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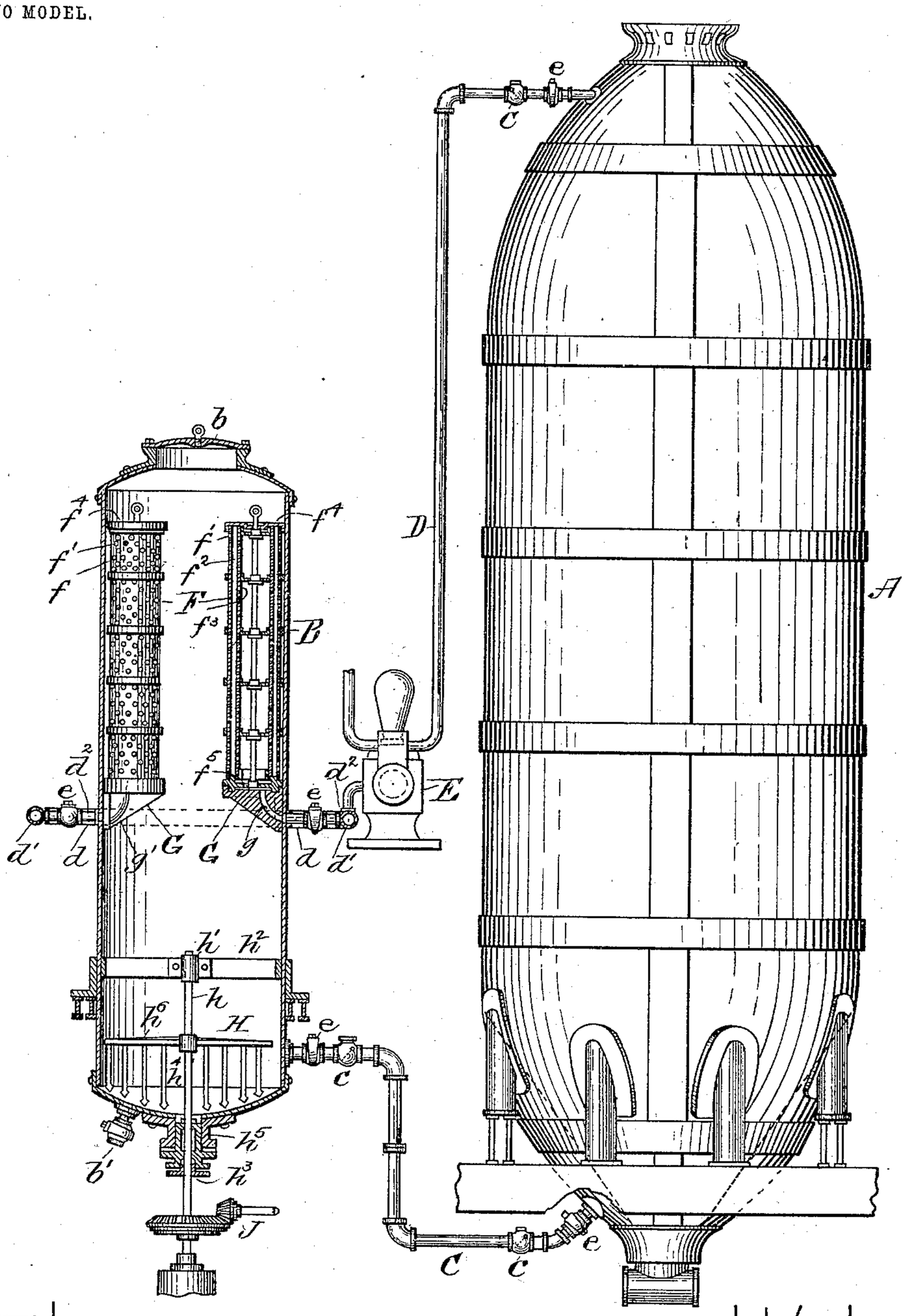
F. E. GORE.

FIBER MANUFACTURING APPARATUS.

APPLICATION FILED MAY 21, 1902.

NO MODEL.



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FIBER-MANUFACTURING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 725,072, dated April 14, 1903.

Application filed May 21, 1902. Serial No. 108,333. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC E. GORE, a citizen of the United States, and a resident of Yarmouth, in the county of Cumberland and State of Maine, have invented new and useful Improvements in Fiber-Manufacturing Apparatus, of which the following is a specification.

