

July 21, 1953

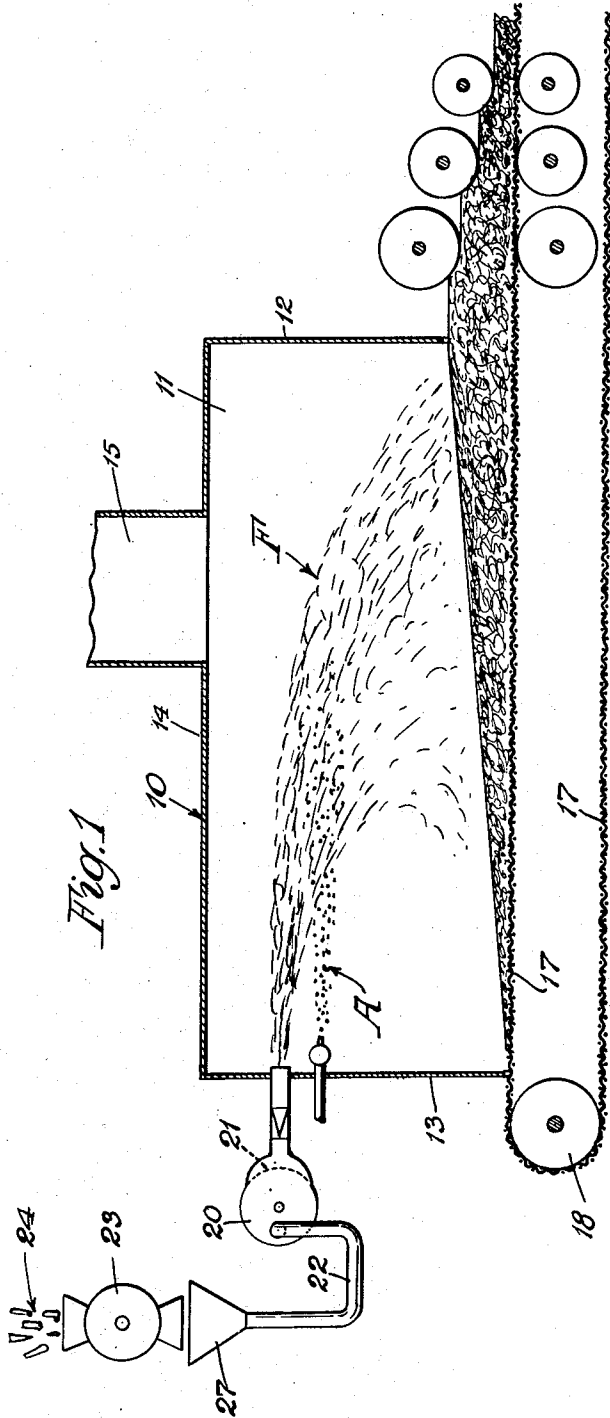
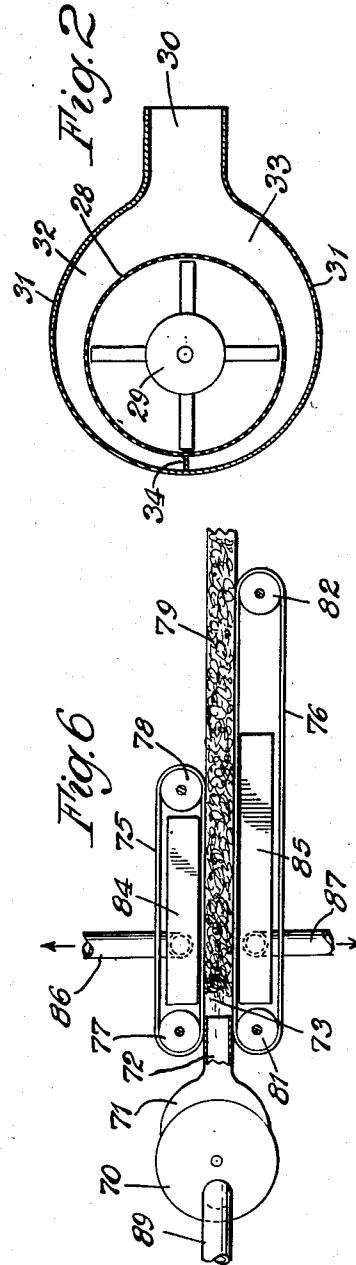
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METHOD FOR DISPERSING AND FELTING FIBERS AND MILL

