Sept. 7, 1965 H. RAPP 3,204,298

PROCESS FOR BREAKING COMPRESSED FIBROUS MATERIAL

Filed June 7, 1962 3 Sheets-Sheet 1

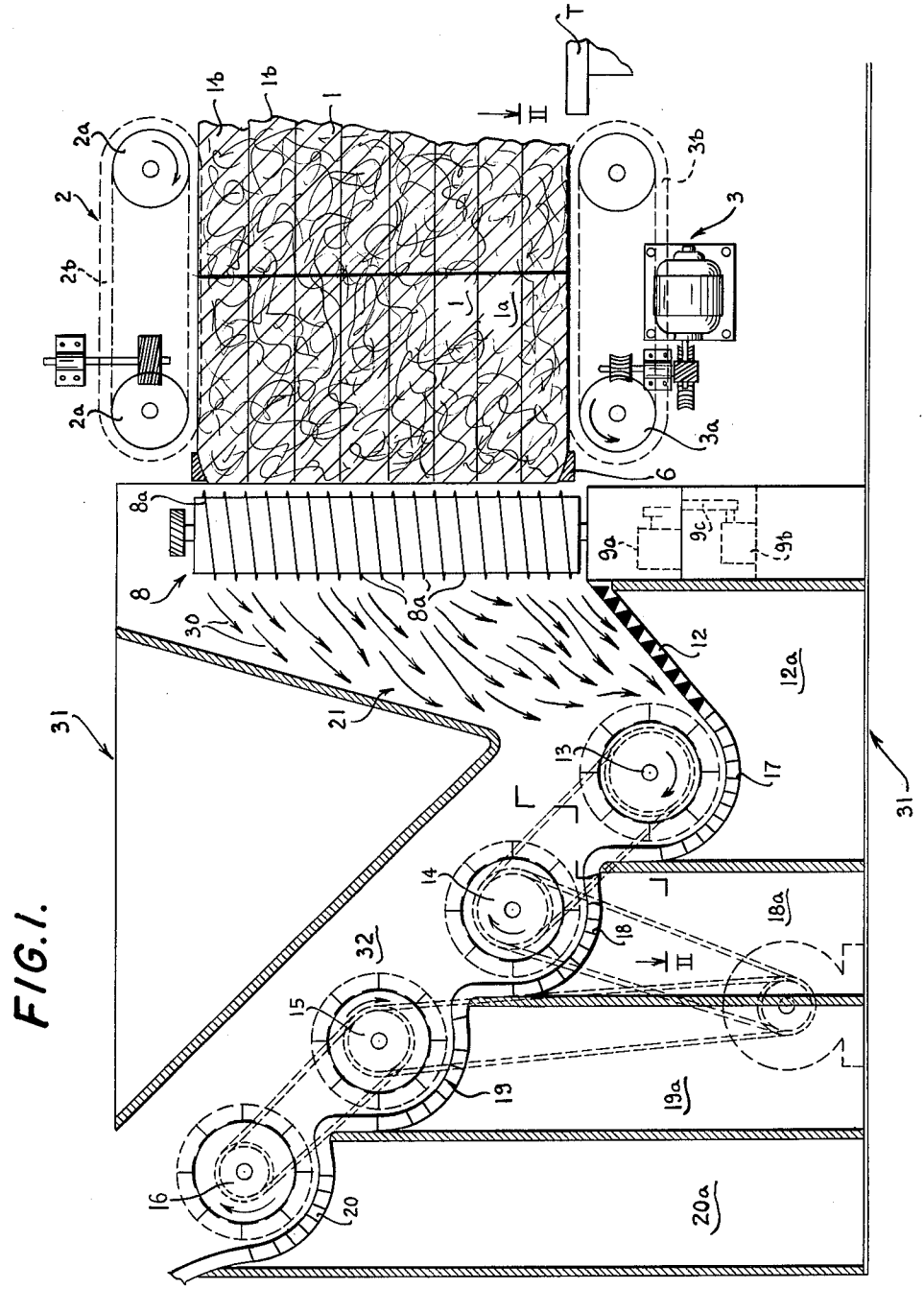

FIG. 1.