My invention relates to the art of making paper or the fiber from which paper or compressed-fiber articles are manufactured; and it consists in an improved apparatus for digesting wood, straw, esparto-grass, jute, bagasse—in short, natural fibrous substances which have cellulose for their basis of constitution.

In the manufacture of fiber from wood, which is a characteristic example of the manufacture above indicated, the caustic or soda process heretofore quite generally employed involves the cooking of wood chips in a closed digester with a solution of caustic soda under steam heat and pressure. By this means the cellulose fiber is freed from the organic matter which is associated therewith in the natural wood. At the close of the cooking of a mass of wood fiber the digested pulp is discharged from the digester, washed, screened, bleached, and then proceeds to later stages in the manufacture for which it is intended. All of these practices are well known to those skilled in the art. Their details vary to suit the specific varieties of wood used, with the personal preferences of individual manufacturers, and with the qualities desired in the final product. Incidental to the caustic process as heretofore practiced has been the initial presence, and perhaps to some extent the production, of sodic carbonate, which at all stages of the process is not only inert so far as concerns the reduction of fiber, but is in many ways a drag and hindrance. Its presence in the digester impedes or clogs the action of the active caustic liquor, it clings to the fiber after the latter has been discharged from the digester, and renders the washing of the fiber more difficult, calls for more water and longer time in the pulp-washing, involving great dilution of the soda liquor thus reclaimed, and when finally carried to the furnaces impairs the burning qualities of the organic residues, so that a large quantity of fuel is required to burn the ash. This troublesome carbonate of soda is present in the originally-prepared soda liquor in amounts varying from ten to twenty-five per cent. of the hydrate of soda actually employed, the cost of hydrate in a chemically-pure form being usually prohibitive. Moreover, as the digesting process progresses a complex of carbon compounds of soda is formed which when added to the carbonate of soda already present in the liquor increases the difficulties and deterrent effects for which the carbonate of soda is already responsible. Thus in the digesting process as heretofore practiced the products of the process itself limit the efficiency of the liquor in its work of freeing the cellulose fiber from those substances in the wood which the paper manufacturer desires to remove. The time required to cook thoroughly a batch of wood fiber, such as poplar, with the process as heretofore practiced is from eight to nine hours and sometimes has to be continued for ten hours. By the employment of my process, hereinbelow described in connection with the description of the apparatus which embodies the invention claimed herein, I have reduced the time required to cook thoroughly a batch of poplar-wood to two and one-half hours. Moreover, by the employment of this process, which I reserve for claim in an application for patent therefor filed by me concurrently herewith in the United States Patent Office, I am enabled to use less caustic for the cooking, less water for washing the fiber, less fuel for burning the spent liquor, and I obtain more fiber than before from a given quantity of wood.

The gist of my process aforesaid lies in the employment continuously and as part of the digesting process of a substance which has the double effect of reducing the carbonate of soda in the liquor to a caustic condition and of reacting upon a considerable propor-

tion of the carbon compounds of soda which are produced by the digesting process, so that they too are restored to a caustic condition. The reaction upon the carbonate of soda, most if not all of which is initially present at the beginning of the digesting process, is simple and easy of analysis. The reaction upon the complex carbon compounds of soda is in its essence obscure, although the net result is clearly to be detected. Both divisions of my process as above set forth are characterized, however, by the removal from the soda of carbon in combination, and I define the process as one of decarbonation of the soda liquor continuously during the digesting process.

In order to carry out my process to its fullest advantage, I make use of an apparatus such as I will now describe, which embodies my invention herein claimed.

Referring to the drawings hereto annexed, A represents a wood-digester of the usual form and character. The steam connections and other parts which are incidental to the structure and operation of the digester are not shown, as they are well known to persons skilled in the art.

B represents a closed decarbonating vessel or tank capable of sustaining the steam-pressure maintained in the digester A. A pipe C leads from the bottom of the digester A to the bottom of the vessel B, and the pipe D through the pump E connects the upper part of the vessel B with the upper part of the digester. The pump E is so situated as to maintain circulation of liquid from the digester A through pipe C, vessel B, and pipe D to the top of the digester. Check-valves *c c c* are placed in suitable situations and serve to prevent any accidental reversal in the above-described circulation, and stop or gate valves *e* furnish means for manually cutting off the communication between the various parts of the apparatus.

