

[54] METHOD AND APPARATUS FOR
DISPERSING TIGHTLY BALED FIBERS

[75] Inventor: Mickey A. Thomas, Duncan, Okla.

[73] Assignee: Halliburton Company, Duncan,
Okla.

[22] Filed: Aug. 18, 1972

[21] Appl. No.: 281,861

[52] U.S. Cl. 19/80 R

[51] Int. Cl. D01g 7/00, D01g 9/00

[58] Field of Search..... 19/80 R, 81, 145.5, 147.5,
19/200, 205; 264/121; 241/101 A

[56] References Cited

UNITED STATES PATENTS

2,183,583	12/1939	Patterson	19/80 R UX
2,451,504	10/1948	Mayo	19/81 X

3,111,719	11/1963	Novonty	19/200
3,192,571	7/1965	Halleux	19/80 R

FOREIGN PATENTS OR APPLICATIONS

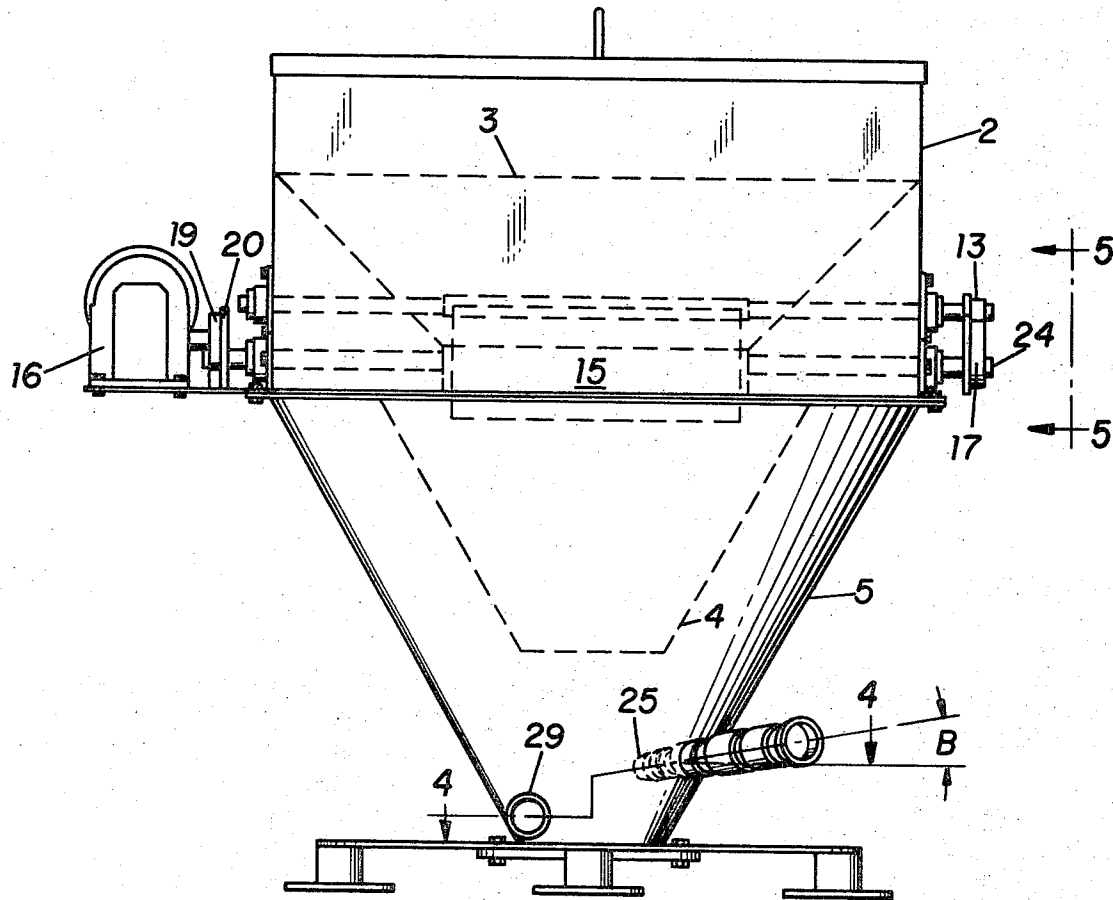
460,120	1/1937	Great Britain	264/121
300,694	11/1928	Great Britain	19/145.5

