overcome friction. By making the upward column and the downward column substantially the same in cross-section the one balances the other and lessens the work of the propeller.

For all the reasons above set forth the invention is most simply carried out in apparatus as follows:

A vessel **10** preferably provides a deep cylindrical well-like container, such as one which is about 27 feet deep and about 13½ feet across. It may be made of wooden staves for chlorination of paper pulp. Within it is formed a tubular shell **11**, which is preferably cylindrical and concentric with the vessel **10**. This may be about 9 feet in diameter. It also may be made of wooden staves, but openings **13** are provided at the top, and openings **14** at the bottom to permit circulation through it of liquid, the level of which is shown at line **15**. A suitable bottom **16** is provided through which there is an outlet opening **17** for the pipe **18** with valve **19**. On the bottom centrally is a baffle cone **20**, as of solid wood to direct the downwardly flowing liquid laterally, and to avoid stagnation. Similarly there is a fillet **21** at the outer edge of the bottom to move stock upwardly, and to avoid stagnation. The top of the vessel **10** has a closure **22** with opening **23**, into which stock may be introduced as from chute **24**.

Part way down in the shell there is an annulus **25** with lower and upper inclined faces **26** and **27** forming a circular throat **28**, having a short cylindrical wall **29**. Within the throat is located a propeller **30** on shaft **31**. The shaft is supported wholly from above the liquid level **15**, as by the bearing or mounting **32**. Driving means is indicated by a gearing box **33** and a motor **35**. The propeller has a depth corresponding closely to the short wall **29** of the throat, and its blades **36** are wide and slightly inclined, and extend closely to the wall **29**. Just above the annulus **25** there are holes **38** about 6 inches square in the shell **11**, to provide for circulation when the level of liquid is below the bottom **39** of the top openings **13**.

Tubes **40** for introducing gas are located to discharge the gas into the shell below the annulus **25**. Preferably these are placed low, giving the gas some opportunity to rise and to react as it rises. Excess gas will not pass the throat **28** in proper operation. Where chlorine is the gas used, rubber hose is suitable for the tubes **40**. The ends **41** project downwardly at an angle as shown. Three ¾ inch rubber hose are suitable for the apparatus described when used for chlorinating paper pulp.

In operation for chlorinating pulp, stock is run into the vessel **10** from chute **24**, thus filling the vessel and the shell. A slurry of 2½% to 4½% consistency is suitable. When the level reaches the holes **38** circulation may begin and chlorine may be introduced. The speed of the rotary propeller may vary and preferably is limited between that low speed which effects the velocity seal, and that high speed which tends to carry gas bubbles down with the pulp, out of the shell and into the up-stream. This does not mean that action does not occur in the up-stream, because the chlorine is soluble to a limited extent, and while in solution it can act in the up-stream. Also, because the motion is relatively slow, the circulation can approach or even pass the upper limit of speed referred to provided that gas bubbles carried into the up-stream disappear as bubbles before they arrive at the top. When chlorination is sufficiently complete the valve **19** may be opened, and circulation can continue until the liquid level drops below the holes **38**.

The holes **38** serve also to short circuit part of the stock. Where little or no bleaching action takes place above the level of the holes on the outside of the shell, there is no need for all the stock to travel up and over the top of the shell to be recirculated. Suitable gates may be provided over the holes **38** to close them in whole or in part. One such gate is illustrated as having guides **43** and **44**, a gate member **45**, and a controlling rod **46**. Control of the gates may limit or prevent the short-circuiting of part of the stock.

The invention therefore contemplates apparatus for the chlorination of pulp by methods dependent upon the type of apparatus described and claimed, the apparatus being highly efficient and greatly improved over the equipment used heretofore, as set forth in the appended claims.

I claim:

1. Apparatus for treating liquid and pulp slurries with gas comprising a vessel, a vertical tubular shell within said vessel open at the top and bottom to liquid in said vessel for circuitous flow of liquid through said shell, means providing an annular constriction in the passage-way through said shell adjacent the upper end providing a reaction chamber below said constriction, propelling means located in and substantially filling the opening of said constriction for circulating the liquid, the opening of said constriction and the size of the propelling means being such that operation of the propelling means creates a velocity of the slurry at said constriction which prevents gas rising through said constriction, and means for discharging gas into said reaction chamber below said propelling means.

2. Apparatus for treating liquid and pulp slurries with gas, comprising a straight-sided vertical tubular vessel, a straight-sided vertical tubular shell within said vessel open at top and bottom to liquid in said vessel for circuitous flow of liquid through said shell, the cross-sectional area of the liquid path of the shell being substantially equal to the remaining liquid path of the vessel whereby circulation up and down is at substantially the same velocity, means providing an annular constriction in the passageway through the shell adjacent the upper end of the shell providing a reaction chamber below said constriction, a rotary propeller located in and substantially filling said constriction for circulating the liquid, the opening of said constriction and the size of the propeller being such that operation of the propeller creates a velocity of liquid at said constriction which prevents gas rising through said constriction, and means for discharging gas into said reaction chamber below said propeller.

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