In the vessel B there is provided the agitator H, which in this case is shown as a shaft *h*, journaled at *h'* in the cross-brace h^2 and at h^3 in the stuffing-box h^5. Arms h^6, from which project rods h^4, constitute the active portions of the agitator H, which is driven from some suitable external source of power, as J.

In the upper part of the vessel B are placed the filters F, two of these being shown in the drawings. Each of these filters consists of an outer cylindrical shell *f* and an inner cylindrical shell f^3. Both these shells are perforated, as at *f'*. The head f^4 closes the filter at the top. The space between the shells *f* and f^3 is filled with closely-packed finely-comminuted filtering material—as, for instance, quartz-sand. The bottom plate f^5 is perforated, or, if desired, consists of a spider-ring. Brackets G are provided, secured to the shell of the decarbonating vessel B, and serve both as seats for the filters F and as conduits through which the circulation to the pipe D is maintained. The brackets G are cast with swells *g'*, wherein are located the ducts *g*, which register with perforations in the shell of the vessel B and the short pipes *d*, which are secured therein. The pipe *d'*, which extends around the vessel B, communicates with all the short pipes *d* and at d^2 connects with the pump E. A manhole at *b* is provided, whereby the filters F may be inserted and removed and the other contents of the vessel B introduced thereto. At *b'* is situated a drain-cock for the removal of the liquid contents of the decarbonating vessel B.

The operation of this apparatus is as follows: A charge of wood-chips (or other material suitable to the manufacture of fiber) is introduced into the digester A in the ordinary manner. Fresh caustic liquor is then run in. This may be in the proportionate quantity usually employed, or, if the economies made possible by the practice of my inventions are to be availed of to their full extent, less than the usual quantity of caustic liquor may be used. The ordinary caustic-soda liquor contains a considerable percentage of carbonate of soda, which remains practically unchanged during the digesting process as heretofore carried on, so that only the remainder of the caustic liquor is practically active; but by the employment of my process this percentage of carbonate is causticized—*i. e.*, transformed into hydrate during the progress of the cooking—and thus becomes active. The quantity of caustic liquor first introduced may therefore be less than the usual amount in proportion to the percentage of carbonate contained and less also by an amount measured by the quantity of spent or partially-spent liquor, which is ascertained by previous experiment to be restored to its active condition after having formed the complex carbon compounds with soda, which are necessary products of the digesting process. I have found by practice of my new process with apparatus such as herein described that with a given weight of poplar-chips for my raw material I can reduce the quantity of fresh caustic from thirty to forty per cent. below the quantity heretofore usually employed for digestion of the wood, and yet the time required for complete reduction of the wood to fiber will be reduced to one-quarter to one-third of the time required with the old digesting process. I effect this reduction of the quantity of caustic by employing liquor reclaimed from a previous cooking to dilute the fresh caustic in the digester and also to fill the vessel B when the latter is charged. Into the vessel B, I then charge a quantity of decarbonating material, such as hydrate of lime, in a finely-divided condition in an amount which may be calculated beforehand as requisite to the reduction of the carbonate of soda present at the initial stages of the process plus the other carbon compounds of soda which may be expected to develop as an incident to the cooking of the wood.

I have found in the practice of my process aforesaid that for ten thousand two hundred

pounds of bone-dry poplar-chips, which require two thousand gallons of fresh eighty-per-cent caustic at 1.075 specific gravity, diluted with fifteen hundred to eighteen hundred gallons of liquor recovered from a previous cooking and which is decarbonated to begin with, six hundred pounds of hydrate of lime, dry, is a quantity sufficient for the purpose.

