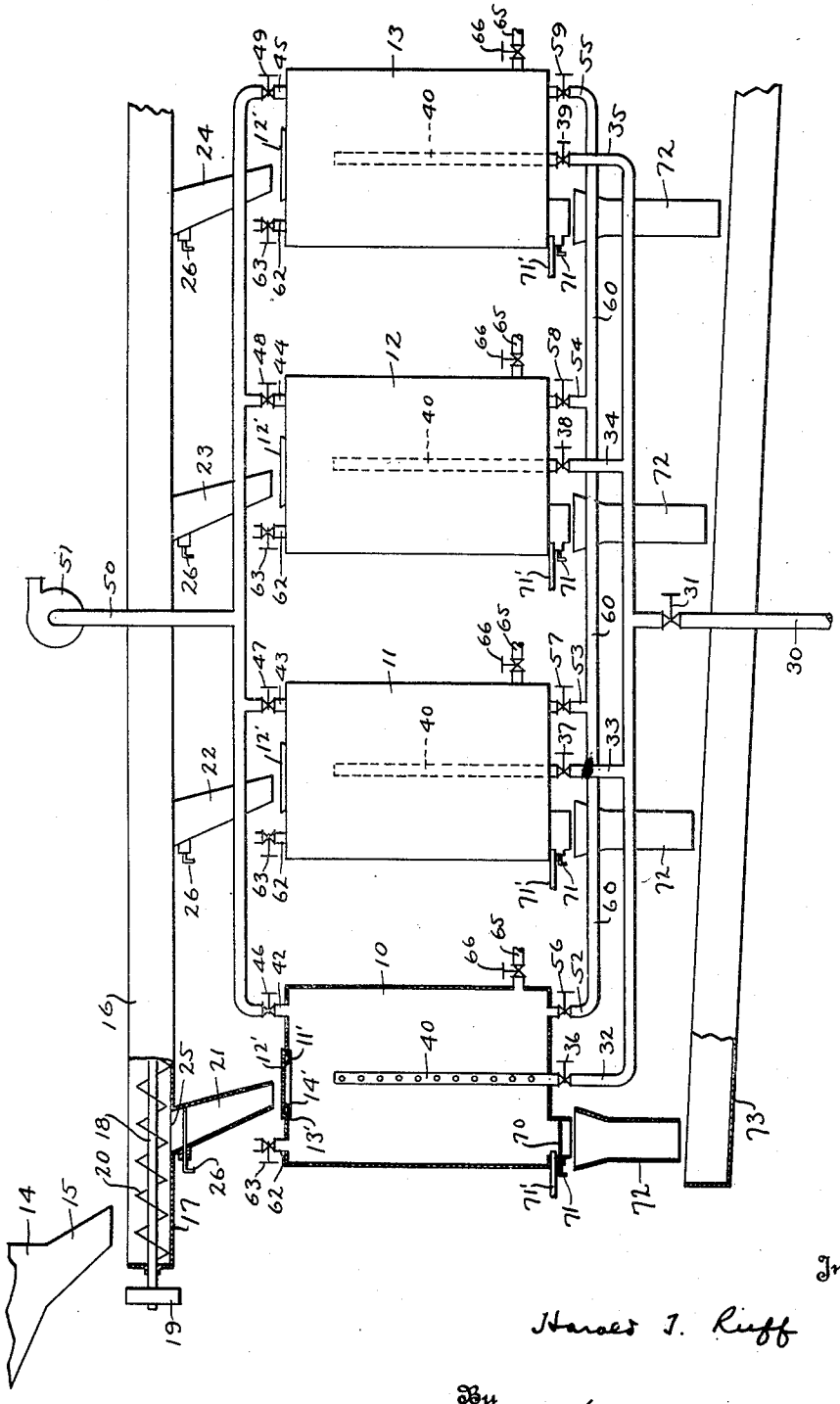
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PAPER MANUFACTURE

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PAPER MANUFACTURE

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This invention relates to the manufacture of paper, and particularly to the treatment of fibrous material in the production of pulp.

One of the principal objects of the invention is to provide a method for effectively and economically treating fibrous material with a halogenating agent in the manufacture of pulp.

Another object of this invention is to provide a method of chlorinating fibrous material at high consistency with a gaseous chlorinating agent, which permits of controlled and effective treatment, with high economy in the use of the chlorinating agent.

