Dec. 23, 1930. T. B. MUNROE 1,785,840

PROCESS FOR PRODUCTION OF FIBERS FOR WALLBOARD AND SIMILAR STRUCTURES

Filed April 6, 1927

Fig. 1.

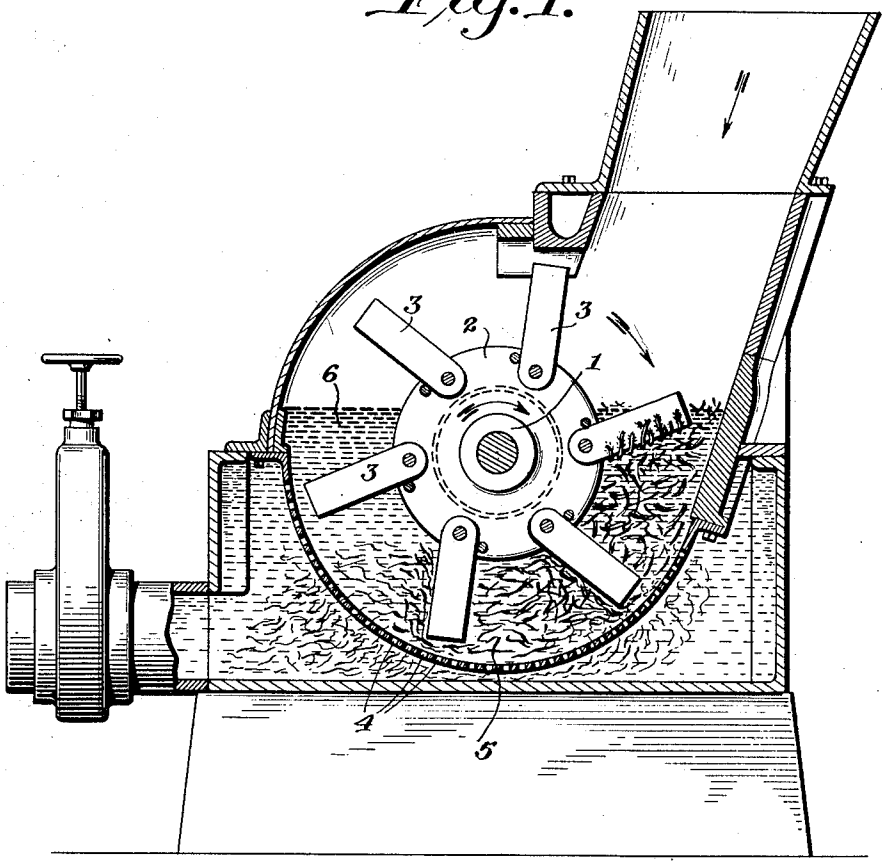


Fig. 2.

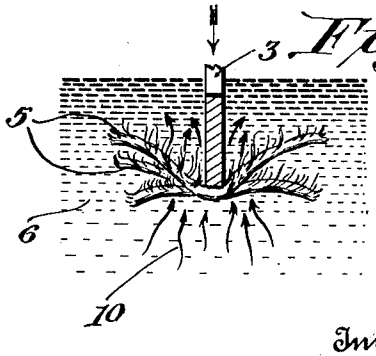


Fig. 3.



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UNITED STATES PATENT OFFICE

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PROCESS FOR PRODUCTION OF FIBERS FOR WALL BOARD AND SIMILAR STRUCTURES

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This invention relates to the preparation of fibers for pulp making purposes suitable for the formation of wall boards and similar structures and has for its object to improve the procedures heretofore employed.

With this and other objects in view the invention consists in the novel steps and combinations of steps constituting the process, and in the novel fiber resulting from said process, all as will be more fully hereinafter disclosed and particularly pointed out in the claims.