Primary Examiner—Dorsey Newton
Attorney, Agent, or Firm—John H. Tregoning

[57] ABSTRACT

An apparatus for breaking up and dispersing tightly baled fibers having high attractive static forces therein comprises a receiver channel having at its lower end thereof a plurality of toothed rollers and and aeration means below the toothed rollers consisting of two or more air or gas jets tangentially located on a compound cyclonic surface.

10 Claims, 6 Drawing Figures



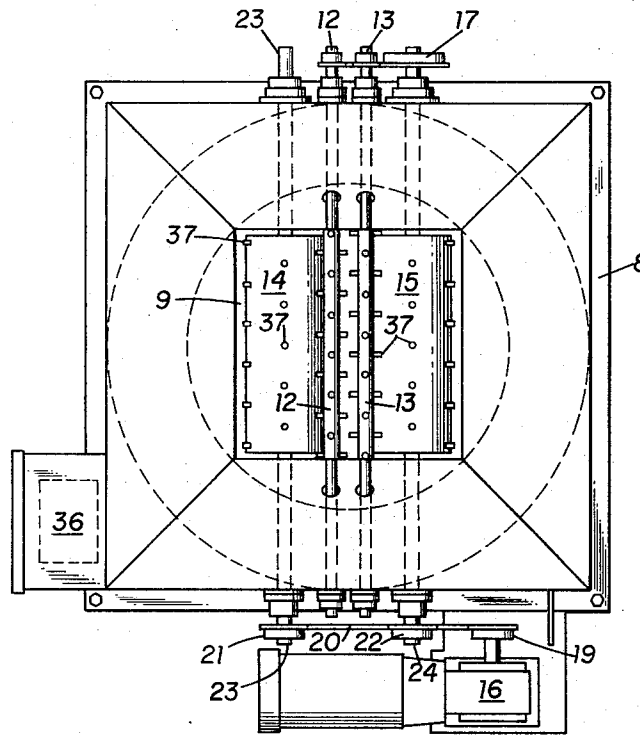


FIG. 3

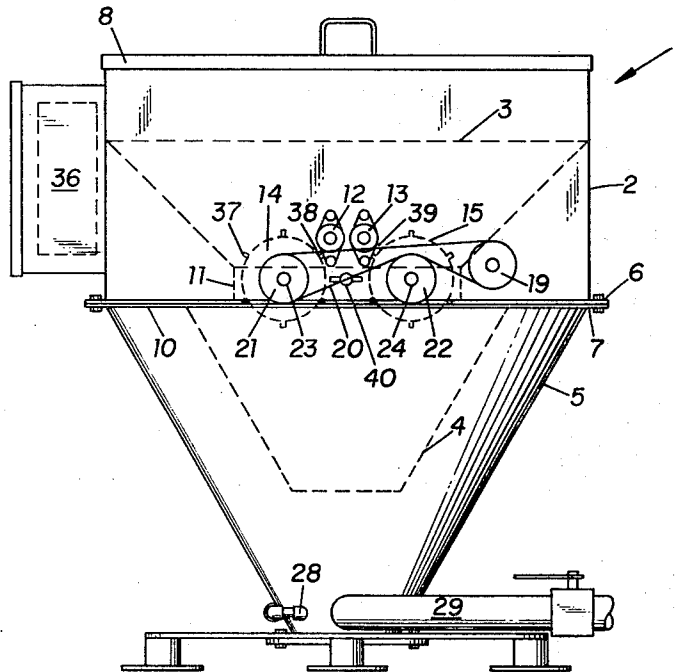


FIG. 1

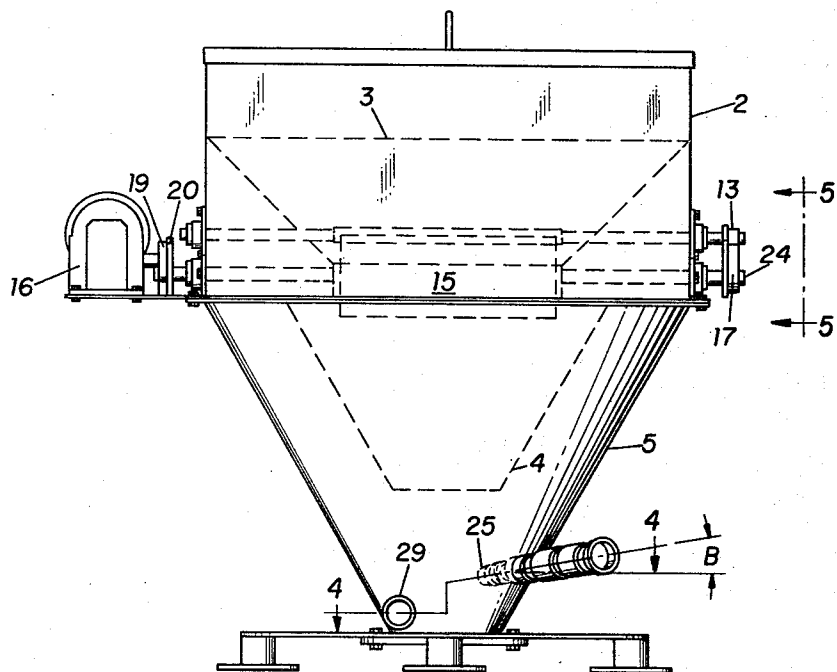


FIG. 2

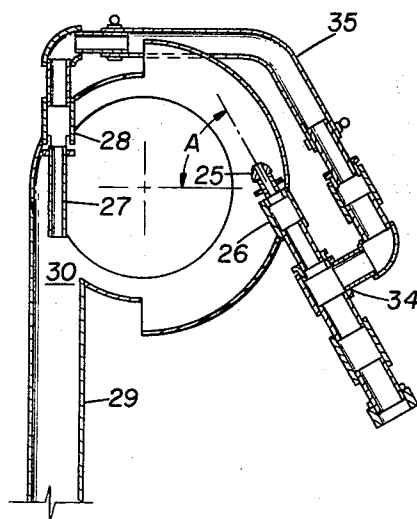


FIG. 4

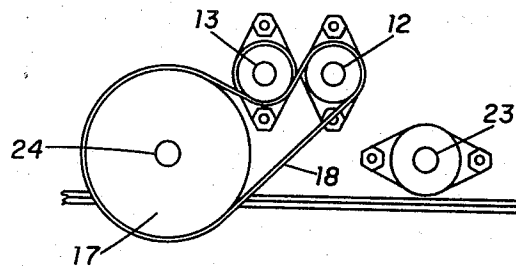


FIG. 5

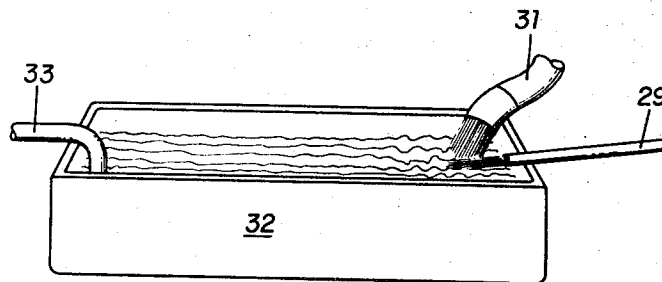


FIG. 6

METHOD AND APPARATUS FOR DISPERSING TIGHTLY BALED FIBERS

BACKGROUND OF THE INVENTION

When natural or artificial fibers are prepared for shipping, they can be baled into large bundles wherein they are compressed and matted to reduce their volume. During this baling process the fibers, which may be anywhere from one-half inch to six inches in length and have a diameter similar to sewing thread (approximately 15 denier), become closely intertwined and entangled and tend to develop a relatively strong attractive force field of static electricity. Upon subsequent separation of the baled fibers into substantially individual fibers the difficulty encountered in overcoming the physical entanglement of the fibers as well as overcoming the static electric forces holding the fibers together has been a major problem to solve.

