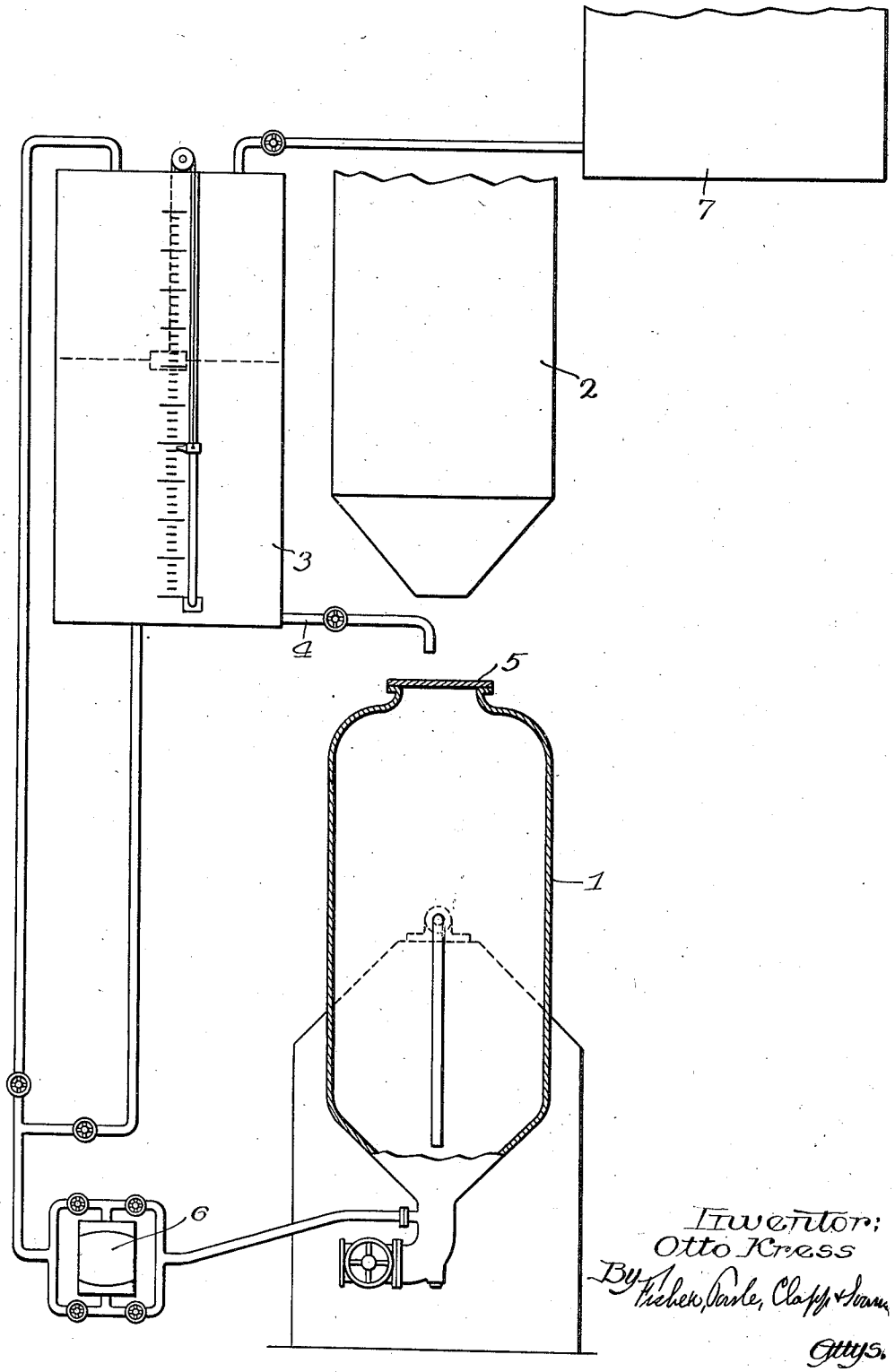
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July 19, 1932. O. KRESS 1,867,626

MANUFACTURE OF WOOD PULP

Filed April 2, 1927



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Patented July 19, 1932 1,867,626

UNITED STATES PATENT OFFICE

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MANUFACTURE OF WOOD PULP

Application filed April 2, 1927. Serial No. 180,407.

The invention relates to the manufacture of pulp for the making of paper and the like, and more particularly to the manufacture of pulp by the sulphate or kraft process.

