Oct. 20, 1925. 1,557,880

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TREATMENT OF RAW MATERIAL IN THE MANUFACTURE OF CHEMICAL WOOD PULP

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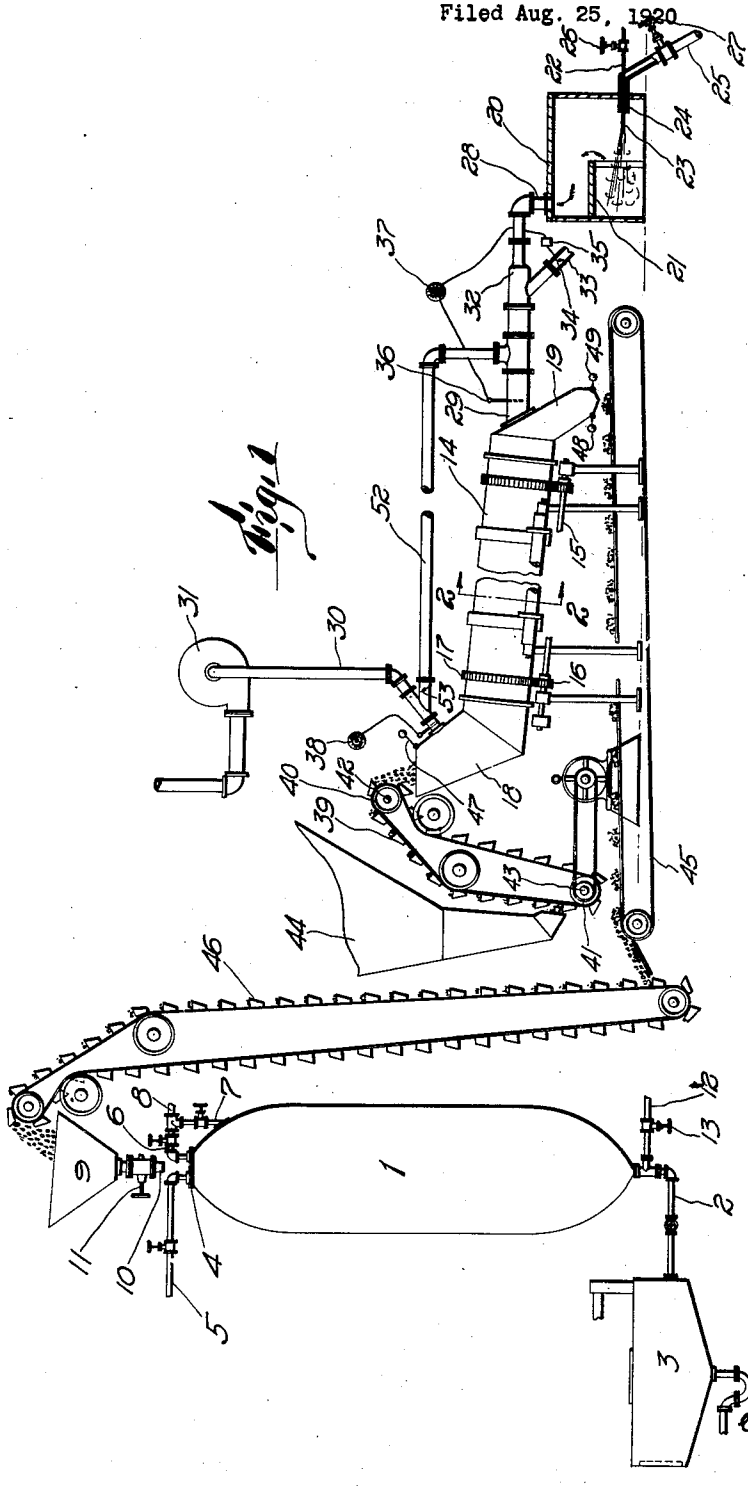


Fig. 1

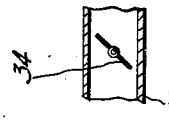


Fig. 3

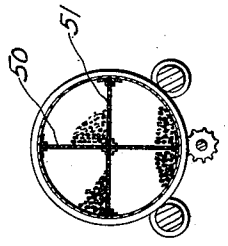


Fig. 2

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UNITED STATES PATENT OFFICE.