Filed Dec. 1, 1949

4 Sheets-Sheet 1



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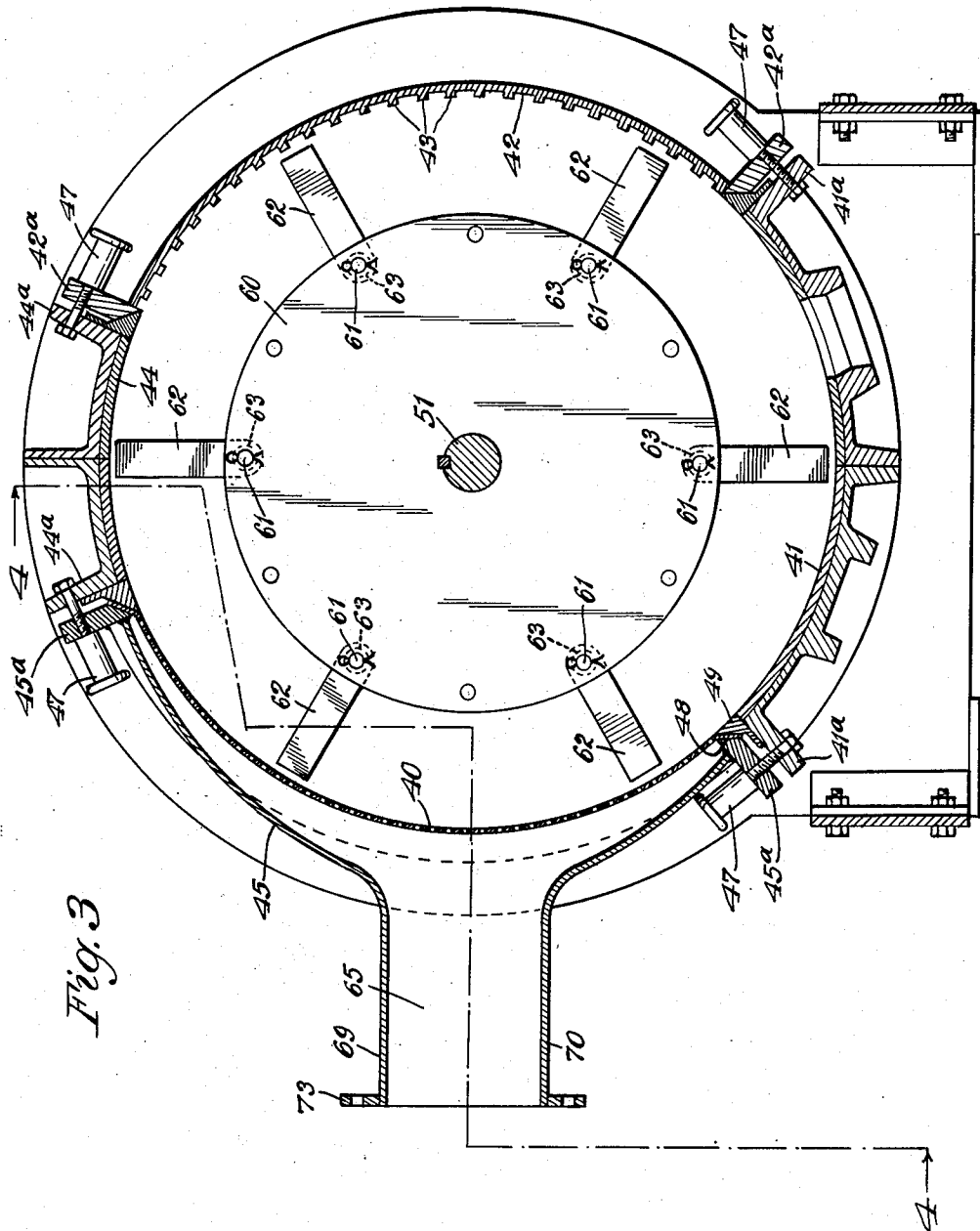
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4 Sheets-Sheet 2