One example of this problem is in the rapidly developing field of fiber-cementing wherein artificial fibers are used in hydraulic cement slurries to impart added strength to cement and concrete structures. To obtain a sufficient strengthening effect, the fibers preferably should be substantially separated and dispersed throughout the structure.

The method and apparatus of this invention achieves this separation and dispersion by physically rending the fibers apart by mechanical rending means combined with air dispersal means and then holding them apart against their natural tendency to reassociate due to static electricity. Maintaining the fibers in the dissociated state is achieved by air agitation and fiber velocity. Once the fibers are dispersed into the cement slurry, the wet cement serves as a grounding matrix and physical barrier, thereby overcoming the static electrical attraction between the fibers and preventing their reassociation.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate the understanding of this invention, reference will now be made to the appended drawings of preferred embodiments of the present invention. The drawings should not be construed as limiting the invention, but are exemplary only. In the drawings:

FIG. 1 is an elevational front view of the dispersing apparatus of this invention;

FIG. 2 is a side elevational view of the apparatus of FIG. 1;

FIG. 3 is a top view of the apparatus of FIG. 1;

FIG. 4 is a detailed cross-sectional top view of the air or gas dispersing means contained in the apparatus of FIG. 1;

FIG. 5 is a detailed view of the drive means for the mechanical dispersal system contained in the apparatus of FIG. 1; and

FIG. 6 is an isometric view of the method and apparatus for adding the dissociated fibers into a fluid matrix.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, the dissociation and dispersal device 1 comprises an upper receiving bin 2 and flow channel 3 which in this embodiment are each pictured having a horizontal rectangular cross section. At the bottom of

the receiving bin 2 and flow channel 3 are located inner and outer frusto-conical cyclones 4 and 5 respectively.

These cyclones have a generally circular cross-section as partially illustrated in FIG. 4. Connection of the frusto-conical cyclones 4 and 5 to the bin and flow channel is accomplished by abutting the flat flanged plate 6, which is fixedly attached to the bottom end of receiving bin 2 and flow channel 3, to the matching flanged plate 7 attached to the concentric cyclones 4 and 5.

One method of attaching the flow channel 3, which slopes downward and inwardly in receiving bin 2, in a fixed relationship in bin 2 is by attaching it at rim 8 and to flange plate 6 as by welding.

Inner frusto-conical cyclone 4 is attached to plate 7 through means such as welding, thereby providing support for the inner cyclone within the outer cyclone.

Plate 6 has a rectangular opening 9 cut therethrough which mates with the lower end opening of flow channel 3. Plate 7 has a circular opening 10 centrally located which mates with the upper circular end of the inner cyclone 4. The rectangular opening 9 overlaps and adjoins circular opening 10 thereby allowing communication of material flow from flow channel 3 through the two adjacent openings and into inner cyclone 4.

At the lower end of flow channel 3 between the tapered inwardly sloping walls and the flange plate 6 is located a short vertical box-like section 11 in which is partially located the mechanical rending means comprising a plurality of dowelled rollers. These rollers are substantially cylindrical horizontally disposed parallel drums each containing a number of spaced dowels 37 projecting outward from their cylindrical surfaces.

At the upper level are two small diameter rollers 12 and 13 placed parallel and horizontal and just far enough apart to prevent the dowels of each from colliding with the cylinder of the other. These rollers are driven in counter-rotation to each other, with roller 12 as depicted in FIGS. 1 and 3, rotating counterclockwise and roller 13 turning clockwise. This effectively prevents any of the matted fibers from passing through the gap between the two small rollers.

At the lower level are two large horizontal parallel co-planar rollers 14 and 15 having a plurality of dowels protruding from their surface. The axes of rotation of these two rollers are located lower than the level of the axes of rollers 12 and 13. The roller 14 rotates in a clockwise direction in conjunction with roller 12, and roller 15 rotates counterclockwise in cooperation with roller 13. This serves to tear away small clumps of the tightly matted fibers from a large bale introduced into the bin 2 and channel 3. Located between rollers 14 and 15 is stationary shaft 40 fixedly attached to opposing walls of vertical box section 11. Shaft 40 has dowels projecting outward from each side in a horizontal plane and spaced to mesh with these of roller 14 and roller 15, and further rend the fibers passing through gaps 38 and 39.

