(No Model.)

J. B. CARTER & J. H. BERST.

PROCESS OF AND APPARATUS FOR DISINTEGRATING FIBROUS SUBSTANCES.

No. 487,912. Patented Dec. 13, 1892.

Fig. 1.

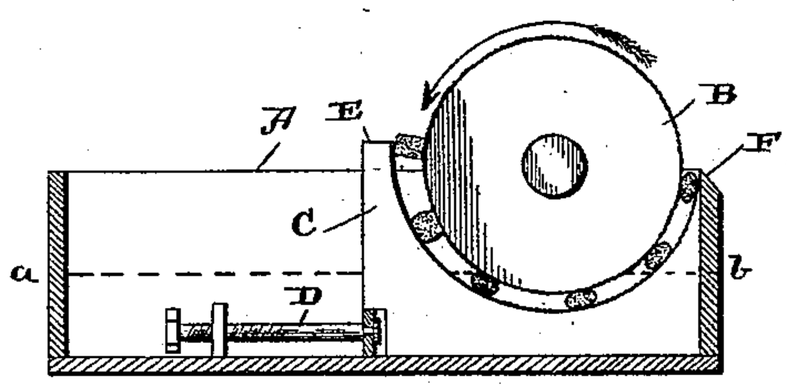


Fig. 2.

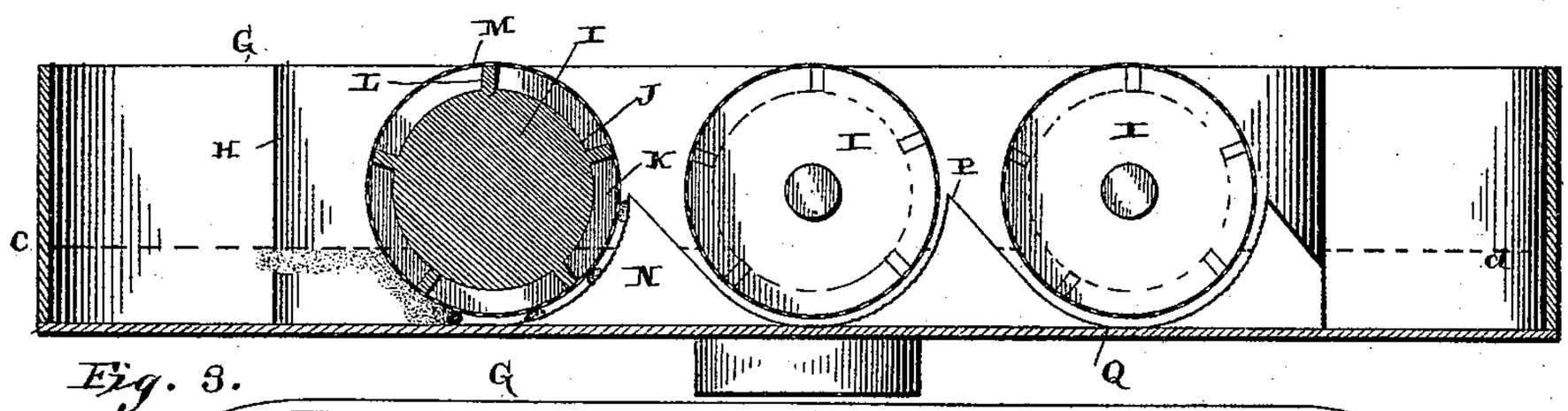


Fig. 3.