Still another object of the invention is to provide apparatus for carrying out the above method, which apparatus is simple in construction, highly effective in operation, providing accurate control with a uniform production of treated fibrous material, while insuring against the escape of objectionable fumes.

Other objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawing and appended claims.

In the drawing, the single figure is a diagrammatic elevational view, partly in section, of apparatus constructed for carrying out the method of this invention.

The invention is applicable to the chlorinating treatment of fibrous materials generally, such as wood, straw, fibrous grasses and analogous materials, in the manufacture of pulp or analogous materials. It is suitable for the treatment of highly lignified fibrous material, and can be employed not only for bleaching, but also as a pulping step in the disintegration of undefibered fibrous material. For example, fibrous material which has been given a preliminary incomplete or partial digestion or steeping so as to incompletely remove non-fibrous bonding constituents, can then be subjected to the treatment of this invention to effect further pulping and removal of such non-fibrous constituents. The invention is also applicable generally for bleaching pulp or fibrous material, or for any pulping or bleaching process involving gas chlorination as a step thereof.

Referring to the drawing, in which a preferred embodiment of the invention is illustrated, a plurality of chlorinating chambers are mounted in alignment, four chambers being shown at 10, 11, 12 and 13 respectively. Each chamber comprises a shell constructed of acid proof material such as tile, the size of the shell depending upon the desired capacity of the particular plant and the number of chambers used. The shell is provided with an opening 11′ in the upper portion thereof closed by a removable cover 12′. Preferably the cover 12′ is water sealed, such as by providing flanges 13′ and 14′ on the top of the chamber to form an annular basin for containing a sealing liquid within which the cover 12′ dips. Fibrous stock to be treated is supplied from a bin or storage tank 14 through the chute 15 to a conveyor 16, shown as an open trough 17 having mounted therein a longitudinal shaft 18 driven by a pulley or gear 19 from any suitable source of power, the shaft carrying a helical screw 20 for progressively feeding the fibrous material along the trough. The common conveyor 16 is arranged above the chlorinating chambers 10—13 in alignment therewith, and is provided at spaced points with a plurality of downwardly depending chutes 21—24 adapted to introduce the fibrous material into the several chambers 10—13 when the respective covers 12′ are removed. Each chute communicates with trough 17 by an opening 25 in the bottom wall thereof, this opening being controlled by a suitable slide valve 26, so that the fibrous material may be selectively fed to each of the chambers by proper manipulation of the valves 26.

The present invention is particularly adapted for the treatment of fibrous material with a gaseous halogenating agent, such as chlorine gas. For the most effective operation, the fibrous material is preferably supplied at a high consistency such as to be readily permeable to gas. For example, fibrous material, or pulp stock, at a consistency in excess of 15% gives very satisfactory results. This material is readily handled by the screw

conveyor illustrated, and is selectively supplied to any one of the chambers during the filling operation. A common chlorine gas main 30 having a control valve 31 communicates with each of the chambers by pipe connections 32—35 having respective control valves 36—39. Each chlorine gas introduction pipe may open adjacent the lower end of its respective chlorinating chamber, or as shown may extend upwardly within the central portion of the chamber as indicated at 40, the pipe being perforated throughout its length within the chamber to secure a uniform distribution of the chlorinating agent through the fibrous material therein.

Gas offtakes 42—45 having respective control valves 46—49 communicate with a common suction main 50 leading to a suitable source of suction such as a suction pump 51. Each of the gas offtakes preferably communicates with the upper portion of its respective chlorinating chamber, so that the introduction of chlorine gas into the fibrous material may be assisted by connecting the respective offtake at the upper portion of the chamber to the suction pump 51, whereby the air within the chamber is exhausted and the chlorine gas uniformly introduced in a rising column within the chamber.

The respective chlorinating chambers are also provided with pipe connections 52—55 having respective control valves 56—59 communicating with the lower portions of each of the chlorinating chambers and connecting to a common by-pass main 60. Each chamber is also provided, preferably adjacent the upper end thereof, with a pipe 62 controlled by a suitable valve 63 which opens to atmosphere or communicates with a suitable source of inert fluid, such as a gas or vapor which does not objectionably react with the chlorinated material or pulp. Adjacent the lower end thereof, each chamber is provided with a pipe 65 controlled by a valve 66 communicating with a source of water or other suitable slushing liquid under pressure.