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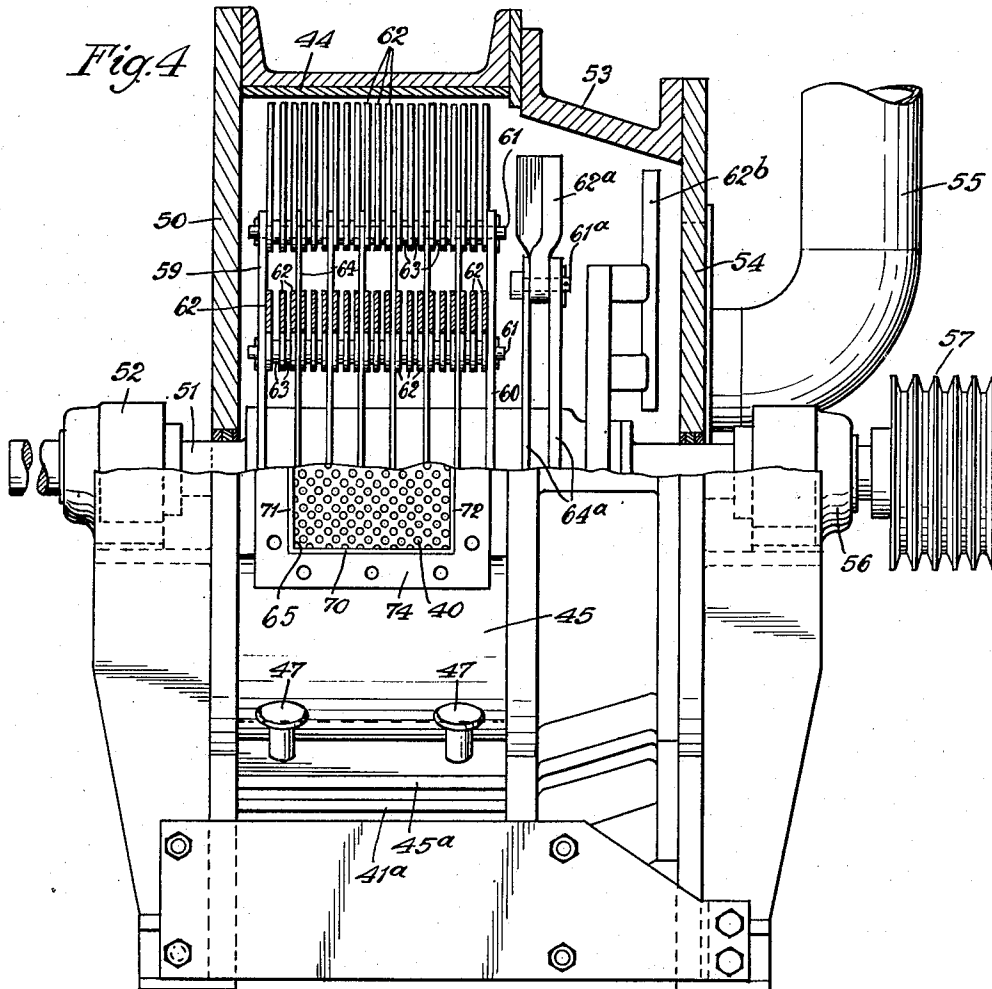
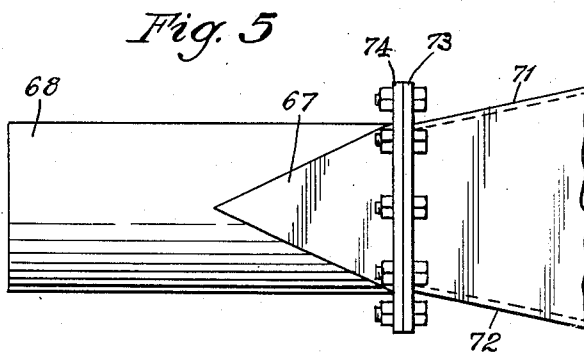
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METHOD FOR DISPERSING AND FELTING FIBERS AND MILL