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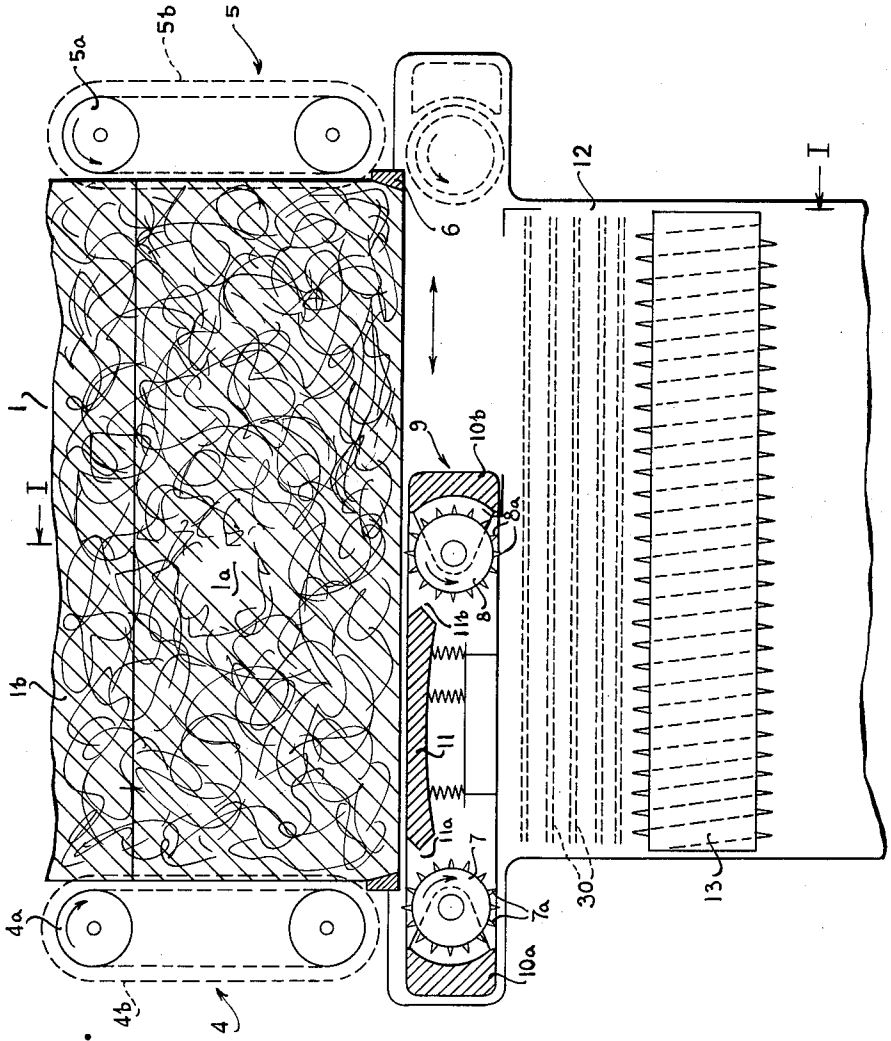

FIG. 2.