Rollers 12 and 13 can be driven by any ordinary power source, such as an electric or gasoline powered motor 16 shown in FIG. 2. Motor 16 working indirectly through pulley wheel 17 (FIG. 5) operates pulley belt or chain 18 which in turn rotates both rollers 12 and 13. As shown in FIG. 2, the motor 16 works directly to drive pulley wheel 19 which in turn, through belt or

chain 20, drives the two large rollers 14 and 15 via pulleys 21 and 22 respectively, mounted on shafts 23 and 24 respectively. Shafts 23 and 24 pass through receiving bin 2 and the lower box-like section 11 of the flow channel 3 and contain rollers 14 and 15 fixedly attached thereto. Shafts 23 and 24 are typically mounted in roller bearings (not shown) at each end.

Referring again to FIG. 2, it is clearly illustrated how rollers 12 and 13 are indirectly driven by motor 16. Motor 16 drives large roller 15 by belt or chain 20 which in turn rotates shaft 24 containing at its opposite end, pulley 17 which drives pulleys on rollers 12 and 13 through belt or chain 18.

Thus the entire mechanical system is operative in response to one power source, motor 16.

It should be noted that rotational direction of any one or all of the rotating shafts can be changed to the reverse direction by rearrangement of the belts and pulleys or by addition of one or more pulleys.

The air or gas dispersal means located substantially in lower frusto-conical cyclones 4 and 5 comprises two or more tangential air or gas jets mounted through the wall near the bottom of outer cyclone 5.

Referring to FIG. 4, which is a discontinuous cross sectional top view of the lower section of outer cyclone 5 taken at line 4—4 in FIG. 2, the preferred embodiment of the air or gas disposal means consists of a primary air or gas dispersal jet 25 located in air conduit 26 which passes through the wall of outer cyclone 5 in a generally angular relationship. In one preferred embodiment, Angle A of FIG. 4 will be from 45° to 80° with a preferable angle of 60° and the angle B of the jet 25 and conduit 26 with the horizontal (see FIG. 2) should be from 0° to about 25° with a preferable angle of 10°, with the jet pointing slightly downward towards the lower end of cyclone 5.

A secondary air or gas nozzle 27 is located tangentially in cyclone 5 passing through the wall thereof as shown in FIG. 4. Nozzle 27 also has air or gas conduit 28 supplying pressurized air or gas to the cyclone 5. Nozzle 25 serves to establish a tornadic whirling effect between cyclones 4 and 5 and also directly below cyclone 4. This whirling effect tends to tear apart the individual fibers from the small clumps passing down from rollers 12, 13, 14, and 15 and maintains the individual fibers entrained in the moving air or gas stream. Nozzle 27, which preferably is oriented in a horizontal position, is directed toward discharge conduit 29 which communicates through opening 30 in the wall of cyclone 5. The air or gas stream from nozzle 27, which passes from the relatively narrow diameter of nozzle 27 into the much larger diameter of conduit 29, establishes a strong venturi effect which pulls the air or gas stream in the cyclones and the entrained fibers into the discharge conduit 29 while maintaining the fibers in their highly dissociated state by continual movement and agitation of the air or gas stream. Thus nozzle 27, acting in cooperation with discharge tube 29, forms an eductor or eductor zone, creating a vacuum in the lower end of the cyclones which draws the dissociated fibers and whirling air or gas mass into the air or gas discharge stream and conveys them down the discharge tube 29 to be dispersed into the matrix.

One method of dispersing the dissociated fibers into the preferred matrix is disclosed in FIG. 6 in which the fiber discharge tube 29 is shown emitting a fast moving stream of air or gas and entrained fibers directly into a

stream of slurried matrix discharging from slurry conduit 31.