In operation, assuming the chamber 10 is to be supplied with fibrous material, the cover 12′ is removed and the valve 26 opened, so that the operation of the screw conveyor 16 serves to feed fibrous material through chute 21 into the chamber 10 until it is substantially filled. The cover 12′ is then replaced, valve 26 closed, and then the cover 12′ of another chamber such as chamber 11 is removed and the valve of chute 22 opened so that fibrous material may then be supplied to this chamber while the chlorinating operation proceeds in chamber 10. This is accomplished by opening valves 31, 36 and 46, so that the chamber 10 is connected to the suction pump and to the chlorine gas main, the chlorine gas thus being drawn into the chamber through the perforated distribution pipe 40 until the level of the gas appears above the fibrous material within the chamber, as can be determined by a suitable sight glass or gage. It is not essential that the chamber be connected to the suction pump during the introduction of the chlorine gas or other chlorinating agent, but this is preferred in order to minimize the danger of gas leakage. The fact that the chlorine is drawn into the chamber under subatmospheric pressure insures against escape of gas from the chamber with resultant contamination of the surrounding atmosphere. When the chamber is properly filled or supplied with chlorinating gas, the valves 36 and 46 are then closed, and the chamber 10 allowed to stand for a suitable time, such as about 20 minutes, to permit the chlorinating action to proceed to substantial completion. Sufficient chlorine gas is supplied to the chamber to insure the substantially complete chlorination of the fibrous material therein.

In the meantime, chamber 11 has been filled with fibrous material and the cover of this chamber replaced, chamber 12 then being supplied and filled with the fibrous material, so that substantially continuous operation of the screw conveyor and the continuous and uniform feeding of the fibrous material from the common conveyor to one of the chambers is secured. Valves 56, 57 and 47 are then opened, so that chamber 11 is connected with suction main 50 by the offtake 43, and the lower portions of chambers 10 and 11 are connected with each other through the by-pass main 60. At this time, valve 63 is also opened so that an inert fluid such as air is drawn into the upper portion of chamber 10 through the pipe connection 62, or this may be permitted by loosening the cover 12′ and permitting air to pass in around the loosened cover. The suction pump 51 then draws this air down through the fibrous material within the chamber 10, serving to drive out excess chlorine gas remaining in the material, the mixed air and excess chlorine gas passing through the by-pass main 60 into the lower portion of the chamber 11. This mixed gas is then drawn up through the fresh untreated fibrous material within chamber 11, so that the chlorine gas contained in this gaseous mixture is absorbed by and reacts with the fibrous material therein.

As the reaction of the fibrous material with chlorine gas is very rapid, substantially all of the chlorine in this gaseous mixture is immediately absorbed by and used in reaction with the fibrous material. Thus the excess chlorine gas is effectively removed from the treated fibrous material in chamber 10, and economy is secured by the use of this gas in treating additional fibrous material in chamber 11. The remaining air and other fluid passes through the offtake 43 to the suction main 50 and is discharged to atmosphere or suitable main. This washing of the treated

fibrous material in chamber 10 is continued until substantially all the excess chlorinating agent is removed therefrom. The valves 63, 56 and 57 are then closed, and the valve 37 is opened, so that additional chlorine gas is supplied from main 30 to the distribution pipe 40 of chamber 11 until this chamber is supplied with the desired quantity of chlorine gas for the completion of the chlorinating action therein.

Valve 66 is opened in the meantime to permit water or other slushing liquid to be introduced into the lower portion of chamber 10 to dilute the treated stock therein and to slush it out through a discharge opening 70 controlled by a suitable valve 71 in the base of the chamber. Preferably the discharge 70 is also water sealed during operation, which may be conveniently accomplished by the provision of a small water pipe 71' for introducing a small amount of water above the valve 71 prior to the chlorinating operation. The fibrous material of high consistency within the chamber 10 moves downwardly therein by gravity as material at the bottom is slushed out from the chamber. This diluted stock discharges through a suitable chute 72 into an inclined trough 72 which extends longitudinally beneath the several chlorinating chambers. The discharge openings 70 of these several chambers, which are controlled by valve 71 in the manner of chamber 10, also feed through suitable chutes 72 into the trough 73, so that a common discharge conveyor or trough receives the treated material discharged from the several chambers and leads this material to a suitable stock chest (not shown).