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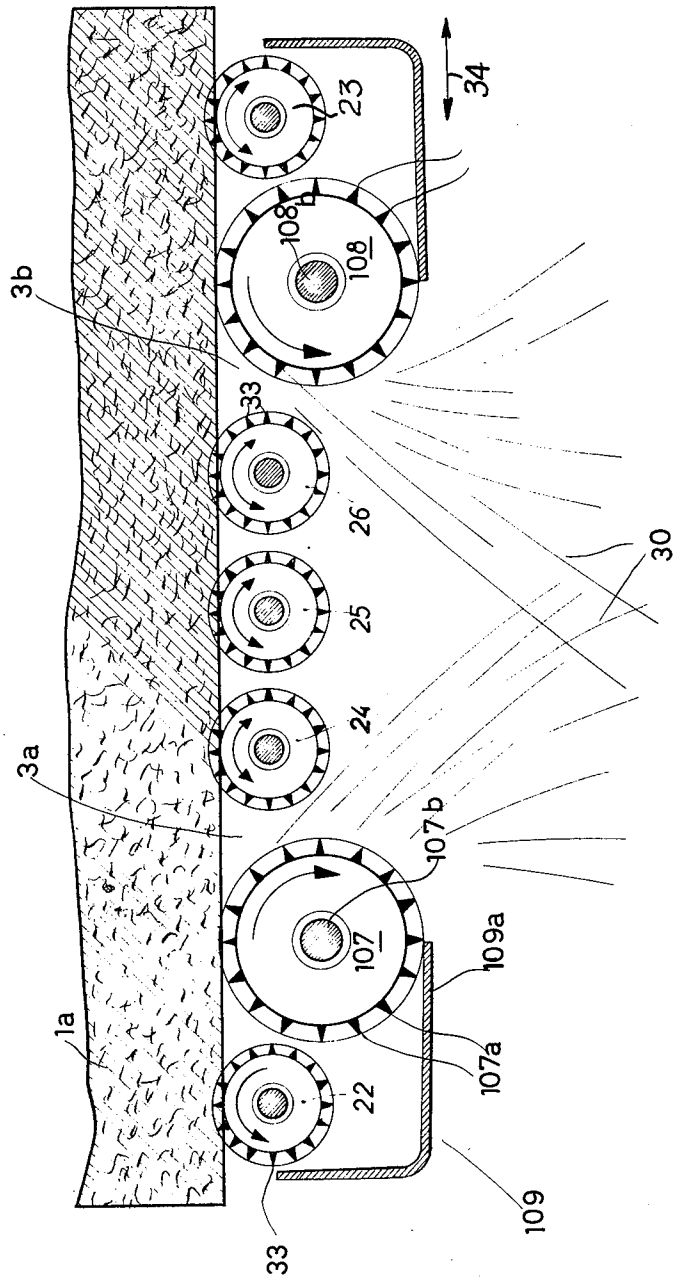
Fig. 3



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PROCESS FOR BREAKING COMPRESSED FIBROUS MATERIAL

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Claims priority, application Germany, June 13, 1961, M 49,329
5 Claims. (Cl. 19—145.5)

The present invention relates to a process for treatment of fibrous materials, and more particularly to a process for breaking and teasing packages of stacked cotton slabs or raw cotton bales. Still more particularly, the invention relates to a process according to which tufts of fibrous material removed from stacked slabs or bales are immediately subjected to a thorough sifting, cleaning and mixing action.

An important object of the invention is to provide an exceptionally simple process for consecutively breaking raw cotton bales or cotton slabs in a continuous operation and according to which the bales or slabs are comminuted into small tufts of uniform or nearly uniform size.

Another object of the invention is to provide a process of the just outlined characteristics which may be carried out with the expenditure of less energy than any process for the same purpose of which I am aware at this time because the instrumentalities used for breaking of bales or slabs act in directions in which the compressed fibrous material offers least resistance to a comminuting action.

A further object of the invention is to provide a process for breaking bales or slabs of compressed fibrous material which constitutes an improvement over the process disclosed in a copending application Serial No. 96,221 filed by Hermann Diesel and assigned to the same assignee now Patent No. 3,139,650.

With the above objects in view, the invention resides in the provision of a process which comprises the steps of stacking two or more bales or slabs of compressed fibrous material, and removing tufts of material in directions in which the compressed fibrous material offers least resistance to breaking. Thus, and since the slabs normally assume the form of substantially rectangular flat bodies, tufts are being removed in directions parallel with the general planes of such bodies. In the event that the slabs are stacked in horizontal planes, the compressed material is subjected to the action of plucking instrumentalities in the form of toothed rollers, bands or the like whose revolving teeth engage the slabs and are simultaneously reciprocated in horizontal planes.