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TREATMENT OF RAW MATERIAL IN THE MANUFACTURE OF CHEMICAL WOOD PULP.

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To all whom it may concern:

Be it known that I, GEORGE A. RICHTER, a citizen of the United States, residing at Berlin, in the county of Coos and State of New Hampshire, have invented new and useful Improvements in the Treatment of Raw Material in the Manufacture of Chemical Wood Pulp, of which the following is a specification.

This invention relates generally to the manufacture of chemical wood pulp such as practiced in the manufacture of sulphite, sulphate or soda pulp so-called, in which the raw material is in the form of chips of wood. In these processes, in order that a standard pulp may be produced, it is highly desirable that the cooking liquor should possess a predetermined strength. For example, in the manufacture of sulphite pulp, in which a calcium bisulphite solution is employed, it is desirable that the liquor should contain a known or constant proportion of SO_2 as combined calcium bisulphite and free sulphurous acid. Consequently, in filling the digesters preparatory to the cooking of the raw material, it is important that the cooking acid should be of a given strength when introduced into the digester, and should not be diluted, except as may be necessary with the introduction of a given quantity of steam to bring the contents of the digester to a proper temperature and to secure a proper pressure. An unknown factor, however, has heretofore been presented in the cooking of the raw material, due to the presence of water contained in the raw material. That is to say, the chips contain a variable quantity of water dependent upon the previous immersion of the pulp wood, its exposure to the elements, the length of time during which it is stored, etc., so that the water contained in the chips may vary from 30% to 60% by weight of the total weight of the wood. Consequently, when the chips containing a maximum quantity of water are introduced into the digester, the cooking liquor is diluted with the excess water and requires a different duration of cook and higher temperature than where the chips contain say but 30% of water.

It is also essential, in the production of high grade pulp, that foreign elements or substances should not be introduced into the digester so as to be commingled with the cellulose as freed from the blow pit. Consequently, care must be taken to prevent the entrance of carbon, coal or other inert foreign materials.

The particular object of the present invention is to provide a method of treating the chips or raw material so that they will contain a predetermined water content, which will be practically unvarying, so that, with a cooking liquor of predetermined acid or alkaline content, a standard high-grade pulp may be secured at all times under substantially the same cooking conditions. This is accomplished by subjecting the chips to a desiccating operation so that the chips, as delivered to the digester, will, as stated, contain a predetermined water content. In accordance with the present invention, the chips are dried by the action of heated gases, the flow of the gases and the passage of the chips through the drying chamber being so controlled as to ensure the delivery of the chips in proper condition. In the preparation of the drying medium for operation, a further object of the invention is to prevent the access thereto of foreign materials, which, if present, would be commingled with the cellulosic product delivered from the digester and would find its way into the pulp with the necessity of affording means for its removal from the pulp.

A further object of the invention is to provide for supplying the heated drying medium at a relatively low cost, in such manner that the drying medium may be delivered to the drying chamber at a previously determined temperature which is not injurious to the chips.

Instead of raising the temperature of the gases by indirect heat, by the use of steam coils, for the purposes of economy I prefer to employ the products of combustion resulting from the burning of a suitable fuel. That is to say, I employ, in conjunction with a drier or kiln of suitable character, a heater in which the fuel is completely consumed so that the gases resulting therefrom are inert, and no solid particles, such as carbon or the like, are delivered with the products of combustion. This is accomplished by the introduction of a sufficient or excess quantity of air into the combustion chamber so as to ensure complete combustion of the fuel without preventing the

burning of the fuel. Inasmuch, however, as the gases resulting from such combustion are at a very high temperature, which, if delivered into contact with the raw material, would injure the latter, I provide means for diluting the hot products of combustion with colder gases, so that the gaseous drying medium may be delivered to the raw material at a predetermined, fairly low temperature. For ensuring the maintenance of a predetermined temperature of the gaseous drying medium, suitable automatic controlling regulators may be employed.