Substantially all of the mixing of fibers and slurry occurs during the collision of the two convergent streams from conduits 29 and 31 and their turbulent entry into the body of slurry in the sluice box 32. From this box a suction line such as line 33 draws the completely mixed slurry-fiber composition from the sluice box 32 and conveys it to the construction site.

Alternatively, it is possible to mix the fiber stream from conduit 29 into the dry bulk material by adding it at the bulk blending machine or into the discharge pipeline leading from the dry bulk blender, prior to the addition of fluids to the materials.

Although in FIG. 4 it is indicated that a common air or gas pressure supply can be used for air or gas nozzles 25 and 27 by the use of wye connection 34 and conduit connecting loop 35 which connects nozzle 27 to the air or gas supply of nozzle 25, it is clear that a separate air or gas supply can be used for each nozzle thereby obviating the need for wye 34 and conduit 35.

A control box 36 can be attached to the upper section of the apparatus as shown in FIGS. 1 and 3, to receive the controls for motor 16. It should further be noted that the motor has been removed from the apparatus in FIG. 1 to more clearly illustrate the drive system for the various roller drums.

Thus in typical operation, the motor 16 will be started thereby driving rollers 13 and 14 in a clockwise direction and rollers 12 and 15 counterclockwise via belts or chains 18 and 20 as described above. The tightly massed and highly charged bale of fibers is placed into the receiving bin 2 whereupon it drops down into flow channel 3 and contacts the above mentioned four dowelled rollers.

The whirling action of the rollers forces penetration of the projecting dowels into the bale, pulling off small clumps of the fibers and passing them through the gaps 38 and 39 between the large and small rollers. The vacuum produced in the eductor zone from the eductor effect of nozzle 27 and tube 29 helps pull the small clumps of fibers from the dowels once they pass through gaps 38 and 39 and bring them into contact with the stream of air from nozzle 25, which stream of air or gas forcefully rends the small clumps into individual fibers and effectively entrains the fibers in the moving air or gas mass. This air or gas mass is then drawn into the discharge tube in the eductor zone and propelled along by the air or gas from nozzle 27.

It should be pointed out that the nature of these fibers is such that should the fibers be removed from the turbulent air or gas mass, they will immediately reassociate and become a tangled mass again as a result of the highly attractive static electric charges on them. This static charge is not discharged until the fibers are dispersed into the slurry matrix, thereby becoming well grounded. Thus it is imperative that the fibers be agitated and velocitized constantly until this grounding is accomplished, and the apparatus of this invention performs this function in addition to the initial rending apart of the baled fibers and dissociating of them in an air or gas stream.

Although a specific preferred embodiment of the present invention has been described in the detailed description above, the description is not intended to limit the invention to the particular forms or embodiments disclosed herein, since they are to be recognized as il-

illustrative rather than restrictive and it will be obvious to those skilled in the art that the invention is not so limited. For example, while the present invention is depicted having a rectangular shaped upper section and frusto-conical lower section, these sections could easily be of any polygonal shape or curvilinear shape. It is also clear that any number of dowelled rollers could be used in place of or in addition to the four described in this embodiment. Also it would be possible to vary the number and orientation of air or gas jets utilized in the lower section as well as placing additional jets in the upper section as well, to further aid the downward movement and dissociation of fibers. It would also be possible to substitute other mechanical rending means for the rollers, such as fingers, gears, chains, teeth, blades, or other mechanical abraders.

In addition, while this invention is described for use in dissociation of artificial fibers, it could also be utilized for natural fibers as well as other fibrous materials such as hay, grass, metals, and fiberglass. Thus the invention is declared to cover all changes and modifications of the specific example of the invention herein disclosed for purposes of illustration, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. Apparatus for dissociating tightly matted fibrous substances, said apparatus comprising:

a material receiving bin for receiving a bale of said fibers;

a flow channel for channeling said bale into a desired flow path, said channel attached to said bin;

mechanical rending means for partially removing small quantities of material from said bale;

a first frusto-conical cyclone section attached to said bin;

a second frusto-conical cyclone section located concentrically within said first cyclone section and communicating with said flow channel;

gas dispersal means within said first frusto-conical cyclone section; and

discharge means for discharging said fibers from said first frustoconical cyclone section.