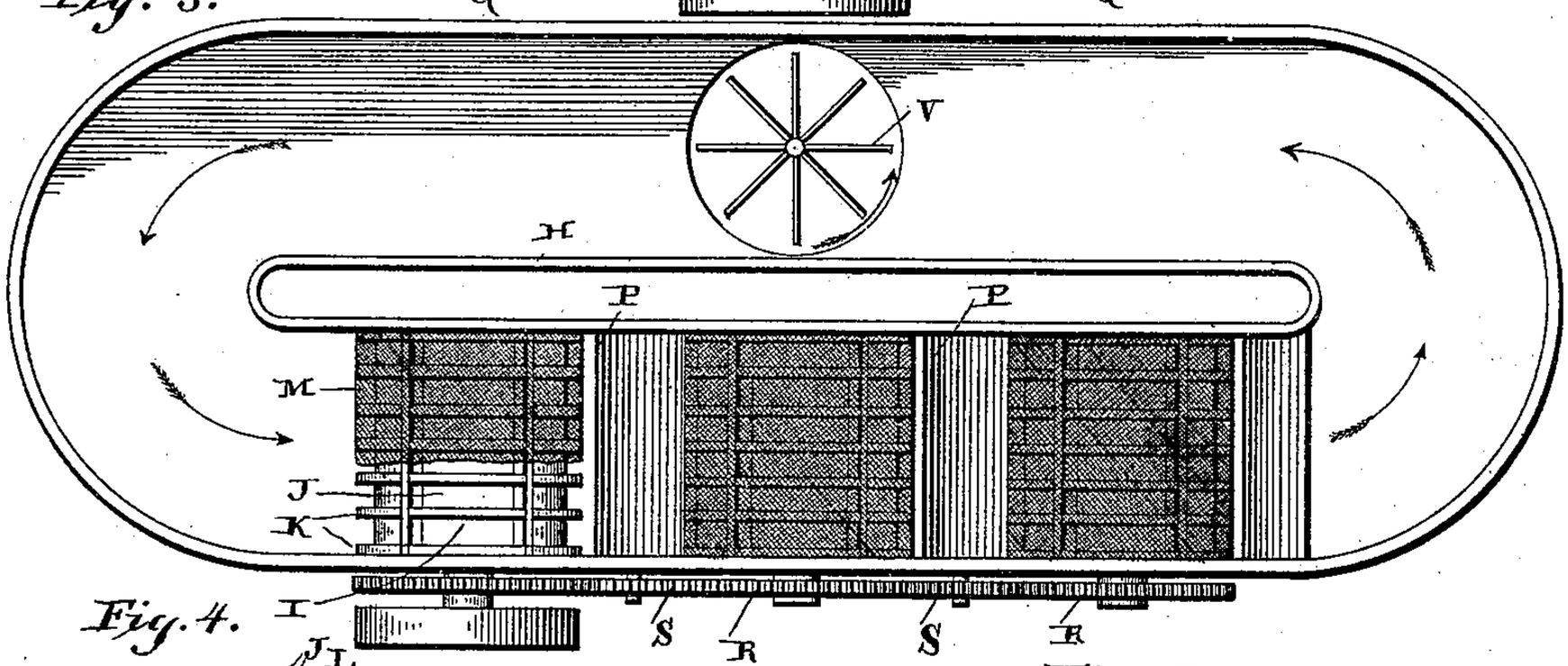


Fig. 4.

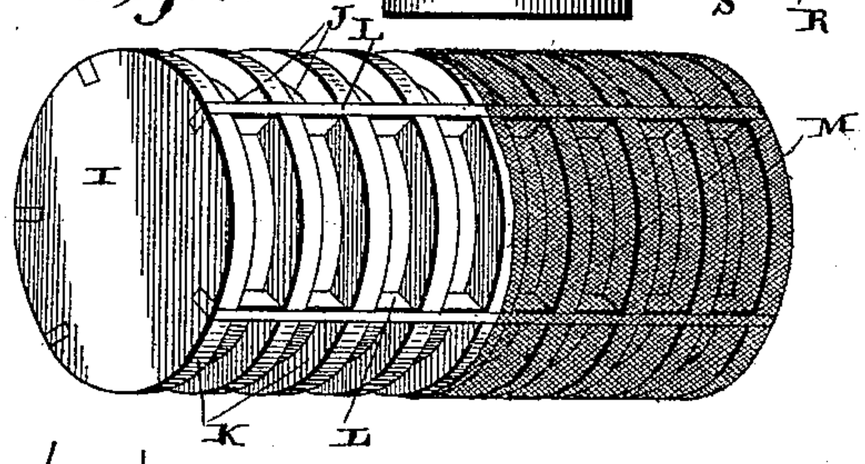
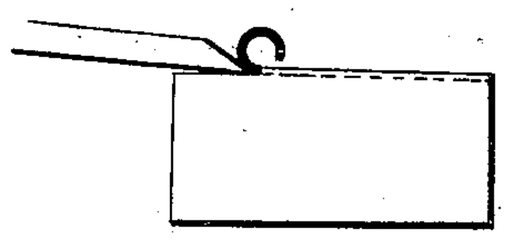


Fig. 5.



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UNITED STATES PATENT OFFICE.

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PROCESS OF AND APPARATUS FOR DISINTEGRATING FIBROUS SUBSTANCES.