Referring to the accompanying drawings, forming a part of this specification in which like numerals designate like parts in all the views,

Figure 1 is a diagrammatic sectional view of a machine found suitable in carrying out this process;

Figure 2 is a diagrammatic enlarged sectional view of a portion of the parts shown in Fig. 1; and

Figure 3 is a diagrammatic enlarged view showing on a greatly exaggerated scale the character of the fibers produced by this invention.

In order that the precise invention may be the more clearly understood it is stated that heretofore the fibers of bagasse and other similar fibers have been prepared by shredding the same before said bagasse stocks have been softened in suitable solutions to loosen the outer encrusting casing of the fibers, and to soften the cementitious material bonding the fibers together. The material when treated has then been cooked in a substantially continuous process wherein the fibers have been in a solution containing such well known chemicals as alkalies, either those of sodium or potassium or those of magnesium or calcium or salts of these elements such as sulphites, or sulphates, or acid salts, or basic salts of these metals, or the soluble salts obtained from fibers from previous cooks together with carbohydrate products of hydrolysis and organic acids which are well known to be formed by the breaking down of the cementitious tissue material of ligno- or pento-celluloses, etc. The carbohydrate materials serve as buffers to hold the hydrogen ion concentration so that the cooking proceeds at a point lying within the range of acidity where acids may not cause damage to cellulose materials in the formation of oxycellulose, etc. The fibers thus cooked are then passed to suitable beating engines where the same are broken down to form the long bagasse fiber so well adapted to the formation of wallboards, but which are entirely too long to be suitable for making paper making pulp. In this process, however, much labor has been entailed because of the necessity for shredding bagasse prior to the cooking action and because at times atmospheric cooking had to be prolonged in order to sufficiently soften certain fibers, so that other fibers were too greatly attacked. If said cooking was not sufficiently prolonged then subsequent refining was required utilizing too much power, or the fibers were found to be insufficiently free from cementitious material to form a board of requisite quality, etc.

A machine known as a Claflin has been heretofore used in the treatment of the fibrous material, said machine consisting of two concentrically disposed cones, somewhat resembling the construction of a coffee mill, between which the fibers admixed with water are fed and subjected to a crushing and cutting action. The result is that many of the fibers are crushed and cut to objectionably short lengths. This crushing and cutting action of the Claflin cone surfaces also has the effect of hydrating the surfaces of the fibers to a relatively large extent. In other words, the pressure exerted upon the water and the fibers causes a hydrating or colloidal action to take place which renders the surfaces of the fibers more or less sticky, and as the surfaces thus produced attract water and tenaciously hold the same, the fibers produced are known in the art as "close." That is, upon taking up a hand full of these treated fibers from the Claflin machine and compressing them, a relatively small amount of water will be squeezed from the same. It results that when subjected to a felting action on a board machine, the water will not leave the stock uniformly and therefore will tend to form a lumpy board rather than one with a uniform thickness, and further it is found diffi-

cult to dry the finished board. If this hydrating action on the other hand did not take place in the Claflin to quite the extent that it inevitably does take place, the water would leave the board much more freely after the felting action has been had and the fibers would be known as "free" and the quality of the board would be more uniform and freer from lumps than is the case when the fibers are passed through the Claflin in the manner described.

This invention, on the other hand, has to deal with a different process of preparing said fibers, in which the bales of bagasse or substantially large portions of bales are fed directly into the cookers of the globe or other suitable rotary type. Steam is then admitted to these cookers under suitable pressure whereupon the bagasse material is cooked under substantially neutral conditions for a considerable period of time in order to break down the chunks of bagasse and to render the fibers more flexible and pliable for subsequent separation. It is to be understood that by this invention the material is cooked only sufficiently to break down the outer encrusting casing of the fibers so that when the latter are passed as bundles through the shredder engine, the action of which on said fibers forms a part of this invention, the said encrusting casings may be readily and mechanically separated from the fibers themselves. Stated in other words, this cooking action is not for a duration of time nor at such a temperature as to deteriorate in any manner, the fibers desired, but said cooking action is stopped as soon as the outer casing is loosened from the bundle of fibers and before any valuable cellulose content of the fibers has been lost. Thus the natural characteristics of the fibers are preserved in that they are not burned nor made brittle, as might be done were the cooking action to be carried on too long, or at too high steam pressure. As an example, this cooking action may be carried out under a pressure of approximately 40 lbs. over a period of time from one half to two and one half hours, but it is to be understood that this invention is not limited to this specific pressure nor time.