The chief object of the invention is to produce a more uniform and economical digestion of the wood by impregnating or saturating the wood chips with the akaline liquor before cooking, and carrying on the process in such a manner that it is commercially practical and efficient.

It has heretofore been proposed to impregnate the wood chips with the hot alkaline liquor under pressure and then, after withdrawing the excess liquor, to subject the charge to cooking temperatures and effect the digestion of the wood by the chemical contained in the impregnated chips. But it is believed that such processes have not met with commercial success for, with liquors of suitable strength for economical and successful mill practice, the chips will not absorb sufficient chemical to produce a proper pulping action. In particular, there will be a very decided deficiency in sodium sulphide in the impregnated chips if the manufacture of kraft pulp is attempted in this way, since the caustic soda is not only absorbed mechanically, but also some of it unites chemically with the wood during the impregnating operation and hence it is taken up by the chips in relatively greater proportion than the sulphide. Also, because of the chemical absorption of the caustic, the excess liquor withdrawn from the charge will be of such large amount and so weak in caustic that it cannot be economically strengthened for re-use and, in particular, cannot be brought up to the desired strength with the available "white liquor" recovered from the operation, since, in commercial practice as is well known, this liquor is necessarily of limited strength. This is because the soda is recovered from the "black liquor" resulting from the digestion process, by evaporation and incineration, in the form of carbonate and is converted or partially converted into caustic by lime; and, since this causticizing reaction is reversible, it is not commercially practical except in solutions of limited strength. Also, in the manufacture of kraft pulp, it would be particularly difficult and impractical to bring back all of the excess liquor withdrawn from the charge after impregnation, to the proper strength and the proper proportions of the active chemicals, caustic soda and sodium sulphide, because of the relatively greater absorption of the caustic by the wood.

In accordance with the present invention, the wood chips, previous to cooking, are impregnated with hot alkaline digestion liquor under pressure, but deficiency in the active chemical ingredients is avoided by withdrawing only a portion of the excess liquor after impregnation, so that the charge is then cooked in the presence of free or unimpregnated liquor of such amount that the chemical contained therein and in the impregnated chips is sufficient to properly pulp the wood. Also, the active chemical ingredients of the impregnating liquor are proportioned to compensate for the relatively greater absorption of the caustic in the impregnating operation and such that sufficient sulphide is left in the digester. By withdrawing a portion only of the excess liquor after impregnation, not only is sufficient chemical retained in the digester for the cooking operation, but the amount which must be strengthened for re-use is materially reduced.

Also, in accordance with the present invention, the impregnating liquor employed has a relatively lower proportion of caustic than the available "white liquor" and such that the liquor withdrawn from the digester after impregnation can be brought back substantially to uniform strength and to substantially uniform proportions of its active ingredients, by the addition thereto of an amount of available "white liquor" that is substantially equal to or less than the amount of liquor left in the digester. In case the "white liquor" required for this purpose is less than the amount of liquor left in the digester, the difference in bulk is made up with water.

Any suitable apparatus may be used, but preferably some such arrangement as shown in the accompanying drawing is employed, and preferably the digester is of the rotary type and the cooking is effected by the in-

jection of steam. The improved process for the manufacture of kraft pulp is carried out substantially as follows:

The chips of from ¾ to ⅞ of an inch long with the grain, are charged through an opening in one end of the digester 1 from a supply hopper 2, and at the same time hot alkaline cooking liquor from an impregnating tank 3 is run into the digester through a pipe 4 to pack down the charge. The digester opening is then closed by a cover plate 5 and additional liquor is drawn from the tank and forced into the digester by a pump 6. The impregnating liquor is hot and preferably at about a temperature of 165 degrees F., a steam coil being provided, if necessary, in the impregnating tank for this purpose. A pressure is also maintained by the pump, preferably of about 135 pounds, for 15 to 20 minutes, to thoroughly impregnate the wood chips with the hot liquor. Other means, such, for example, as the introduction of air or steam into the upper portion of the digester could be employed for applying pressure to the liquor during the impregnating operation, but a pump is convenient both for forcing the liquor into the digester and also for withdrawing part of the liquor therefrom.

Before cooking, a portion only of the excess liquor is withdrawn by the pump, which is of the reversible type, and is returned thereby to the impregnating tank. The charge is then cooked while the digester is rotated in the usual manner, and preferably by the introduction of steam of 125 to 135 pounds pressure through a pipe leading through one of the digester trunnions, for a period of about two hours. Then the pulp is blown from the digester and washed and the resulting "black liquor" is treated in the usual way for making fresh "white liquor."