SPECIFICATION forming part of Letters Patent No. 487,912, dated December 13, 1892.

Application filed February 9, 1892. Serial No. 420,856. (No model.)

To all whom it may concern:

Be it known that we, JOHN B. CARTER and JESSE H. BERST, of Kokomo, in the county of Howard and State of Indiana, have invented certain new and useful Improvements in Processes of and Apparatus for Disintegrating Fibrous Substances; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

Our invention relates to a process of and apparatus for the mechanical reduction of fibrous substances to their primitive fibers.

Heretofore fibrous materials—such as wood and straw—have generally been mechanically reduced to be converted into pulp by grinding or cutting the stock into a powder and then subjecting this reduced stock to a beating process in a pulp-beating engine to give it the felting quality necessary before it can be converted into paper. The objection to these methods is that the primitive or natural fiber is cut, crushed, or broken, so that there is not now any known mechanical process by which the primitive fibers and tissues of the stock can be disintegrated and separated to leave them in their natural shape and length.

By means of our process to be fully described hereinafter, which is carried out by an apparatus substantially like that herein shown, we are enabled to mechanically disintegrate and separate the primitive fibers and tissues of fibrous substances without cutting, grinding, breaking, or otherwise injuring them to the slightest degree by revolving a quantity of the stock to be reduced upon its own axis under proper pressure.

In the accompanying drawings, Figure 1 is a vertical longitudinal section of an apparatus embodying our invention. Fig. 2 is a similar view of a modified form. Fig. 3 is a plan view of the same. Fig. 4 is a perspective view of one of the modified rolls. Fig. 5 is a view showing the manner of cutting the slabs to be rolled.

A indicates a tank or vessel of any suitable size, in which is suitably journaled a roller B. Placed beneath this roller B is a concaved rolling surface C, slightly roughened, and which is adjustably held in relation to the lower periphery of the roll by means of a screw D, as will be readily understood. The inlet end E of the concaved surface C is further from the periphery of the roll B than the exit end F, for a purpose to be described farther on. This tank A has placed therein a quantity of water, which is preferably of a depth indicated by the dotted line *a b*. In order to allow the water in the tank A to pass between the roller B and the surface C, the said surface is narrower than the tank, to leave a space between it and the side of the tank for this purpose, as will be readily understood. In this instance the surface C is formed of a solid block of suitable material, though it may be made in any other convenient or desirable manner without affecting the spirit of our invention.

The wood to be mechanically disintegrated is cut into pieces or blocks approximately an inch square and twelve inches long, with the grain running lengthwise thereof, and placed into a boiler, where they are subjected to steam-pressure from ten to fifteen hours, until they have become slightly softened.

The shape or form of the wood is not essential to the carrying out of our process; and we therefore do not limit ourselves in this respect.

Instead of forming the wood into blocks, as just described, it may be formed into curled slabs with the grain running lengthwise and of from one-quarter to one-half of an inch in thickness, as shown in Fig. 5. We prefer, however, to prepare the wood by cutting it into shavings similar to excelsior, then boiling or steaming them. This is advantageous for the reason that pigment and coloring-matter are more readily removed from the wood in the boiling process when in this form, and also for the reason that when so prepared a portion of the process hereinafter described can be omitted, which is necessary when the wood is prepared in billets or slabs. In either case the prepared wood will be subjected to low steam-pressure for the purpose of slightly softening it. These blocks, billets, or curled slabs are then placed in the inlet end of the concave rolling-surface C, and are caught by the roller B, which is slightly roughened to take a hold upon the curled slab or billet to

prevent it from slipping, as is also the concaved surface for the same purpose. The roller B is revolved in the direction indicated by arrow at any suitable speed, and the billet or slab is rolled upon its own axis and at right angles to its grain between the rollers and the concaved surface. As the billet is rolled it assumes first substantially a cylindrical form, and as it is gradually carried to the exit end it assumes an elliptical shape, as shown, until it drops out of the exit end. This rolling or revolving of the stock upon its own axis under pressure causes the plane of pressure upon the stock to be continually changed, and effects an abrading or moving action of the fibers one upon the other throughout the entire body thereof, which is exceedingly effectual in completely separating the fibers whether the quantity of stock be in the form of a billet or in the form of a wad of "half-stuff," to be fully described farther on. The space between the periphery of the roller and the concaved surface is regulated according to the size of the billet or curled slab, so that it is not subjected to sufficient pressure while being rolled to crush, break, or injure the fibers thereof in any manner whatever.