The filters F are put in place upon the brackets G before the vessel B is charged with liquor and hydrate of lime. Then the digester A and the vessel B are closed. All valves *e* are opened, and steam is admitted to the digester in the usual manner and the cooking begins. As the pressure and temperature rise in the digester the pump E is started and the liquid contents of the closed system, which comprises the digester A, vessel B, and their pipe connections, are circulated from the bottom of the digester through the pipe C, through the vessel B, and consequently through and into reactive association with the mass of decarbonating materials, such as hydrate of lime, which is contained in the vessel B, into and through the filters F, which confine all solid matter to the vessel B, through the ducts *g*, pipes *d* and *d'*, pump E, and pipe D back to the digester. Meanwhile power is applied to the agitator H at J, so that the circulating caustic liquor is intimately mingled with the decarbonating material, such as hydrate of lime, in the vessel B. The results of this continuous process of decarbonating the caustic liquor during the progress of the cooking of fiber are from beginning to end highly beneficial, and their benefits extend to the subsequent stages and incident processes of the manufacture and are set forth at length in my application for the process patent mentioned hereinabove. At the start, assuming that the vessel B has been charged with spent liquor and hydrate of lime or such other decarbonating material as the manufacturer may discover to be suited to his purpose, the decarbonating material reacts upon the spent liquor, converting the carbonate of soda which may be present into hydrate and separating from the soda a considerable part of the organic matter which is combined therewith, so that the entire body of liquor is placed in the most active condition possible before the circulation through the closed system causes it to pass again into the digester. As the liquor in the digester after acting upon the wood passes into the vessel B from the pipe C charged with compounds formed by the soda with organic matter in the wood and with carbonate of soda which was either initially present or has been incidentally formed the decarbonating material reacts upon this partially-spent liquor, converting the simple carbonates and a considerable portion of the more complex carbon compounds of soda into caustic. Thus the carbonate of soda which was present in the fresh caustic wherewith the digester was charged is hydrated and the liquor enriched in proportionate measure, while the complex carbon compounds formed during the digesting process are in large part broken down and the soda restored in proportionate measure to active condition. The circulation is kept up during the entire cooking process. The decarbonating material continuously converts or reconverts the carbonates to hydrates and to a partial extent also separates the soda from the complex carbon compounds which have been formed in the digester and restores the liquor to the fiber in the digester, where it renews its action on the fiber with vigor unimpaired by the deterrent present of simple carbonates and with the similar deterrent effect of the complex carbon compounds of soda very materially reduced. The rate at which the circulation shall be maintained may be varied to suit the needs and notions of individual manufacturers. I have found by practice that the substantial freedom of soda liquor from carbonate and from those complex carbon compounds which are susceptible of being reacted upon by decarbonating material is properly maintained by a circulation which will entirely change the contents of the digester five times during the cooking process.

The filtration which I have described above as part of my process will be found desirable wherever the fiber is to be used for the manufacture of the finer grades of paper. The process may be carried on without filtration, thereby allowing the hydrate of lime to be circulated along with the caustic liquors during the cooking. Thereafter the lime may be washed out of the fiber or retained as a filler or make-weight wherever the presence of the lime will not be detrimental to the uses for which the fiber is intended—for instance, in case of the manufacture of fiber for wrapping-paper, bag-paper, or sheathing-paper.

What I claim, and desire to secure by Letters Patent, is—

1. In an apparatus for cooking fiber, the combination of a digester, a decarbonating vessel, passages connecting the said vessel with the digester, and means for maintaining circulation through the digester, decarbonating vessel and connecting-passages.

2. In an apparatus for cooking fiber, the combination of a digester, a decarbonating vessel, an agitator therein, passages between the decarbonating vessel and the digester, and means for maintaining circulation through the digester, decarbonating vessel and connecting-passages.

3. In an apparatus for cooking fiber, the combination of a digester, a decarbonating vessel, filtering devices, passages between the digester and decarbonating vessel, and means for maintaining circulation through the digester, decarbonating vessel, filtering devices, and connecting-passages.

4. In an apparatus for cooking fiber, the

combination of a digester, a decarbonating vessel, an agitator therein, filtering devices, passages between the digester and decarbonating vessel, and means for maintaining circulation through the digester, decarbonating vessel, filtering devices and connecting-passages.

5. In an apparatus for cooking fiber, the combination of a digester, a decarbonating vessel, passages connecting the digester and decarbonating vessel, brackets in the decarbonating vessel, filters supported thereon, ducts in the brackets communicating with the passage leading to the digester, and means for maintaining circulation through the digester, decarbonating vessel, filters, ducts and connecting-passages.

6. In an apparatus for cooking fiber, the combination of a digester, a decarbonating vessel, an agitator therein, passages connecting the digester and decarbonating vessel, brackets in the decarbonating vessel, filters supported thereon, ducts in the brackets communicating with the passage leading to the digester, and means for maintaining circulation through the digester, decarbonating vessel, filters, ducts, and connecting-passages.

Signed by me at Yarmouth, Maine, this 16th day of May, 1902.

FREDERIC E. GORE.

Witnesses:
EDW. H. WILSON,
GEO. M. LORING.