I do not at this time regard it as desirable to remove all of the water contained in the chips so as to deliver the chips in a bone-dry condition. I prefer, on the contrary, that the chips, when delivered from the drier ready for introduction into the digester, should contain a small quantity of water, say approximately 20% to 30% of the total weight of the chips, this for three reasons: first, that the reduction of the moisture content to approximately zero would involve additional fuel consumption in the drying of the chips; second, that, with a fair amount of moisture in the chips delivered from the drier, I am able to employ a relatively high temperature of the drying medium without burning or injuring the chips; and, third, because the higher the temperature of the gaseous drying medium entering the drying chamber, a greater heat economy will be realized and the chips may be dried to the proper moisture content in a shorter time.

On the accompanying drawing, I have shown more or less diagrammatically and conventionally an apparatus embodying the present improvement and which may be employed in carrying out my process.

I shall describe the process more particularly in connection with the manufacture of sulphite pulp, but it will be understood, as previously indicated, that it is just as applicable to the manufacture of other forms of chemical wood pulp, as sulphate or soda pulp.

On the drawing, 1 indicates a digester such as utilized in the manufacture of sulphite pulp, and this digester is illustrated as being connected by a blow pipe 2 with the usual blow pit 3. During the cooking operation, the upper end of the digester is closed with a removable cover 4 to which is connected a pipe 5 of the acid system and a relief pipe 6, which, together with a second pipe 7 leading from the side of the digester near its upper end, communicates with the pipe 8 of the relief recovery system. At 9 I have shown conventionally a hopper or receptacle for containing the chips which are to be delivered through the top of the digester by a spout 10 having a butterfly valve 11. As thus far described, the apparatus does not differ from that ordinarily employed in the manufacture of sulphite pulp in which calcium bisulphite solution, containing a given proportion of free sulphurous acid, is employed.

Heretofore it has been the practice, as previously indicated, to provide the digester with its complement of raw material and cooking acid, and then, by a steam line 12 controlled by a valve 13, to introduce steam into the closed digester at intervals to bring the digester contents to the desired temperature under the desired pressure for the period of duration of the cook.

In the practice of the present invention, it is of course possible to use many different forms of driers, but, for the purpose of illustration, I have shown on the drawing a drier of the ordinary type which comprises an elongated cylinder 14, whose axis is inclined at an acute angle to the horizontal and which may be rotated slowly by a power-driven shaft 15 having pinions 16 intermeshing with large gears 17 on the cylinder or drum. Into the upper end of this heater, I introduce the chips to be dried, and, from the lower end of the cylinder, the dried chips are discharged. At the chip-receiving end of the drier, I employ a stationary head 18 into which the chips may be delivered either by shovelling them thereinto or by the use of a conveyer for delivering the chips in a steady stream. At the delivery end of the drier, there is a head 19 from which the dried chips may be delivered for collection and introduction into the digesters. The ends of the drum may be suitably journaled or trunnioned in the heads 18 and 19.

At 20 I have shown a furnace for producing the heated gaseous drying medium. This furnace may be of any suitable construction. I have shown a simple form which may be made of magnesia brick or other suitable material utilized in the construction of furnaces, and I have shown it as provided with an arch 21 of heat-resisting brick. As the fuel, I prefer to employ fuel oil, although it is quite apparent that I may use, if desired, either a solid or a gaseous fuel. If a solid fuel is employed, such as coal, it should be finely powdered, so that, when consumed, there will be no solid products of combustion. Producer gas may likewise be employed to advantage. As shown, however, the fuel under slight pressure is introduced through a pipe 22 to a nozzle 23. The nozzle extends through a larger nozzle 24 formed on the end of an air pipe 25 through which a large volume of atmospheric air may be forced under desirable pressure. Except for the introduction of the fuel and the air, which contains sufficient oxygen to ensure complete combustion of the fuel, the