We have found that the rolling of the material in the manner just described loosens and separates the primitive fiber thereof in a manner not heretofore accomplished by mechanical means. It will be readily conceived and understood that while this material is being rolled under pressure in a soft condition all of the fibers throughout the whole billet or slab are moved from their natural relative positions. Several passages of the material through this roll will so separate and disentegrate the primitive fibers by rolling them apart that the billet or slab when it comes from the exit end of the roll cannot be handled without coming to pieces. It will be noticed that while the material is being rolled it is at the same time kept well saturated with water, which is between the roller B and the concaved surface C, which during the process washes the material, and the continued rolling thereof under water imparts thereto a felting quality. This disintegrated material can then be passed, as above described, a sufficient number of times to convert the fibers into a pulp suitable to be converted into paper.

From this description it will be seen that the billet or slab is reduced to its primitive fibers without mashing, cutting, or injuring them, which is not the case in other disentegrating or reducing machines. We have found that fibers of wood are very short and have pointed ends. Under a powerful magnifying glass we find that the fibers of hard wood—such as hickory—are about an eighth of an inch long. In all woods the fibers are coated and united by a resinous matter which unites them and makes the solid wood.

When it is desired to reduce the material to its finest fibers and to make the disentegration and separation of all the fibers complete and perfect we pass the material in the manner above described a sufficient number of times to cause it to separate. We then continue this same process or method of revolving or rolling a suitable quantity of the stock upon its own axis by placing the disintegrated mass of fibers in a tank G of the modified machine, which has a proper quantity of water therein, as indicated by dotted line *c d*. Journaled within this tank at one side of a central vertical partition H are any desired number of rolls I. These rolls I are provided with annular grooves J, to form annular ribs K, and with longitudinal ribs L. Placed around each of these rollers is a wire-netting or screen M, which thus forms a water-space between the screen-surface and the bottom of the grooves, as will be understood. Placed below these rolls are the concaved surfaces N, which are shaped, as shown, with the back fall P continuing on to the inlet end Q of the succeeding roll. These rolls are driven by means of a belt passing around a pulley upon the shaft of one of them, and motion is transmitted from this to the other rolls by means of the gear-wheels R and idlers S, placed between them, which revolve all the rolls in the same direction, or they can be driven by belts or in any other convenient manner. The water-line in this tank is preferably a little above the inlet end of the concave surface, so that the material placed in the water will float into the inlet. When the rolls are started, the water is caught by the longitudinal ribs L and carried over to the back fall of each roll, and thereby a current is caused in the tank around the vertical partition, as shown by arrow. This current carries the partially-reduced mass to the first roll. The water passing through the screen causes the pulpy mass to thicken and collect thereon, and as the roll revolves this thickened and collected mass is brought in contact with the concaved surface and formed into a roll or wad, which is rolled on its axis between the roll and the concaved surface, passing out the exit end thereof to the next roll. It will be understood, of course, that while in this instance the greater portion of the fibers will be collected to extend in a line with the axis of the wad the other fibers will be in all possible positions. This, however, does not affect our process of rolling a quantity of stock upon its own axis, for the abrading or rolling action of the fibers one upon the other is still continued by the changing of the line of pressure upon the wad, which causes further reduction and washing thereof. The longitudinal ribs upon the roll carry sufficient water to the exit end to wash this roll or wad down the inclined surface to the inlet end of the next roll, thus making the feeding action entirely automatic. The water carried over also keeps the rolled mass thoroughly saturated, which is very desirable in the reduction of fiber, as it is impossible to keep the pulpy mass too wet dur-

ing the reducing process. In this manner the partial disintegrated material is gathered by the roll and carried around by it, which forms it into a roll of a size equal to the space between the screen and the rolling-surface. It is then carried around the central vertical partition by the current, and is again caught by and passes through the rolls. The material is subjected to this rolling process sufficiently long to perfectly disintegrate and separate the fibers of the wood and to give to it the necessary felting quality. Owing to the construction of these last-mentioned rolls, a large quantity of the pulpy mass can be gathered by the rolls, and as the material thus gathered is rolled and squeezed the water therein passes through the screen into the water-way grooves of the rolls. This enables the process to be carried on much more rapidly than would be possible if the rolls were solid, and by this squeezing action forces the water through the collected mass and washes it. The necessity for subjecting the disintegrated material to this last rolling action in the modified machine to make a very fine disintegration is that the roll B cannot be placed near enough to the concaved surface C to make disintegration fine and perfect, as such an adjustment would crush the fiber in the first instance, which must be avoided. However, we desire it to be understood that the last rolling action is exactly the same as the first, and is only carrying the process shown in Fig. 1 to a greater degree to make the fibers finer, as the first rolling action would be amply sufficient for coarse paper or card-board by passing the material a sufficient number of times.