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4 Sheets-Sheet 3



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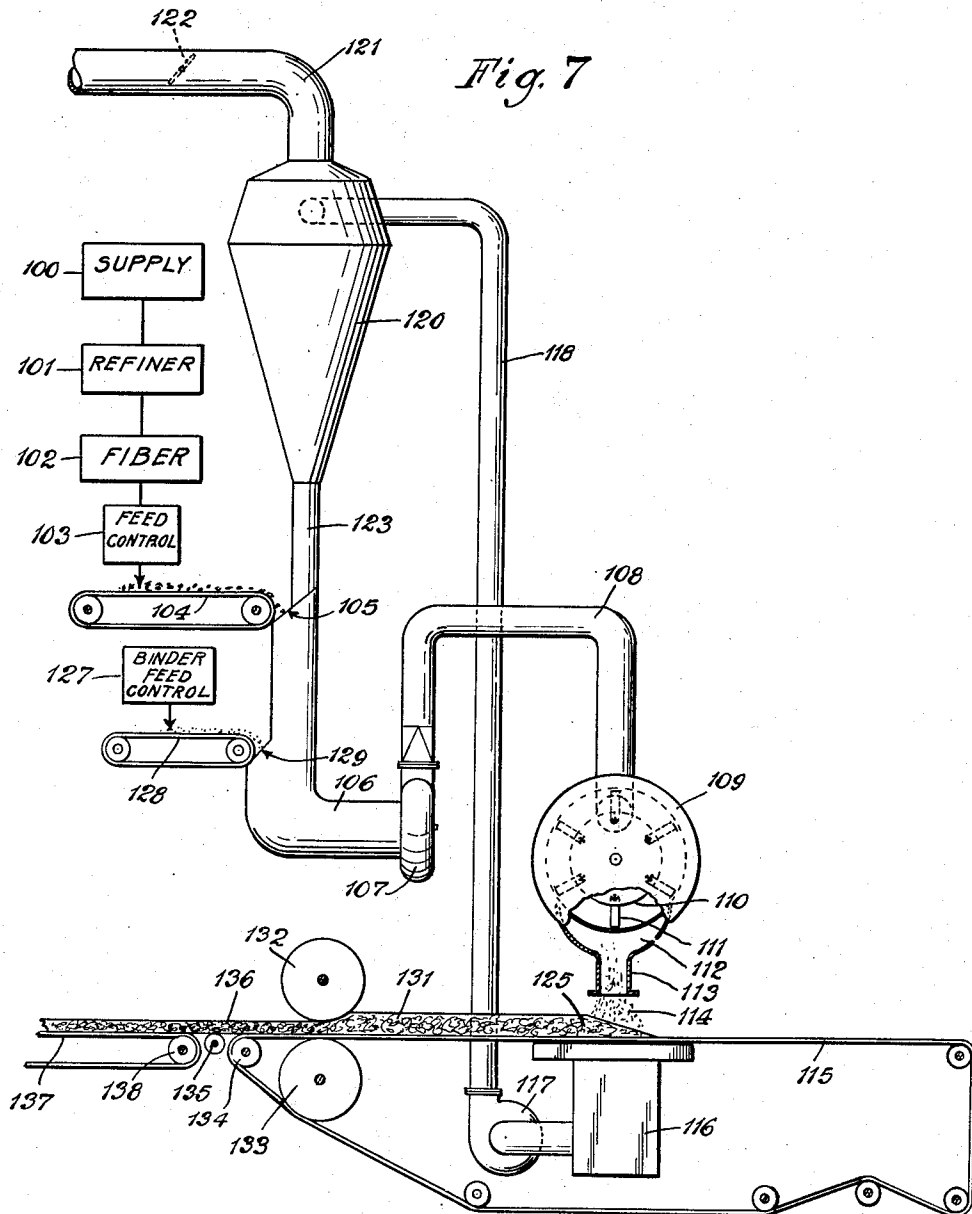
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METHOD FOR DISPERSING AND FELTING FIBERS AND MILL

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UNITED STATES PATENT OFFICE

2,646,381

METHOD FOR DISPERSING AND FELTING
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The present invention relates to the individualization of the vegetable fibers for dispersal in air, and in particular to apparatus for such practice, and to utilization of such suspensions.