After this cooking action, the material is then passed to a suitable shredding engine, such as that somewhat diagrammatically illustrated in Figure 1. This shredder consists of a central shaft 1 on which is provided a plurality of parallelly disposed disks 2, and pivoted to each disk adjacent the circumference thereof are a plurality of swinging hammers 3, so that as the shaft and disks are rapidly rotated, the hammers will swing out radially and deal true hammer-like blows upon any material that is disposed in the machine, all in a manner well known. In the regular commercial type of Jeffrey pulverizers there is generally a series of sharp cutting edges, not shown, disposed in a circular path beyond the extreme outer ends of the rotating hammers so that the material is struck by the hammers against these cutting edges and is thus cut and broken up, etc. This particular type of machine, however, is not very desirable for the purposes of this process. Instead of this said arrangement of cutting edges against which the material is to be forced by the hammers, there is substituted a smooth perforated curved bottom 4 devoid of what might be termed the cutting edges of the ordinary Jeffrey pulverizers. Further, in the said ordinary Jeffrey machines the material is treated in a more or less dry state, that is to say, the material being treated is not immersed in water. In carrying out this invention, on the other hand, the purpose is entirely different and the action is entirely different, as will now be disclosed. Instead of providing a container for the material that has an open bottom as is the case in the ordinary Jeffrey machine, there is provided a tank which will hold water and preferably water above the horizontal plane of the central shaft 1, to which the above mentioned disks are attached. Into this machine is flowed a slush containing say from 2% to 3%, or even up to 10%, of fibers, so that the apparatus when used for the present purpose will contain say from 90% to 99% of water, and from 10% down to say 1% of fibers. Of course, these proportions may be varied to suit particular circumstances. A suitable proportion in practice is found to be 1½% of fibers to 98½% of water.

When one of these shredders similar to the Jeffrey type is thus provided with water and its cutting edges are displaced by the curved perforated plate, as above mentioned, and the relatively small quantity of fibers is present in the water of the apparatus, and when the shaft 1 is rapidly rotated, as for example within a range of 1200 to 3500 R. P. M., the following effect is had: The hammer blows delivered by the apparatus are very, very sudden, and the water being substantially incompressible by said blows, the action is almost equivalent to striking a very hard resisting surface for a very brief interval of time and then having that surface suddenly yield. When the fibers 5 are thus caught between the water 6, and the hammers 3, the result is that for a brief instant of time the bundles of fibers are subjected to a hydraulic pressure which has the effect of driving the water a very slight distance through the previously softened encrusting casing of the fiber bundles and thus slightly hydrating the same, and rendering them more or less colloidal on the extreme surface of the fibers. On the other hand, the resistant water being yieldable after said brief instant of time has passed, the fibers are not broken at all as

they would be in a Claflin machine for example. In other words, they are yieldably sustained by the water on all sides and thus are not abruptly transversely bent or subjected to breaking strains at all; nor are they really subjected to crushing strains as is the case in the Claflin and other machines which have been used heretofore.

Stated in other words, a little consideration will show that if the fibers are subjected to crushing strains which are transmitted to the center of the fibers, they will be crushed very much as a match or a small piece of wood would be crushed if placed on an anvil and struck with a hammer, which is an action analogous to what takes place in a Claflin machine, resulting in splintering, breaking and cutting up the fibers into relatively short lengths. But if, on the other hand, the fibers are floated in a mass of water as indicated in Figs. 1 and 2, and suddenly struck, the yielding quality of the water after a brief instant of time has passed is sufficient so that the interior of the fibers are found not to be crushed at all, but all the remaining encrusting casing material that was brought into the mill is readily stripped from the fibers. Further than this, the resistance offered by the liquid has been found to be such that the bundles of fibers are truly acted upon, so that the individual fibers are separated from their adjacent fibers along their longitudinal lengths where the cementitious tissue has been proviously weakened. The result is an exceedingly strong, clean and abnormally long fiber which is unsuited for paper making purposes but which is very valuable indeed for the making of a wallboard as above described which may be termed insulating lumber.