The improved process may be carried out with an apparatus which comprises means for advancing stacked slabs endwise against one or more revolving plucking rollers which are reciprocated in such a way that their teeth move in directions substantially parallel with the general planes of the slabs. It is preferred to mount two or more plucking rollers in a reciprocable carriage and to rotate the rollers in opposite directions so that they move tufts of fibrous material toward a plane which is located midway between and which is perpendicular to the plane common to the axes of the plucking rollers.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims, The improved process itself, however, together with additional features and advantages thereof, will be best understood from the following detailed description of certain specific embodiments of a bale breaking apparatus with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal section in a vertical plane through a first apparatus, the section of FIG. 2 being taken in the direction of arrows as seen from the line I—I of FIG. 2;

FIG. 2 is a horizontal section through the apparatus as seen in the direction of arrows from the line II—II of FIG. 1; and

FIG. 3 is a similar horizontal section through a modified apparatus which is shown on an enlarged scale.

Referring now in greater detail to the illustrated embodiments, and first to FIGS. 1 and 2, there is shown an apparatus for breaking a parallelepiped stack **1** of slabs consisting of compressed fibrous material and for thereupon sifting, mixing and cleaning tufts of fibrous material which are removed from the slabs. As shown in FIG. 1, the stack **1** comprises a first package of superimposed slabs **1***a* which are disposed in horizontal planes, and a second package of superimposed slabs **1***b* which are also disposed in horizontal planes and which are located rearwardly of the slabs **1***a*. The slabs **1***a* or **1***b* may but need not be of identical thickness. A third package of slabs may be assembled on a stacking table T which is shown to the right of the package **1***b*. In other words, the packages of stacks **1***a*, **1***b* and tht package momentarily assembled on the table T may form a continuous body of stacked horizontal slabs, and the two foremost packages are engaged by a composite conveyor which, in the embodiment of FIGS. 1 and 2, comprises four endless conveyors including an upper conveyor **2**, a lower conveyor **3**, a first lateral conveyor **4**, and a second lateral conveyor **5**. Each of these conveyors comprises a pair of driven sprockets **2***a*, **3***a*, **4***a*, **5***a*, and an endless needle band or apron **2***b*, **3***b*, **4***b*, **5***b* which is trained around the respective sprockets. The stack-engaging inner runs or stringers of the aprons **4***b*, **5***b* are driven downwardly, as viewed in FIG. 2, and the stack-engaging inner runs of the aprons **2***b*, **3***b* are driven in a direction to the left, as viewed in FIG. 1, so as to advance the package of slabs **1***a* endwise against a pair of toothed plucking rollers **7** and **8** which are best shown in FIG. 2 and which are mounted in a specially constructed carriage **9**. The aprons **2***b*—**5***b* define between themselves a passage of substantially rectangular cross section through which the packages of stacked slabs advance toward the carriage **9**. Before reaching the plucking rollers **7** and **8**, the package of stacked slabs **1***a* passing through the discharge end of the composite conveyer must advance through a rectangular frame **6** which defines a passage of diminishing cross section and which thus causes a final compression of the slabs **1***a* before they reach the teeth **7***a*, **8***a* of the respective plucking rollers.

As shown in FIG. 1, the teeth **8***a* of the plucking roller **8** are preferably arranged in the form of one or more helices so that, when the roller **8** revolves, each horizontal layer of each slab **1***a* will be subjected to the action of these teeth. The arrangement of teeth **7***a* on the periphery of the plucking roller **7** is analogous. Both plucking rollers revolve about vertical axes and in opposite directions so that, and as viewed in FIG. 2, the left-hand roller **7** revolves in a clockwise direction and the right-hand roller **8** revolves in an anticlockwise direction.