During the emptying of the chamber 10, the chlorination of the fibrous material in chamber 11 proceeds to completion, while chamber 12 is filled with fibrous material or stock to be treated. The valves 37 and 47 having been closed when sufficient chlorine has been introduced into chamber 11, then at the completion of the chlorinating action therein, the valves 57, 58 and 48 are opened and also valve 63 of chamber 11. so that air is drawn into and through the fibrous material within chamber 11 to wash out the excess chlorine gas from the fibrous material therein, the mixed air and chlorine gas passing through the by-pass main 60 into the lower portion of chamber 12 in the manner previously described for chambers 10 and 11. During this time, chamber 13 is being filled with fresh fibrous material, while the emptying operation of chamber 10 is being completed. This operation is then repeated for chambers 12 and 13, so that the excess chlorine gas washed out of the fibrous material in chamber 12 is absorbed by and reacts with the fibrous material in chamber 13; and then in the next stage of operations chambers 10 and 13 are connected by the by-pass main 60 so that the excess chlorine gas washed out of the fibrous material in chamber 13 is passed through the by-pass main and into chamber 10 which has been again filled with fibrous material to be treated. This cycle of operations is then repeated in the order stated.

While a smaller or larger number of chlorinating chambers can of course be used, preferably at least four such chambers are connected in a unit as shown, so that two of the chambers may be connected through the by-pass main for washing action of the chlorinating material in one chamber and the absorbing of the excess chlorine gas driven off of that material by the additional fibrous material in the other chamber, the third chamber at this time being emptied of treated fibrous material, and the fourth chamber being filled. A substantially continuous supply of the fibrous material to one of the chambers is thus permitted by the common feeding conveyor 16, and a uniform discharge of treated fibrous material from one of the chambers is received during operation by the trough 73 and supplied to a stock chest for further treatment. Other suitable gaseous halogenating or chlorinating agents can be used in accordance with this invention, such as gaseous bromine, or chlorine gas mixed with other gases. For example. a mixture of chlorine and air may be used to give a less active chlorinating reaction.

This invention thus provides a convenient means of treating shredded or cooked lignified fibrous material, or pulped material, with a gaseous halogenating agent to effect further pulping, or bleaching, or both pulping and bleaching. The use of a non-halogenating agent such as air in order to displace the excess gaseous halogenating agent such as gaseous chlorine. is found an effective means of washing the pulp without the necessity of liquid washing. or the employment of apparatus other than the chlorinating chamber which can be satisfactorily lined or made of acid-proof material to resist corrosion. Such air washing very efficiently removes excess chlorinating agent, leaving at most only a very small quantity which is absorbed by the pulp in a short reaction time. Any small residual quantity of free chlorine left in the pulp can be neutralized by the addition of a small amount of some suitable anti-chlor in the well known manner. In this manner, it is possible to insure that no free chlorine remains in the pulp admixed with the reaction products of the chlorination, which reaction products contain a large percentage of hydrochloric acid. Such mixture of reaction products with free chlorine produces a very corrosive material, which is difficult to handle except in apparatus constructed of or lined with porcelain or acid resisting tile. By the present method and apparatus any objectionable free chlorine is effectively elim-

inated from the pulp and reaction products prior to removal from the chlorination chamber, thus rendering the subsequent treatment free from corrosion difficulties. The preliminary treatment of lignified fibrous material with chlorine gas substantially diluted with air has the advantage of providing for control of the chlorination reaction, avoiding objectionable local overheating with consequent injury of the cellulose fibers. After the preliminary incomplete chlorination in this manner, the fibrous material can then be treated with more concentrated or substantially pure chlorine gas without objectionable results, providing for the completion of the chlorinating reaction in an effective manner. The process provides for the use of an excess of chlorine for the final chlorinating step, and at the same time provides for economical utilization of this excess of the chlorinating agent without necessitating an elaborate recovery system.

While the method herein described, and the form of apparatus for carrying this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In the manufacture of pulp, the method which comprises subjecting fibrous material to treatment with a halogen, then passing a fluid through the treated fibrous material to drive out excess halogen, and passing the mixed fluid and halogen discharging from said fibrous material through additional fibrous material to thereby use the excess halogen in treating the additional fibrous material.