Actual practice shows that the fibers thus produced are what are called "free fibers". That is to say, the hydrating action on the surface of the individual fibers being considerably less than that which takes place in the Claflin beaters, said fibers are found not to retain their water with the same tenacity, or to the same extent as do the fibers delivered from the Claflin machines. Therefore, when these fibers are passed through the felting machine and felted into the finished board, the board is found to be free from lumps, to be smoother and more uniform in texture and quality, and much more easily dried than is the case with Claflin treated fibers.

Furthermore, since the fibers are not subjected to the above mentioned crushing action or strains passing through the center of the fibers in the manner that is experienced in the Claflin machines, they are found to have greater strength in the finished board. The reason for this is that fibers prepared by a Claflin may be compared to splinters which when felted into a board and said board subjected to strain, will slip readily one over the other. The fibers produced by this shredder on the other hand, may be compared to wool or to fibers provided with numerous hairs. Such fibers, when felted into a board and said board subjected to strain, are found to be interlocked. That is, the hairs of one fiber will hook over the hairs of additional fibers and will cause the fibers to develop their tensile strength to the end that there will be only a relatively small slippage of fibers one over the other. That is, the individual tensile strengths of the fibers will multiply and give a higher total strength to the board. Stated in still other language, when the fibers 5 are thus treated in the shredder disclosed above, each of the individual fibers 5 will be found to be provided with a greater or less number of fuzzy or hook-like irregular surfaces which under a magnifying glass show more or less tendrils or very fine fur-like protuberances 7 on the fibers, enabling them to entangle themselves with each other or to truly have a felting action with each other, somewhat similar to two fibers of wool as distinguished from two fibers of cotton. In addition to this, and due to the method of cook, all of the natural pith will not have been lost or destroyed, with the result that said fibers will have particles of pith accompanying the same as indicated at 8. These pith-like protuberances and hook-like projections assists valuably in the production of a wallboard as herein disclosed in that they prevent the fibers in the finished board from slipping over each other under strain to the same extent that they would otherwise.

An additional advantage of using the perforated plates 4 over using the cutting edges above mentioned is that these perforated plates classify the fibers and do not permit the fibers to leave the apparatus until the fibers have reached the desired degree of fineness. That is, use has been made of a plate provided with a great plurality of 1-inch perforations, and also use has been made of a similar plate having ¾-inch perforations, the holes of both plates being spaced substantially 1 3/8 inches center to center. It seems rather strange that a 1-inch perforation can control the size of a fiber that may run down to 1/64 inch, but in actual practice it is found that if a ¾-inch hole plate 4 is substituted for a 1-inch hole plate 4, the resulting fiber is reduced in diameter by approximately the same ratio as the holes in the plate have been reduced in diameter. The water in the apparatus is preferably made to pass through more or less rapidly all the time by means not shown.

As an illustration of the use of this type of shredder the following run was actually made. Stock was fed to the shredder at a consistency of 1.4%, i. e., 1.4% dry fiber to 98.6% water.