The carriage **9** for the rollers **7**, **8** simultaneously serves as a means for preventing removal of large batches of fibrous material from the stacked slabs **1***a*. In addition, the carriage **9** may accommodate a motor **9***a* (shown schematically in FIG. 1) which is drivingly connected with the shafts of the rollers **7**, **8**, e.g., through a suitable reducing gearing, so as to rotate these rollers in opposite directions. The base structure of the housing **31** of the apparatus accommodates a reversible motor **9***b* which serves as a means for reciprocating the carriage **9** back and forth along the left-hand end faces of the slabs **1***a*, as viewed in FIG. 1. This motor **9***b* may drive the car-

riage through a rack-and-pinion assembly **9***c* or the like. The means **9***a* for rotating the plucking rollers **7, 8** in opposite directions, and the means **9***b*, **9***c* for reciprocating the carriage **9** along the end faces of the slabs **1***b* are not shown in minute detail since many types of such rotating and reciprocating means may be used, for example, simple gear trains, belts and pulleys, sprockets and chains, hydraulic or pneumatic motors, and many others. All that is necessary for satisfactory operation of my improved bale breaking apparatus is that the rollers are rotated and that the carriage moves back and forth along the slabs **1***a* in such a way that the teeth **7***a*, **8***a* are reciprocated in horizontal planes and that the axes of the rollers **7, 8** remain parallel with themselves when the carriage **9** reciprocates. It will be noted that the general planes of the slabs **1***a*, **1***b* are perpendicular to the axes of the plucking rollers **7, 8** and to the common plane of these axes.

As shown in FIG. 2, the carriage **9** comprises several sections including a hood-shaped first baffle or shield **10***a* which partially surrounds the plucking rollers **7**, a hood-shaped second baffle or shield **10***b* which partially surrounds the roller **8**, and a substantially plate-like third baffle or shield **11** which extends between the rollers **7, 8** and which is immediately adjacent to the front end faces of the slabs **1***a*. The shields **10***a*, **10***b*, **11** define between themselves two vertical apertures or windows **11***a*, **11***b* through which the rollers **7, 8** project into actual engagement with the slabs **1***a*. It is preferred to construct the carriage **9** in such a way that the rollers **7, 8** and/or the shields **10***a*, **10***b*, **11** are adjustable with respect to each other so as to change the width of the apertures **11***a*, **11***b*. The directions in which the rollers **7, 8** rotate are selected in such a way that tufts **30** of fibrous material removed from the slabs **1***a* are caused to pass through the windows **11***a*, **11***b* and behind the central shield **11**. In other words, the tufts **30** are advanced from one side of the vertical plane common to the axes of the rollers **7, 8** to the other side of this vertical plane. The vertical plane common to the axes of rollers **7, 8** is the same vertical plane in which the carriage **9** reciprocates back and forth along the slabs **1***a*. As soon as the package of slabs **1***a* is broken up, the continuously or intermittently advancing needle aprons **2***b*–**5***b* move the next package (slabs **1***b*) into the range of revolving and reciprocating teeth **7***a*, **8***a*.

It is preferred to provide the frame **6** with hard and highly polished material-engaging inner faces to reduce friction when the conveyers **2**–**5** are in operation.

At the left-hand side of the carriage **9**, as viewed in FIG. 1, the housing **31** of the apparatus defines a downwardly inclined channel **21** of diminishing cross section (as seen in a vertical plane) whose intake end is adjacent to the carriage and through which the tufts **30** advance into the range of a first teasing roller **13**. The bottom wall in the channel **21** assumes the form of a grate **12** through which any particulate matter heavier than the tufts **30** can descend by gravity into a receptacle **12***a*. Such heavier particulate matter may consist of stones, metallic particles and the like which are accidentally contained in the compressed fibrous material of the slabs. The grate **12** is preferably removable so that it may be replaced by a grate whose bars are spaced at a greater or lesser distance from each other. The teasing roller **13** breaks up the tufts **30** and permits foreign particles which might have been entrapped in the tufts **30** to drop by gravity through the bars of a second grate **17** which is located below this teasing roller and which allows such particles to descend into the receptacle **12***a*. Additional teasing rollers **14, 15, 16** and additional grates **18, 19, 20** are located in a flat upwardly inclined second channel **32** which comunicates with the channel **21** and through which the fibrous material is drawn by suction produced by a suitable apparatus, not shown. The particles descending through the grates **18, 19, 20** accumulate in receptacles **18***a*, **19***a*, **20***a*, respectively. If desired, the receptacle **12***a* may be subdivided into two receptacles one of which receives particulate matter descending through the grate **12** and the other of which receives foreign particles descending through the grate **17**. The channel **32** discharges comminuted, cleaned and intermixed tufts into a next machine, e.g., a cleaning apparatus, which is not shown in the drawings. The mixing action of the teasing rollers **13**–**16** is of particular advantage when the package momentarily engaged by the teeth of the plucking rollers **7, 8** consists of slabs containing different fibrous materials. The manner in which the teasing rollers **13**–**16** may be driven is preferably the same or similar to that disclosed in the aforementioned copending application Serial No. 96,221 of Hermann Diesel to which reference may be had if necessary.