While we have described and shown a roll and a concaved surface coacting therewith for rolling the stock, it will be understood that this is not essential or indispensable, for the stock may be rolled between straight surfaces.

Our process consists in rolling or revolving a quantity of the stock to be reduced under pressure upon its axis between surfaces, so that the natural relative positions of the fibers thereof are constantly changing and the fibers rolled apart. This disturbance is noticed most at first at the center of the billet or roll, and as the operation proceeds gradually approaches the periphery.

When the wood is put into the form of shavings, as before set forth, the roll B is dispensed with and the shavings are only subjected to the action of the modified rolls. From this it will be seen that the roll B and the modified rolls are separate machines, either of which will serve to carry out our process, while under the conditions first specified herein we prefer to subject the billets to the action of the roller B and then to the modified rolls to further reduce the fiber and give to it a felting quality. It will also be understood that the billets or slabs can be placed directly in the modified machine without first subjecting them to the action of the roller B and concave roller-surface C. In this instance the slab or billet will preferably be guided to the first roll in its first passage in order that it may be fed thereto in its proper position to be operated upon.

After the pulpy mass has passed through the modified rolls they pass out in the form of small rolls, and it is desirable to break them up before they reach the roll for a second pass. This is done by means of an agitator V, of any suitable construction, which is placed within the tank G. In this way the rolls of pulpy mass after passing through the rolls are thoroughly broken up, to be again gathered by the first roll, as before described. By means of this operation the fibers of the mass are caught and rolled in a different position each time, which makes the disintegration more rapid and thorough, as will be understood, than would be possible if the rolls were not broken up by an agitator of some kind.

By our process the disintegration is more rapid than by the ordinary process, for the reason that the whole of the billet or substance being reduced is acted upon at one and the same time and not merely the surface thereof, as heretofore. The fiber is superior to other mechanically-reduced fiber, as it is not cut, crushed, broken, or injured in any manner.

It will be seen that our process differs radically from those which have preceded us in that we roll the wood and cause the fibers to be rolled or tumbled apart in contradistinction to rubbing, cutting, crushing, and grinding, as has been the practice heretofore. It will also be noticed that the wood is rolled at first at right angles to its grain, so that the fiber is not broken, as would be the case if rolled in a line therewith. However, after it has been reduced to a semi-pulpy state and thus made pliable the fiber can be wadded into a promiscuous ball and passed through the modified rolls shown in Figs. 2 and 3 without injuring them in any manner.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The herein-described process of disintegrating fibrous substances, consisting in revolving a suitable quantity of the stock to be reduced upon its own axis under pressure.

2. The herein-described process of disintegrating fibrous substances, consisting in revolving a suitable quantity of stock to be reduced upon its own axis and at right angles to the grain thereof.

3. The herein-described process of disintegrating, washing, and felting fibrous substances, consisting in repeatedly rolling upon its own axis under pressure and under water a suitable quantity of stock after each rolling operation, breaking the resulting wad, and then gathering the separated stock into a wad and again rolling it upon its own axis.

4. A fiber-disintegrating apparatus com-

prising a rolling mechanism for partially disintegrating it, combined with rollers having a screen-surface with water-ways inside thereof and a concaved surface coacting therewith, substantially as shown.

5. A fiber-disintegrating roll having annular ribs to form water-ways and a screen placed around it, combined with a concaved surface coacting therewith, substantially as described.

6. A fiber-disintegrating roll having grooves to form water-ways made in its periphery and a netting placed upon its outer surface, whereby water-ways are formed behind the netting, substantially as and for the purpose set forth.

7. A fiber-disintegrating roll having annular grooves to form water-ways and longitudinal ribs, for the purpose specified, combined with a concaved surface and a wire-netting placed around the said roll, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

JOHN B. CARTER.
JESSE H. BERST.

Witnesses:
ALLEN S. PATTISON,
J. M. NESBIT.