This mixture of fiber and water was fed to the shredder at a rate sufficient to insure 760 lbs. dry weight of fiber per minute passing through this particular machine and very satisfactory fibers were produced without difficulty. A disadvantage of the Claflin machine was also found to have been overcome by this shredder. That is, due to the fact that in a Claflin the metallic surfaces are rubbing in contact as in a coffee grinder, it takes a large amount of power to run it even though it may not be doing any useful work. In this shredder, on the other hand, this disadvantage is overcome, for unless stock and water is being fed to the shredder, there being no mechanical contact between the moving parts of the shredder except at the bearing points, it takes only a small amount of power to run it idly. Therefore, the power expended in operating this shredder for handling fiber is expended almost entirely on the reduction of the fiber itself. In fact, it was found that it only takes approximately one-half the power to do the same amount of work with the same quantity of stock in the shredder as in the Claflin. Further, it is evident that the sudden blows of the hammers produce sudden agitations of the water as indicated by the arrows 10, Fig. 2, and these movements of the water cause the fibers 5 to rub against themselves to a very considerable extent which still further separates them from their inter-cementitious material without breaking or injuring the fibers, and also increases the hook-like projections above referred to, thus improving the entangling ability of the fibers.

After the fibers have thus been shredded or separated from each other they are then passed to a suitable washer and subsequently they may have added thereto, any suitable water proofing medium as desired, as well as any filler material to form a more homogeneous mass in the subsequent wallboard. That is to say, if it is desired to waterproof the fibers, said fibers are treated at this step of the process with a suitable water proofing medium, as well as provided with other material generally of lesser fiber dimensions which will form with the relatively long fibers a suitable filler to build up the structure of the wallboard. It is immaterial what the nature of the filler is, as any suitable material could be used, but generally this filler has been composed of relatively short fibers which are adapted to materially aid in the tying or bonding together of the relatively long fibers, after passing through the beating engine. After the long fibers, admixed with water-proofing material or the desired filler, or both have passed through the beating engine to thoroughly mix the same, and to interlace the fibers, then the mass is passed to the felting machine and made into the wallboard.

Particular attention is directed to the fact that in cooking the fibers, the solution of a previous cooking may be utilized, in which is incorporated the natural soluble salts obtained from the fibers from previous cooking, together with the carbohydrate products of hydrolysis and organic acids. The particular feature of this invention resides in the lessening of the cost of preparing the fibers forming the wallboard, in that large portions of bales, if not the entire bale, can be inserted directly in the rotary cooker where the steam under slight pressure, will break down the mass of fibrous material as the same rotates. There will be considerable condensation within the cooker and this will also aid in the disintegration of the fibrous mass. This in combination with the fact that the material undergoes cooking action in the presence of its own soluble salts and degradation products provides a process which has proven of great value when carried out on large scale proportions. Further, the fibers produced under such a process as described herein have retained such natural characteristics as flexibility and softness, so that the same may be satisfactorily worked with, in subsequent operations such as felting. With the fibers thus produced there may be a proportion of the original pith content adhering, but in any event a large proportion of the fibers have pith-like protuberances and hook-like projections, which materially aid in the tying together of the filler material and the relatively long fibers to make a homogeneous mass.

It will therefore be seen that this process consists in subjecting the raw fibrous material in large masses of bale-like proportions to a cooking action in the presence of a suitable chemical which may be produced from previous cooks and which may include the products of condensation as well as the soluble salts and degradation products of previous cooks. This cooking is carried out at a temperature and for a time sufficient to sub-divide the large masses into fiber bundle proportions and to loosen the encrusting casing of said fibers but insufficient to produce fibers suitable for paper making. The fiber bundles thus produced are then subjected to a shredding action whereby the fibers are freed from their cementing tissues and said casing by hydraulic action under the force of the rotating hammers during which step the fibers will be classified according to the size of the perforations in the plate below the rotating hammer. The final separation of the fibers is accomplished along the line of their longitudinal cementing tissues and, due to the resistant nature of the liquid in the shredder as well as the high velocity at which the fibers are forced through said liquid, the bundles of the fibers will be separated so that the individual fibers will maintain their relatively long lengths and other natural characteristics such as flexibility, strength, etc. As brought out previously the success of this

shredding action has been found due to the hydraulic friction which obtains to a high degree and the momentary impacts between the fibers and the resistant fluid caused by the rapidly rotating hammers on which the fibers are carried.

It is obvious that those skilled in the art may vary the details of construction as well as the arrangements of parts and the procedure disclosed herewith without departing from the spirit of the invention, therefore it is not desired to be limited to the foregoing except as may be required by the claims.