2. In the manufacture of pulp, the method which comprises subjecting fibrous material to treatment with a gaseous halogen, then passing a fluid through the treated fibrous material to drive out excess halogen, passing the mixed fluid and halogen discharging from said fibrous material through additional fibrous material to thereby use the excess halogen in treating the additional fibrous material, continuing the passing of the fluid until the first mentioned fibrous material is substantially free of excess halogen, then removing the treated first mentioned material, and subjecting the additional fibrous material to further treatment with a gaseous halogen.

3. In the manufacture of pulp, the method which comprises subjecting fibrous material to treatment with a gaseous halogen, then passing a fluid through the treated fibrous material to drive out excess halogen, passing the mixed fluid and halogen discharging from said fibrous material through additional fibrous material to thereby use the excess halogen in treating the additional fibrous material, continuing the passing of the fluid until the first mentioned fibrous material is substantially free of excess halogen, then introducing a liquid into the first mentioned fibrous material to dilute this material and to slush it out of the treating zone, and subjecting the additional fibrous material to further treatment with a gaseous halogen.

4. In the manufacture of pulp, the method which comprises subjecting fibrous material at a high consistency such as to be readily permeable to gas to treatment with chlorine gas, then passing air through the treated fibrous material to drive out excess chlorine gas therefrom, and passing the mixed air and excess chlorine gas discharged from the treated fibrous material through additional fibrous material to thereby use the excess chlorine gas in the treatment of the additional fibrous material.

5. In the manufacture of pulp, the method which comprises subjecting fibrous material at a high consistency such as to be readily permeable to gas to treatment with chlorine gas, then passing air through the treated fibrous material to drive out excess chlorine gas therefrom, and passing the mixed air and excess chlorine gas discharged from the treated fibrous material through additional fibrous material to thereby use the excess chlorine gas in the treatment of the additional fibrous material, continuing the passing of the air until the first mentioned fibrous material is substantially free of excess chlorine gas, then removing the first mentioned treated material, and subjecting the additional fibrous material to further treatment with chlorine gas.

6. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, means for supplying fibrous material thereto, means for supplying a halogenating agent to one of said chambers, means for supplying a washing fluid to said chamber to drive off excess halogenating agent from the fibrous material therein, an offtake for the mixed washing fluid and excess halogenating agent driven off from said chamber, and a connection communicating with said offtake for introducing said mixed washing fluid and said halogenating agent into a second chamber into contact with fibrous material therein.

7. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, means for supplying fibrous material thereto, means for supplying a gaseous halogenating agent to one of said chambers, means for supplying a washing fluid to said chamber to drive off excess halogenating agent from the fibrous material

therein, an offtake for the mixed washing fluid and excess halogenating agent driven off from said chamber, a connection communicating with said offtake for introducing said mixed washing fluid and said halogenating agent into a second chamber into contact with fibrous material therein, means for the removal of treated fibrous material from said first mentioned chamber, and means for supplying additional gaseous halogenating agent to said second chamber.

8. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, means for supplying fibrous material thereto, means for introducing a halogenating agent to one of said chambers, means for supplying an inert gas to said chamber to drive off excess halogenating agent from the fibrous material therein, an offtake for the mixed inert gas and excess halogenating agent driven off from said chamber, a connection communicating with said offtake for introducing said mixed inert gas and excess halogenating agent into a second chamber into contact with fibrous material therein, means for introducing a liquid into said first mentioned chamber to slush out treated material therefrom, and means for supplying additional halogenating agent to said second chamber.

9. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, means for introducing fibrous material into each of said chambers, valve controlled inlets for the introduction of chlorine gas into each of said chambers, valve controlled offtakes for each of said chambers, suction means connected to said offtakes, means for introducing air into one of said chambers, and a connection between said first chamber and a second chamber, whereby said suction means is adapted to draw air into said first chamber and through the treated fibrous material therein to wash out excess chlorine gas from said fibrous material, the mixed air and excess chlorine gas then being drawn through said connection into said second chamber and into contact with fibrous material therein, the remaining fluid passing through the offtake of said second chamber to said suction means.

10. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, means for introducing fibrous material into each of said chambers, valve controlled inlets for the introduction of chlorine gas into each of said chambers, valve controlled offtakes communicating with the upper portions of each of said chambers, suction means connected to said offtakes, means for introducing air adjacent the upper portion of one of said chambers, and a connection between the lower portion of said one chamber and the lower portion of a second chamber, whereby said suction means is adapted to draw air into said first chamber and through the treated fibrous material therein to wash out excess chlorine gas from said fibrous material, the mixed air and excess chlorine gas then being drawn through said connection into said second chamber and into contact with fibrous material therein, the remaining fluid passing through the offtake of said second chamber to said suction means.

11. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, a common supplying means for fibrous material, means for selectively controlling the feeding of fibrous material from said common supplying means to each of said chambers, a common main for halogenating agent, and means for selectively controlling the supplying of halogenating agent from said main to each of said chambers.

12. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, means for supplying fibrous material to each of said chambers, a common chlorine gas main, means for selectively controlling the supplying of chlorine gas from said main to each of said chambers, a common suction main, a suction means therein, and means for selectively controlling communication of each of said chambers with said common suction main.

13. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, means for supplying fibrous material to each of said chambers, a common chlorine gas main, means for selectively controlling the supplying of chlorine gas from said main to each of said chambers, a common suction main, a suction means therein, means for selectively controlling communication of each of said chambers with said common suction main, means for selectively introducing air into each of said chambers, and means for the passage of gaseous products from one of said chambers to another.

14. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, means for supplying fibrous material to each of said chambers, a common chlorine gas main, means for selectively controlling the supplying of chlorine gas from said main to each of said chambers, a common suction main, a suction means therein, means for selectively controlling communication of each of said chambers with said common suction main, means for selectively introducing air into each of said cham-

bers, a common by-pass main, and valve controlled connections between each of said chambers and said by-pass main.

15. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising a plurality of chambers, a common supplying means for fibrous material, means for selectively controlling the feeding of fibrous material from said common supplying means to each of said chambers, a common chlorine gas main, means for selectively controlling the supplying of chlorine gas from said main to each of said chambers, a common suction main, a suction means therein, means for selectively controlling communication of each of said chambers with said common suction main, means for selectively introducing air into each of said chambers, a common by-pass main, valve controlled connections between each of said chambers and said by-pass main, and means for removing treated fibrous material from each of said chambers.

16. Apparatus of the character described adapted for the treatment of fibrous material in the manufacture of pulp, comprising at least four chambers, means for supplying fibrous material to each of said chambers, means for selectively supplying gaseous chlorine to said chambers, means for selectively introducing air into said chambers, means for passing gaseous products from one of said chambers to another, and means for removing treated fibrous material from each of said chambers, the arrangement being such that two of said chambers are adapted to be placed in communication so that air and excess chlorine gas may be passed from the treated fibrous material in one chamber into the untreated fibrous material in another chamber, while a third chamber is being supplied with fibrous material, and a fourth chamber is being emptied of treated fibrous material.

17. In the manufacture of pulp, the method which comprises treating fibrous material with a gaseous halogenating agent admixed with a substantial proportion of a non-halogenating gaseous diluent, and subsequently treating the fibrous material with a more concentrated gaseous halogenating agent.

18. In the manufacture of pulp, the method which comprises treating fibrous material with a gaseous halogenating agent admixed with a substantial proportion of a non-halogenating gaseous diluent, the quantity of gaseous halogenating agent used in this treatment being insufficient to effect complete halogenation of the fibrous material, and subsequently completing the halogenating of the fibrous material by treatment with an excess of a more concentrated gaseous halogenating agent.

19. In the manufacture of pulp, the method which comprises treating fibrous material with a chlorine gas admixed with a substantial proportion of air as a diluent, and subsequently treating the fibrous material with a substantially more concentrated chlorine gas.

20. In the manufacture of pulp, the method which comprises treating fibrous material with an excess of a gaseous halogenating agent, so that at the completion of the halogenating reaction a substantial amount of the gaseous halogenating agent remains in the fibrous material, removing such excess halogenating agent in gaseous form from the fibrous material, and passing removed gaseous halogenating agent into reaction contact with additional fibrous material.

21. In the manufacture of pulp, the method which comprises first treating fibrous material with chlorine gas diluted with air, then treating the said fibrous material with an excess of more concentrated chlorine gas to complete the chlorinating reaction, removing the excess chlorine in gaseous form from the chlorinated fibrous material, and passing the removed excess of chlorine in gaseous form into contact with additional fibrous material.

In testimony whereof I hereto affix my signature.

HAROLD T. RUFF.