In the formation of fiber mats by deposition of fibers from suspension in air, as by gravity deposition, or by pressure felting, or by suction felting, there are difficulties in keeping the fibers in individualized condition against flocking. In some cases it is common practice to apply liquid adhesive to the fibers by injecting into the dispersed fibers a mist or spray of liquid which is or which contains the binder or adhesive. It is most desirable that all of the fibers be exposed to the spray so that all receive binder. When fibers are present in flocks or clots before receiving binder, the desired application of binder is not achieved. In particular, wetted clots deposit as such or in larger flock-form, and non-uniform mats of poor quality are the result on drying the deposited mat, with or without compression before drying. Hence, it is important to expose individualized fibers in the path of the binder spray.

Sometimes powder binder is introduced so that it falls with the fibers in forming a dry fiber mat. It is equally important that clots be minimized so that a uniform deposition of fiber results, with a uniform distribution of solid binder when the latter is used.

In commercial production of mats in the manners described, it is necessary that fiber be introduced at a rapid rate, and since the fiber is preferably carried in suspension in air, it is a commercial objective to minimize the quantity of air moved, and maximize the concentration of fibers in the air.

Experience has shown that the higher the concentration of individualized fibers in air, the more they tend to clot; and also that the tendency to clot is increased by the presence of surfaces on which the air-suspension of fibers may impinge.

In actual practice in formation of mats by deposition from air suspensions of individualized fibers, it has developed that a final individualization step should be practiced as near as practicable to the point of dispersal of the fibers for deposition. This eliminates the clot formation which otherwise takes place in conduits, and it breaks up the clots so formed in bringing air containing fiber to the final disperser by way of conduits.

As a final disperser, or individualizer, there is used a type of apparatus having a perforated

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cylindrical face and a concentric rotor to effect passage of fibers through said face. This is commonly in the form of a cylinder containing an axial rotor with swinging radial hammers, the ends of which just clear the inner periphery of the cylinder. The cylinder is perforated with holes, or is provided as a suitable screen, providing, for example, openings of about $\frac{3}{8}$ inch diameter when the fiber is wood fiber. Where only a portion of the cylinder is so perforated, the remaining portion of the inner periphery may have obstacles, such as ribs positioned as geometrical elements of the cylinder, against which the radial hammers rub clots to effect disintegration. This same action takes place also at the edges of the perforations.

Air containing fibrous material to be finally individualized is introduced into the hammer-mill in operation at high speed of the rotor, so that an air stream passes out through the perforated portion carrying individualized fibers with it. The rotor itself may be constructed to create this air stream. The structure and operation generally described above present problems which are overcome by the present invention.

It is a general object of the invention to minimize clot-formation in providing a continuous stream of air having a high concentration of individualized easy-felting fibers which are thereafter felted into a mat of highly uniform quality.

It is a particular object of the present invention to provide apparatus for the individualizing and discharging as above referred to, for injecting at high velocity a stream of air carrying a high concentration of individualized fibers into and well along the length of a dispersal and deposition chamber, with the substantial avoidance of clotting after final individualization.

It is a particular object of the invention to provide a combination of hammer-mill disintegrator and a discharge nozzle therefor which avoids clotting of individualized fibers passing therethrough.

The invention will be best understood from the illustrations in the accompanying drawings in which:

Fig. 1 represents diagrammatically in cross-section the general nature of the deposition process.

Fig. 2 is a diagrammatic view illustrating the principle involved.

Fig. 3 is a vertical cross-section of the disperser and nozzle taken normally to the axis.

Fig. 4 is a vertical cross-section of the disperser taken on line 4—4 of Fig. 3.

Fig. 5 is a plan view of the spout portion of the nozzle, showing a slight taper.

Fig. 6 is a more or less diagrammatic representation of the device with its nozzle discharging into a felting space between two parallel conveyor screens through which the air escapes and between which a fiber mat is formed.

Fig. 7 represents another use of the fiber discharging device directing an expanding stream onto a moving screen to which suction is applied, and in such manner that air employed in the process is recirculated.