What is claimed is:—

1. The process of preparing fibers for wallboard pulp which consists in subjecting the raw fibrous material to a cooking action in the presence of a suitable chemical produced from previous cooks and at a temperature and for a time sufficient to loosen the encrusting casing material of said fibers but insufficient to produce fibers suitable for paper making; freeing the fibers from their cementing tissues and said casing by hydraulic action under force; and recovering the fibers thus produced.

2. The process of preparing fibers for wallboard pulp which consists in subjecting the raw fibrous material in large masses of bale-like proportions to a cooking action in the presence of a suitable chemical and at a temperature and for a time sufficient to subdivide said masses into fiber bundle proportions and to loosen the encrusting casing material of said fibers but insufficient to produce fibers suitable for paper making; classifying said fibers while freeing the fibers from their cementing tissues and said casing by hydraulic action under force; and recovering the fibers thus produced.

3. The process of preparing fibers for wallboard pulp which consists in subjecting the raw fibrous material in large masses of bale-like proportions to a cooking action in the presence of a suitable chemical produced from previous cooks and including the products of condensation and at a temperature and for a time sufficient to subdivide said masses into fiber bundle proportions and to loosen the encrusting casing material of said fibers but insufficient to produce fibers suitable for paper making; freeing the fibers from their cementing tissues and said casing by hydraulic action under force; and recovering the fibers thus produced.

4. The process of preparing fibers for wallboard pulp which consists in subjecting the raw fibrous material in large masses of bale-like proportions to a cooking action in the presence of a suitable chemical and at a temperature and for a time sufficient to subdivide said masses into fiber bundle proportions and to loosen the encrusting casing material of said fibers but insufficient to produce fibers suitable for paper making; subjecting the fiber bundles to hydraulic action under rotative force to free the fibers from their cementing tissues and said casing as well as to classify said fibers; and recovering the fibers thus produced.

5. The method of improving the production of fibers for wallboard pulp which consists in subjecting the raw fibrous material in large masses of bale-like proportions to a cooking action by steam in the presence of a suitable chemical including the natural soluble salts obtained from said material and at a temperature and for a time sufficient to subdivide said masses into fiber bundle proportions and to loosen the encrusting material of said fibers but insufficient to produce fibers suitable for paper making; separating said fibers along the line of their longitudinal cementing tissues while maintaining the length and natural characteristics thereof; and recovering the fibers thus produced.

6. The method of improving the production of fibers for wallboard pulp which consists in subjecting the raw fibrous material in large masses of bale-like proportions to a cooking action by steam at an approximate pressure of 40 pounds in the presence of the natural soluble salts obtained from said material from previous cooks and for a time sufficient to subdivide said masses into fiber bundle proportions and to loosen the encrusting material of said fibers but insufficient to produce fibers suitable for paper making; separating said fibers at a high velocity along the line of their longitudinal cementing tissues while maintaining the length and natural characteristics thereof; and recovering the fibers thus produced.

7. The method of improving the production of fibers for wallboard pulp which consists in subjecting the raw fibrous material in large masses of bale-like proportions to a cooking action by steam at an approximate pressure of 40 pounds and for a time sufficient to subdivide said masses into fiber bundle proportions and to loosen the encrusting material of said fibers but insufficient to produce fibers suitable for paper making; separating said fibers at a high velocity by rotary action in a resistant fluid along the line of their longitudinal cementing tissues while maintaining the length and natural characteristics thereof; classifying the fibers while separating the same; and recovering all the fibers thus produced.

8. The method of improving the production of fibers for wallboard pulp which consists in subjecting the raw fibrous material in large masses of bale-like proportions to a cooking action by steam at an approximate pressure of 40 pounds in the presence of a suitable chemical produced from previous cooks and for a time sufficient to subdivide said masses into fiber bundle proportions and to loosen the encrusting material of said fibers

but insufficient to produce fibers suitable for paper making; separating said fibers at a high velocity by rotary action ranging from 1200 to 3500 R. P. M. in a resistant fluid along the line of their longitudinal cementing tissues while maintaining the length and natural characteristics thereof; classifying the fibers while separating the same; and recovering all the fibers thus produced.