2. The apparatus of claim 1 wherein said mechanical rending means comprises four dowelled axially rotated drum rollers with said rollers arranged to work in two pairs of counterrotating intermeshing systems, and power means arranged to drive said rollers.

3. The apparatus of claim 1 wherein said gas dispersal means comprises:

a first gas nozzle having a gas supply conduit attached thereto, said first nozzle and conduit passing through the wall of said first frusto-conical cyclone section and being capable of injecting a stream of pressurized gas into said first frusto-conical cyclone section; and

a second gas nozzle located in said first frusto-conical cyclone section and having a gas supply conduit attached thereto, said second nozzle being capable of injecting pressurized gas into said first frusto-conical cyclone section.

4. The apparatus of claim 3 wherein said discharge means comprises a discharge conduit axially aligned with said second gas nozzle and capable of receiving a flow of gas directed from said second nozzle and thereby create an eductor effect; said discharge con-

duit passing through the wall of said first frusto-conical cyclone section.

5. Apparatus for dispersing dissociated individual fibers from a tightly matted bale, said apparatus comprising:

upper container means for receiving said matted bale and channeling said bale downwardly, said upper container means including: a substantially rectangular outer bin having an open upper end and an open lower end; and

a flow channel, having an open upper end and an open lower end, fixedly secured at the open upper end thereof within said outer bin with the walls of said flow channel sloping downwardly and inwardly from the open upper end to the open lower end thereof;

mechanical dispersal means located in the lower end of said flow channel for tearing small quantities of fibers from said bale;

lower container means attached to said upper container means and communicating therethrough with said upper container means, said lower container means including: an inner frusto-conical cyclone communicating with said flow channel; and an outer frusto-conical cyclone, having an open top portion and a closed bottom portion, attached at the top portion thereof to the lower end of said outer bin and concentrically surrounding said inner cyclone;

air dispersal means located in said outer cyclone for breaking said small quantities of fibers into individual fibers; and

discharge means for removing said fibers from said apparatus and maintaining said fibers in a dissociated state.

6. The apparatus of claim 5 wherein said mechanical dispersal means further comprises at least one pair of counter rotating meshing dowelled roller drums axially horizontally disposed in said flow channel and power means for driving said rollers, and said air dispersal means further comprises first air supply means located in said outer cyclone passing through the wall thereof at a horizontal angle of from 45° to 80° and a vertical angle of from 0° to 25°, and second air supply means located substantially tangentially within said outer cyclone near the bottom thereof.

7. The apparatus of claim 6 wherein said discharge means comprises eductor means located in said outer cyclone for applying a downward vacuum pull on said fibers in said cyclones said outer bin and said flow channel, and a discharge conduit located in the bottom portion of said outer cyclone and passing through the wall thereof.

8. The apparatus of claim 7 wherein said eductor means comprises an air nozzle communicating with said second air supply means, wherein said air nozzle is arranged in close proximity to said discharge conduit and is axially aligned therewith to direct a stream of air from said second air supply means into said conduit, and wherein the diameter of said nozzle is substantially less than the diameter of said conduit.

9. A method of dissociating tightly baled materials having strong physical entanglement and strongly attractive static electrical charges therein, said method comprising:

7

subjecting said tightly baled material to a physical
rending and breaking said bale into small quantities
of material;
introducing a stream of compressed gas into said
small quantities of material;
whirling said small quantities of material in a turbu-
lent stream of gas and dissociating said small quan-
tities of material into individual fibers,
applying a vacuum to the turbulent stream of gas and
dissociated fibers entrained therein thereby draw-
ing the turbulent stream of gas and dissociated fi-

8

bers into an eductor zone; and
applying a pressurized gas stream to the eductor zone
thereby conveying the dissociated fibers from the
eductor zone in a velocitized agitated condition.

10. The method of claim 9 further comprising con-
veying the dissociated fibers in a velocitized agitated
condition to a desired destination through a conduit
from the eduction zone in response to the pressurized
gas stream.

* * * * *

15

20

25

30

35

40

45

50

55

60

65