It is to be understood that the present invention may be used in other ways than those illustrated. The primary purpose is to form a continuous stream at high concentration of individualized fibers for many uses to which such a stream may be subjected. Since the primary objective of the applicant is to produce homogeneous felts from air suspensions of the fibers, the present application illustrates several ways in which the nozzle may discharge its stream for felting.

In the practices where liquid adhesive is applied to individualized fibers, the application is commonly effected in a settling chamber rather than in a conduit or other constricted channel which would finally become obstructed by adhesive accumulation of fibers on its walls. In a large settling chamber this danger is minimized or otherwise it is easily compensated for.

Where adhesive is not employed and the fibers in the stream are dry, more constricted felting regions may be employed. In the present application two such cases are illustrated. In one the fibers are ejected into a space which is substantially a continuation of the space within the nozzle so that the stream of fibers is not expanded, but the stream of air is expanded by reason of passage through filtering screens against which the fibers felt.

In the second case herein illustrated, the air and fiber streams are but slightly expanded, as in a region over a conveyor screen through which the air escapes and on which the fibers mat. The screen may have suction to enhance the differential pressure at the felting area of the screen, and the suction may be arranged to recirculate the air passing through the screen so that it is replenished with fibrous material.

In Fig. 1 a large chamber, for example 20 feet long by 10 feet in height, and of any desired width, such as 10 feet, is formed by side walls 11, end walls 12 and 13, a ceiling 14, suitably vented as at 15, and a floor which is an endless conveyor 17 running over end roll 18. The conveyor 17 is preferably in the form of a wire screen, in part for the purpose of minimizing its actual top surface to which the formed mat may adhere, in part for additional venting, and also for mechanical reasons.

The numeral 20 designates a disperser in the form of a hammer mill, and the dotted line 21 represents an exemplary extent of the mill periphery which is perforated to discharge fibers. The conduit 22 delivers into the mill an air current carrying fibers and fibrous material coming initially from a primary disintegrator 23 of any suitable kind.

Disintegrator 23 may be a hammer mill into which is fed fibrous material, such as pulp sheets or laps or pieces thereof designated 24. The disintegrated product as formed is a fluff which is

not guarded against clotting on its way to the disperser 20 by way of hopper 27 connected to conduit 22. The mill 20 provides suction to draw air and fiber into the hopper.

Because of the length of chamber 10 into and along which the fiber is to be dispersed, a suitable nozzle is required on the disperser 20, to inject the air-suspension of fibers at a sufficiently high speed to carry into the chamber, for dispersal as stream F, into which is mixed a mist A of adhesive-carrying liquid.

In preferred practice, the invention sacrifices some capacity for additional discharge pressure, by employing about 110° of the periphery of the mill. The following description refers to such a practical embodiment of the invention.

The present invention includes the nozzle structure and its relation to the final disperser. However, it must be first explained that the invention pertaining to the nozzle may have many embodiments adapting it for use with many conventional types of mills. Some dispersing mills have the entire periphery open as the perforated area through which to discharge. Other mills have only a fraction of the periphery so perforated. The function of the mill is not changed by these characteristics, but its operating performance and capacity are thus subject to modification.

A very small area of perforation gives limited capacity, but it may give higher discharge pressures. An entirely perforated periphery gives larger capacity, but lower operating discharge pressure. Fig. 2 illustrates more or less diagrammatically, a hammer mill having a periphery 28 and a rotor 29. The periphery 28 is perforated around the entire circumference.

According to the present invention, a nozzle structure in such a mill has a spout portion 30 and a housing portion 31 encompassing the discharge area of the mill, in this case the entire periphery. Between the walls of the housing portion 31 and the cylindrical wall of the mill there are conveyance spaces 32 and 33 leading from the perforations to the discharge orifice 30. It is a characteristic of the present invention that the portion of the periphery most distant from the discharge orifice along the line of each conveyance space is narrowest and that the conveyance space flares outwardly from the remote region giving a constantly enlarging and streamlined space defined by smoothly curved walls of the nozzle housing 31 and cylindrical outer wall portions of the mill housing 28. Thus, the two spaces together are crescent-like or forked in cross-section and where the tips of the horns or branches of the fork come together, as illustrated in Fig. 2, there is a dividing partition designated 34. The function of this partition is to prevent a secondary circulating current of air around the discharge periphery of the mill. Although there are two channels 32 and 33 which enlarge in cross-section, the cross-section of the stream entering each channel is in fact gradually reduced from the semi-cylindrical area of the mill to half the area of the opening of nozzle 30.