furnace is otherwise preferably closed, as it is desired to be able to regulate the introduction of the fuel and the air to a nicety. The fuel pipe 22 and the air pipe 25 are provided with suitable valves 26, 27, respectively. At 28 I have shown the stack through which the products of combustion pass from the furnace, and this stack is connected by a conduit 29 with the head 19 of the drier or kiln. An exhaust pipe 30 leads from the head 18 and is connected preferably with a suction fan 31 for the purpose of causing the gaseous drying medium to pass through the drier at a regulated rate of speed and in predetermined volume. The temperature of the gaseous products of combustion from the furnace may be very high, as I have previously stated; that is to say, they may range from the temperature of 1600° to 2500° F., and the direct contact of such gases with the raw material, during the time that the said raw material is passing through the drier, would injure the chips. I therefore provide for diluting the products of combustion with other cooler gases. For this purpose, I have shown the conduit 29 as being provided with a Y-coupling 32, one branch connected with the stack 28 and the other branch connected with an air conduit 33 through which a cold gas (e. g. atmospheric air) may be introduced. As shown, the chips and the gaseous drying medium are illustrated as having a counter-current flow, but it is quite evident that, if desired, the gaseous drying medium and the raw material may be caused to flow in the same direction. In any event, however, the incoming hot gases to the drier should be diluted with a cold gas delivered in such volume that the gases entering the drier will have a temperature ranging from 300° to 500° F. or thereabouts. Preferably an automatically-controlled damper is employed for regulating the admission of air to the conduit 29 to ensure the maintenance of the gaseous drying medium at a predetermined temperature where it enters the drier. Any suitable form of damper control may be employed such as used in household furnaces, and, as such devices are well known, I have not undertaken to illustrate one in detail. At 34, I have shown a butterfly damper with which is connected an electrically controlled regulator 35 for operating the damper. At 36 a thermostat of suitable construction is indicated as extending into the conduit 29 near its connection with the head 19, and at 37 I have indicated conventionally a recording temperature gage. I have not sought to illustrate the electrical circuits employed in connection with these instrumentalities, but have indicated the same only in the most conventional fashion, as these instrumentalities are well known and may be purchased in the open market. Of course, it is desirable that the temperature of the outgoing gases, after they have performed their function, should be observable to assist the operator in regulating the flow of chips through the drier, and consequently I have shown the stack 30 as being provided, near its point of connection with the head 18, with a recording temperature gage 38.

It is quite evident that any suitable means may be employed for feeding the chips into the receiver end of the drier. Preferably, however, I prefer to employ a feeding apparatus, the operation of which may be regulated at will, so as to vary the volume of the chips passing through the drier in a given period of time. This feeding device is illustrated as comprising a bucket conveyer 39, which is shown conventionally, and the chains or sprockets of which track upon suitable wheels 40, 41, on the shafts 42, 43. One or the other of the shafts 43, 42 is preferably driven by a variable-speed electric motor, so that the speed of travel of the conveyer may be increased or decreased as required. The chips are delivered to the bucket conveyer by a spout 44 leading from the storage bin in which the wet chips are contained. The dried chips delivered from the drier are deposited upon a suitable form of conveyer 45 by which they are delivered to a bucket conveyer 46 which transports them to and delivers them into a dried chip hopper 9. It is desirable that the chip-receiving and the chip-delivering apertures or mouths in the heads 18 and 19 should not deliver excess air to the drier, but that each should be provided with a damper or gate which will open to receive or deliver the chips, and close when the chips are not delivered thereagainst. The receiving head 18 is illustrated as being provided with a pivoted counterweighted gate 47 which will open under the weight of the chips delivered thereto by the bucket conveyer 39, and the head 19 at its mouth is provided with the two pivoted and counterweighted gates 48 and 49 which will open under the weight of the chips and permit the latter to be delivered to the conveyer 45.