9. The process of preparing fibers for wallboard pulp which consists in subjecting the raw fibrous material to a cooking action in a solution containing the soluble salts obtained from previous cooks at a temperature and for a time sufficient to loosen the encrusting casing of said fibers but insufficient to produce fibers suitable for paper making; subjecting the fibrous mass to hydraulic friction of high degree to separate the fibers therefrom; and recovering the fibers thus produced for forming into a wallboard.

10. The process of preparing fibers for wallboard pulp which consists in subjecting the raw fibrous material to a cooking action in a solution containing the soluble salts obtained from previous cooks at a temperature and for a time sufficient to loosen the encrusting casing of said fibres but insufficient to produce fibers suitable for paper making; forcing the fibrous mass through a resistant fluid to separate the fibers along their cementing tissues; and recovering the fibers thus produced for forming into a wallboard.

11. The process of preparing fibers for wallboard pulp which consists in subjecting the raw fibrous material to a cooking action in a solution containing the soluble salts obtained from previous cooks at a temperature and for a time sufficient to loosen the encrusting casing of said fibers but insufficient to produce fibers suitable for paper making; forcing the fibrous mass through a resistant fluid at high circular velocity to separate the fibers along their cementing tissues; and recovering the fibers thus produced for forming into a wallboard.

12. The process of preparing fibers for wallboard pulp which consists in subjecting the raw fibrous material to a cooking action in a solution containing the soluble salts obtained from previous cooks at a temperature and for a time sufficient to loosen the encrusting casing of said fibers but insufficient to produce fibers suitable for paper making; separating the fibers from their cementing tissues and said casing by subjecting the fibrous mass to impact with a resistant but yieldable fluid; and recovering the fibers thus produced for forming into a wallboard.

13. The method of refining fibrous matter comprising suspending said matter in dilution of less than 5% concentration of fiber in a relatively unyielding fluid medium, and subjecting said suspended matter to impacts delivered at a velocity of approximately 3500 feet per minute.

14. The method of refining fibrous matter comprising suspending said matter in dilution of less than 5% concentration of fiber in a relatively unyielding fluid medium, and subjecting said suspended matter repeatedly to impacts delivered at a velocity of approximately 3500 feet per minute until the desired refinement is obtained.

15. The method of refining fibrous matter comprising suspending said matter in dilution of less than 5% concentration of fiber in a relatively unyielding fluid medium, and simultaneously fibrilizing said matter and classifying the separated fibers while so suspended.

16. The method of refining fibrous matter comprising suspending said matter in dilution of less than 5% concentration of fiber in a relatively unyielding fluid medium, and simultaneously fibrilizing said matter and classifying the separated fibers while so suspended, the fibrillation accomplished by impact of the matter by yieldably mounted members moving at a velocity of approximately 3500 feet per minute, the matter repeatedly acted upon by said members until it reaches the optimum degree of subdivision or refinement, and the classification accomplished by screening the fibers separated by said members.

17. A product of manufacture comprising refined fibrous material subdivided and refined through impacting action of yieldably mounted impact members, operating at high velocity, upon fibrous material in dilute fluid suspension, of about 5% or less concentration of fiber.

18. A product of manufacture comprising refined fibrous material subdivided and refined through impacting action of yieldably mounted impact members, operating at high velocity, upon fibrous material in dilute fluid suspension, of about 5% or less concentration of fiber, the maximum size of refined fiber determined by perforated means preventing escape of the fibers from the sphere of action of the impacting members until reduced to the predetermined maximum size for the individual fibers of the product, as determined by the size and shape of the perforations in the perforated means, the fiber thereby simultaneously refined and classified.

In testimony whereof I affix my signature.

TREADWAY B. MUNROE.