At least the median shield **11** may be biased by helical springs **11***c* or the like so as to yieldingly bear against the end faces of the slabs **1***a*. The other shields **10***a*, **10***b* may be biased in similar manner if desired. The apparatus of my invention may utilize a carriage with rigidly mounted shields if the nature of the slabs is such that the springs **11***c* may be dispensed with. The shields **10***a*, **10***b*, **11** may consist of sheet metal or the like. If they are biased by springs, the pressure which the shields exert against the slabs is selected in a way to avoid excessive friction.

FIG. 3 illustrates a portion of a modified bale breaking and teasing apparatus which comprises a different carriage **109**. This carriage includes a casing **109***a* for vertical shafts of idler rollers **22**–**26** which replace the shields **10***a*, **10***b*, **11** and whose teeth **33** bite into and loosen up the fibrous material of the slabs **1***a* which are in the range of teeth **107***a*, **108***a*. As shown, one or more toothed idler rollers **(24–26)** may be mounted in the space between the plucking rollers **107, 108**, one idler roller **(22)** may be located at the outer side of the plucking roller **107**, and a further idler roller **(23)** may be provided at the outer side of the plucking roller **108**. The rollers **22**–**26** may but need not be driven since they are compelled to rotate automatically when the carriage **109** is reciprocated along the end faces of the slabs **1***a* (see the double-headed arrow **34**). The manner in which the teeth **107***a*, **108***a* are arranged in helical groups, the manner in which the vertical shafts **107***b*, **108***b* are driven, and the manner in which the carriage **109** is reciprocated along the slabs **1***a* are preferably the same as described in connection with FIGS. 1 and 2. The tufts **30** of fibrous material removed by the teeth **107***a*, **108***a* are directed toward a vertical plane which is located midway between the plucking rollers **107, 108** and which is perpendicular to a vertical plane common to the axes of the shafts **107***b*, **108***b*.

The idler rollers **22**–**26** may consist of wood or a similar material, and they constitute a composite shield which prevents removal of large batches of fibrous material from the slabs **1***a* when the carriage **109** reciprocates along the package momentarily engaged by the plucking rollers **107, 108**. If desired, the shafts of the rollers **22**–**26** may be mounted in suitable roller bearings or the like to reduce friction.

An important advantage of my improved apparatus is that, since the shafts of the plucking rollers **7, 8** or **107, 108** are vertical, since these plucking rollers are caused to reciprocate in a horizontal direction, and since the teeth of the plucking rollers are preferably arranged in helical groups, the teeth **7***a*, **8***a* or **107***a*, **108***a* will break the slabs **1***a*, **1***b*, etc. uniformly without necessitating any other but forward movement of the slabs. In other words, the rather complicated mechanism disclosed in the aforementioned application Serial No. 96,221 which mechanism is used to reciprocate the stacked slabs while they are being engaged by the teeth of a plucking roller, and also the grid which separates the plucking roller from the end faces of the slabs may be dispensed with without in any way impairing the efficiency of the improved

apparatus. Furthermore, the rate at which the plucking rollers 7, 8 or 107, 108 can remove tufts of fibrous material from stacked slabs may be varied at will, either by changing the rate of speed at which the needle aprons 2*b*–5*b* are driven or by changing the width of windows 11*a*, 11*b* or windows 111*a*, 111*b* (FIG. 3) through which the respective plucking rollers advance tufts of fibrous material into the interior of the apparatus, i.e., toward the teasing rollers.