The various instrumentalities are all so regulated that, as the drum or drier slowly rotates, wet chips are delivered thereto and flow continuously to the lower end thereof and are finally delivered to the conveyer 45 in a condition in which they contain a predetermined percentage of moisture, say 30% for instance. The heated gaseous medium for drying the chips is caused to flow through the heater at a regular rate and to enter the drier with a predetermined temperature, say one which may be selected between 300° and 400° F.

I have found that it is desirable to prevent disintegration of the chips as they pass

through the drier, and therefore they should not be agitated too greatly during their passage. As the drier rotates, the chips are lifted on the up-going side and are dropped and rolled over and over as they pass from end to end thereof. This constant lifting and dropping through a relatively long path has a tendency more or less to crumble the chips and form slivers and sawdust, a thing to be avoided. I have overcome this difficulty by a novel construction of the drier by which it is transversely divided by longitudinally extending partitions into a plurality of compartments which in cross section are sector shaped. In Figures 2, I have illustrated a transverse section through the drying cylinder, and it will be seen that it is provided with two transverse, longitudinally extending partitions 50 and 51 which divide the drier into four sector-shaped compartments, each of which is adapted to contain a relatively limited quantity of the chips. Inasmuch as the drier is rotating, for example at a speed of 1 R. P. M., and as the whole cylinder is connected to the head 19 into which the heated gases are delivered, the gases are caused to flow through the compartments in equal proportions.

I have also been able to effect an economy by utilizing a portion of the tail gases from the cylinder and circulating the same through the cylinder. While this tail gas comprises a certain small percentage of moisture, such moisture, if kept within reasonable limits, does not operate deleteriously when mixed as a diluent with the incoming hot gases from the furnace; in fact, I am able to secure a certain economy of fuel by utilizing a portion of the tail gases for this purpose. As shown on the drawing, a conduit 52 leads from the stack 30 to the gas conduit 29, so that a part of the gas is re-circulated through the drier. The conduit or pipe 52 is provided with a valve or damper 53 which may be adjusted as to position so as to regulate the volume of tail gases which are re-circulated through the drier.

Persons skilled in the art will appreciate the advantages of the apparatus and process as hereinbefore stated. A marked fuel economy is secured by employing the products of combustion of a suitable fuel and bringing them into direct contact with the raw material. In this way, I dispense with indirect heating of the drying medium such as by the employment of steam pipes over which air is passed. By the regulation of the supply of oxygen to the burning fuel, the products of combustion may be kept free from soot, cinders, carbon or other forms of solid material without the necessity of subjecting the products of combustion to a process of purification, although I should not regard it as a departure from the present invention if means were employed to purify the hot products of combustion before causing the same to come into contact with the wet material. The most important feature of advantage, however, is that the chips are dried so as to contain always a given percentage of moisture, as a result of which the cooking of the chips may be carried out under optimum conditions without variation in the strength of the cooking liquor due to dilution thereof by water contained in the chips.

What I claim is:—

1. A method of conditioning wood chips for the manufacture of chemical wood pulp, which comprises burning a fuel to produce hot flue gas, cooling such flue gas by an externally-derived cold gas to produce a dry medium having a predetermined relatively low temperature, subjecting the chips directly to the desiccating action of the mixed gases by causing such gases and said chips to flow continuously through a closed container in direct contact, returning more or less of the previously used gas for admixture with the incoming mixed gases, and regulating the flow of gases and chips whereby the water content of the chips is reduced to a predetermined low point.

2. The combination of a drier arranged to cause the material to be dried to pass therethrough, a furnace equipped for the combustion of fuel and having its stack connected directly with said drier, whereby the products of combustion may be caused to pass therethrough, means for supplying the raw material to the drier wherein it is exposed to the direct action of the gaseous drying medium, means for circulating a portion of the tail or exit gas through the drier, and means for regulating the relative flow of gas and raw material through said drier, whereby the water content of said material may be reduced to a predetermined point.

In testimony whereof I have affixed my signature.

GEORGE A. RICHTER.