As stated, only a portion of the excess or unimpregnated liquor is withdrawn from the digester and returned to the tank, and such as to leave from 17 to 22 pounds of active chemical per 100 pounds of dry wood in the digester, and substantially in the proportions of two parts of NaOH to one part of Na_2S. The amount of chemical left in the charge depends upon the kind of wood, its moisture content and the desired character of the pulp. Also, as noted, the impregnating liquor contains a substantially lower proportion of caustic than the available "white liquor", and such that the liquor withdrawn from the digester and returned to the impregnating tank can be brought back sustantially to uniform strength by the addition thereto of the available "white liquor" from a supply tank 7. Preferably also, the impregnating liquor is as high in content of caustic as will permit this strengthening and such that the return liquor can be brought back to its original strength and amount by the addition of an amount of "white liquor" equal to the amount of liquor left in the digester.

Thus, if the available "white liquor" contains about 10 per cent by weight of caustic soda and 5 per cent by weight of sodium sulphide, the impregnating liquor will preferably contain about 6 per cent of caustic and 4.5 per cent of sulphide. In treating tamarack, hemlock and jack-pine, in the manner described with such a liquor for the manufacture of sulphate pulp, about 40 gallons of liquor of a temperature of about 165 degrees F., for each 100 pounds of dry wood will be run into the digester as it is filled with chips, and then about 10 gallons additional for each 100 pounds of wood will be pumped in, or until a hydrostatic pressure of about 135 pounds is developed and maintained for a period of 15 to 20 minutes, to thoroughly impregnate the chips, so that the digester will contain about 50 gallons of liquor having about 25 pounds of NaOH and about 18.76 pounds of Na_2S or about 43.76 pounds of total active chemical, for each 100 pounds of dry wood contained in the charge. Then for each of 50 gallons of liquor which has been placed in the digester, about 34 gallons are withdrawn and returned to the impregnating tank, leaving about 16 gallons per 100 pounds of charge left in the digester. But, because of the chemical absorption of the caustic by the wood, the proportion of this ingredient is materially decreased in the withdrawn liquor, and it contains only about 4 per cent of caustic and 4.3 per cent of sulphide, so that each 34 gallons of return liquor contains 11.84 pounds of NaOH and 12.19 pounds of Na_2S. Hence there is left in the digester 25 minus 11.34 or 13.66 pounds of NaOH and 18.76 minus 12.19 or 6.57 pounds of Na_2S, making a total of 20.23 pounds of active chemicals for each 100 pounds of dry wood in the charge, and in the proportions of substantially two parts of caustic to one part of sulphide. Then by adding to each 34 gallons of return liquor, 16 gallons of "white liquor" containing about 10 per cent or 13.34 pounds of NaOH and about 5 per cent or 6.67 pounds of Na_2S, the return liquor is brought back to its original amount and each 50 gallons thereof will contain about 6 per cent or 11.34+13.34=24.68 pounds of NaOH and about 4.5 per cent or 12.19+6.67=18.86 pounds of Na_2S.

After impregnation of the chips and the withdrawal of a portion of the excess liquor from the digester, the active chemicals in the charge will be, as stated, about 20 pounds per 100 pounds of dry wood, and in the proportions of about two parts of caustic to one part of sulphide. Of these active chemicals, however, the impregnated chips will contain the greater proportion of the caustic, and the free or unimpregnated

liquor, the greater proportion of the sulphide. If all excess or free liquor were withdrawn, there would be, as stated, a deficiency in caustic and such a marked deficiency in sulphide that satisfactory kraft pulp could not be produced. It is particularly noted that if the wood were at all wet it would absorb substantially the same amount of caustic as if it were dry, but the amount of sulphide absorbed would be very materially reduced. The present improved process, however, avoids any difficulty in treating either dry or wet wood.

The figures above noted will of course vary with the strength of the available "white liquor," the character of the wood treated and the pulping action which is desired. In good commercial practice, the "white liquor" will contain caustic and sulphide in the proportions of two parts of caustic to one of sulphide. Also it will vary in its content of active chemicals from 8.4 to 11 per cent of NaOH and from 4.2 to 5.5 per cent of Na_2S, and the impregnated liquor may vary from about 5.4 to 6.3 per cent of caustic and from about 4 to 5.7 per cent of Na_2S, or from 9.4 to 12 per cent of total active chemical. As stated, it is preferable to use as strong impregnating liquor as will permit the proper strengthening of the return liquor in the manner described. In this way the undue weakening of the resulting "black liquor" is avoided and the cost of evaporation decreased. A relatively stronger impregnating liquor will proportionately decrease the amount of free liquor which is left in the digester for the cooking operation, and a relatively weaker impregnating liquor will require that a proportionately greater amount be retained in the charge and will usually require water in addition to the available "white liquor" in bringing it back to substantially uniform amount and proportions of its active ingredients.