It will be readily understood that, if necessary, the carriage 9 or 109 may be provided with a single plucking roller or with three or more plucking rollers. Each plucking roller may consist of several tubular sections which may be replaced independently in the event that certain teeth of a plucking roller are damaged or destroyed. By utilizing composite plucking rollers, it is possible to replace damaged sections of one or more rollers without necessitating replacement of the entire roller.

My improved process can be carried out in a breaking and teasing apparatus which requires less power than any conventional apparatus of which I am aware at this time. This is due to the fact that the teeth 7*a*, 8*a* or 107*a*, 108*a* remove tufts in the direction of least resistance, namely, in the general planes of the slabs. The compressed fibrous material of the slabs offers less resistance to a comminuting action if such action takes place in directions perpendicular to directions in which a slab was compressed.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A process of simultaneously breaking up at least two substantially flat slabs of compressed fibrous material, comprising the steps of superposing at least two substantially flat slabs so that their superimposed faces are located in a plane of superimposition and their end faces are located in a common removal plane transversal to said plane of superimposition; and removing tufts of fibrous material simultaneously from the end faces of all of the superposed slabs in said removal plane in a direction substantially parallel to said plane of superimposition.

2. A process of simultaneously breaking up at least two substantially flat slabs of compressed fibrous material, comprising the steps of superposing at least two substantially flat slabs so that their superimposed faces are located in a common substantially horizontal plane, and their end faces are located in a common substantially vertical removal plane; and removing tufts of fibrous material simultaneously from the end faces of all of the superposed slabs in said substantially vertical plane and in a direction substantially parallel to said common horizontal plane of said slabs.

3. In a process of simultaneously breaking up a plurality of substantially flat slabs of compressed fibrous material with a vertically arranged rotatable elongated plucking roller the steps of vertically superposing a plurality of substantially flat slabs at a location remote from said plucking roller so that their superimposed faces are located in respective common substantially horizontal planes and their end faces are located in a common substantially vertical plane; continuously moving said plurality of superposed slabs in substantially longitudinal direction toward and with said end faces thereof into engagement with said vertically arranged rotatable plucking roller; and rotating said plucking roller about its substantially vertical axis so as to remove tufts of fibrous material simultaneously from the end faces of all of the superposed slabs.

4. In a process for simultaneously breaking up a plurality of substantially flat slabs of compressed fibrous material with at least one elongated vertically disposed plucking roller having a plurality of teeth disposed along a vertical helix, the steps of vertically superposing a plurality of substantially flat slabs at a location remote from said plucking roller so that their superimposed faces are located in respective common horizontal planes and their end faces are located in a common vertical plane; continuously moving said plurality of superposed slabs in substantially horizontal direction with their end faces toward said vertically arranged plucking roller; compressing edge portions of said slabs adjacent said end faces immediately ahead of said plucking roller in directions transverse to that of the movement of said slabs during the movement thereof toward and into engagement with said plucking roller; rotating said plucking roller about its substantially vertical axis of rotation while reciprocating it in horizontal direction thereby removing tufts of fibrous material simultaneously from the end faces of all of the superposed slabs.

5. In a process for simultaneously breaking up a plurality of substantially flat slabs of compressed fibrous material with a pair of elongated vertically disposed plucking rollers, the steps of vertically superposing a plurality of substantially flat slabs at a location remote from said pair of plucking rollers so that their superimposed faces are located in respective common horizontal planes and their end faces are located in a common vertical plane; continuously moving said plurality of superposed slabs in substantially horizontal direction with their end face toward said pair of vertically disposed plucking rollers; compressing edge portions of said slabs adjacent said end faces immediately ahead of said plucking rollers in directions transverse to said movement of said slabs during the movement thereof toward and into engagement with said plucking rollers; rotating said pair of plucking rollers in opposite directions about respective vertical axes of rotation transversely spaced from one another while reciprocating said rollers in horizontal direction, and thereby removing tufts of fibrous material simultaneously from the end faces of all of the superposed slabs substantially in the direction of said movement and toward a plane midway between the axes of said rollers for causing admixture of said tufts.

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