In practice, the "return" liquor and the "white" liquor are tested to determine the strength of the active chemicals therein and the amounts of these liquors passed into the impregnating tank are regulated accordingly to leave in the digester the amount of chemicals required for the pulping operation and to restore the impregnating liquor to substantially uniform strength and amount. For convenience in thus handling these liquors, the impregnating tank is provided with a float actuated gauge. It is also noted that the amount of liquor contained in the impregnating tank at the beginning of any cycle of operations should be substantially the same and somewhat in excess of that required to effect the impregnation of the charge.

The improved process has been carried out commercially in the manufacture of sulphate pulp and it has been found that, because the cooking of the chips is more uniformly effected, the yield and strength of the pulp are materially increased and also that the time and amount of chemicals required are reduced, and that as stated, it is equally satisfactory for the pulping either of wet or dry wood. It is also noted that in accordance with the improved process, the impregnating liquor is such that the required amount of chemicals for the pulping operation is left in the digester for each cook and that the liquor withdrawn after the impregnating operation can be brought back to substantially uniform strength and amount with available "white liquor" and, if required, with the addition of water. Hence the process can be repeated indefinitely in a commercially efficient manner and without the accumulation of excessive amounts of weak return liquor which could not be economically utilized.

Obviously, changes may be made in the details set forth without departure from the scope of the appended claims.

I claim as my invention:

1. The method of making kraft wood pulp which comprises impregnating a charge of wood before cooking with hot liquor under pressure and which impregnating liquor contains substantially from 5.4 to 6.3 per cent of sodium hydroxide and substantially from 4 to 5.7 per cent of sodium sulphide, withdrawing a portion only of the excess liquor and of such amount that substantially from 17 to 22 pounds of active chemicals per 100 pounds of wood is left in the digester and in the proportions substantially of two parts of sodium hydroxide to one part of sodium sulphide, then cooking the charge, and restoring the withdrawn impregnating liquor to its original strength and amount by the addition of recovered "white liquor" containing substantially from 8.4 to 11 per cent of sodium hydroxide and from 4.2 to 5.5 per cent of sodium sulphide substantially in the proportions of two parts of sodium hydroxide to one part of sodium sulphide, substantially as described.

2. The process of preparing "sulphate" or kraft pulp in successive cycles of operation, which comprises impregnating each digester charge before cooking with hot alkaline liquor under pressure of substantially 90 pounds per square inch or more and containing substantially from 9.4 to 12 per cent of active chemicals in a proportion of substantially from 1.2 to 1.3 parts of sodium hydroxide to one part of sodium sulphide, withdrawing a portion only of the free liquor after impregnation and of such an amount that from 17 to 22 pounds of active chemicals per 100 pounds of dry wood are left in the digester and in substantially the proportions of two parts of sodium hydroxide to one part of sodium sulphide, then cooking the charge and restoring the withdrawn impregnating liquor to its original strength, amount and proportions of

active chemicals for the subsequent operation by the addition thereto of an amount of recovered "white liquor" substantially equal to the amount of impregnating liquor left in the digester and containing substantially from 12.5 to 16.5 per cent of active chemical and substantially in the proportion of two parts of sodium hydroxide to one part of sodium sulphide, substantially as described.

3. The process of preparing sulphate or kraft pulp in successive cycles of operation, which comprises impregnating each digester charge before cooking with hot alkaline liquor under pressure of substantially 90 pounds per square inch or more and containing substantially 10.5 per cent of active chemicals in the proportions of substantially one and one quarter parts of sodium hydroxide to one part of sodium sulphide, withdrawing a portion only of the free liquor after impregnation and of such an amount that substantially 20 pounds of active chemicals per 100 pounds of dry wood are left in the digester and substantially in the proportions of two parts of sodium hydroxide to one part of sodium sulphide, then cooking the charge and restoring the withdrawn impregnating liquor to its original strength, amount and proportions of active chemicals for the subsequent operation by the addition thereto of an amount of recovered "white liquor" substantially equal to the amount of liquor left in the digester and containing substantially 15 per cent of active chemicals and substantially in the proportions of two parts of sodium hydroxide to one part of sodium sulphide, substantially as described.

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