In the drawings in Fig. 3 the mill casing is in the form of a cylinder comprising the perforate or screen portion 40, a smooth section 41, a bar-section 42 having disintegrating ribs 43, and another smooth section 44. Outside of the screen portion 40 is a housing 45 which fits over the perforations. The mill parts 41, 42, 44 and housing 45 have radial flanges 41^a, 42^a, 44^a and 45^a, all suitably secured together by

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clamping members or bolts all indicated by the numerals 47, to form and maintain the cylinder. The flanges 45^a are beveled as shown at 48, and opposite the bevels are correspondingly-faced retainers 49. Screen 40 has its edges bent to fit with suitable gaskets (not shown) between the flanges 45^a and the retainers 49 for removably mounting it and for readily replacing it.

The arcuate extent of the screen may vary widely as described. As shown it covers about 107°. The rib-portion 42 also covers about 107°. The housing has an end plate 50 through which passes a rotor axle 51, to an outside bearing 52. The opposite end of the housing has a conical extension 53 housing mechanism functioning largely to facilitate distribution of material into the mill. An end plate 54 has an opening therein connected to an intake pipe 55, which is the pipe 22 in Fig. 1. The axle 51 extends through end wall 54 and through a bearing 56 where its end carries a friction driving pulley 57 for multiple V-belts.

The rotor has a sort of squirrel-cage cylinder structure of which the cage-bars are pivots for the swinging hammers. The rotor axle 51 is keyed to end plates 59 and 60 which carry between them at equal arcuate distances near their peripheries tie bolts 61 forming the bars of the squirrel-cage structure. The tie bolts 61 are axles on which are suspended a multiplicity of blade-like hammers generally designated by the numeral 62. The hammers are spaced apart by spacing collars 63 around the tie bolts 61, and also by spacing disks 64 disposed in spaced relation between the side plates 59 and 60, these spacing disks serving to resist the outward pull on the tie bolts as the result of the centrifugal force exerted by the multiple hammers 62 at high speeds of the rotor, for example, 1750 R. P. M. with a radial distance of approximately 18 inches to the ends of the hammers. Laterally of the hammers 62 which move over the perforate cylindrical portion 40, there is a secondary portion having blades 62^a with a slight twist to act as impellers for knocking material entering the machine through conduit 55 into the mill proper. The twisted blades also act as fan blades to supplement the main blower action of the primary hammers 62. The blades 62^a swing on bolts 61^a mounted between disks 64^a. The rotor also carries radial striking bars 62^b which serve to break up large clumps or bodies of fibrous material entering the mill, these bars passing the discharge orifice of conduit 55.

The nozzle housing 45 which is secured outside and over the screen 40 of the mill as shown in Fig. 3, in cross-section forms a crescent-like space over the screen with its two horns flaring away from a spout structure 65. The smoothly curved inner walls of the housing 45 also curve into parallel horizontal top and bottom walls of the spout, which is substantially 8 inches high for the size of rotor described. The spout 65 is so formed on its sides that it tapers slightly to a squared opening, and the squared opening is then extended by a short straight length of conduit 67, approximately 10 inches long, said extension changing in cross-section from the squared opening at its union with the spout 65 to its terminal circular discharge end 68. The spout 65 extending from the housing 45 has respectively top and bottom walls 69 and 70, with side walls 71 and 72, all terminating in a flange structure 73 around a square opening, to which the extension 67 is connected by its flange 74. Onto the

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extension 67 may be mounted a substantially straight length of circular pipe, for example, up to 8 feet in length as the discharge nozzle.

In operation the conduit 55 functions as a suction conduit by reason of the windage produced by the action of the rotor. The suction draws in the fluffy clotted fibrous material fed to it from the primary dispenser 23. With constant speed of operation of the rotor the supply of air and fiber brought to the mill is substantially constant. The rotor acts to create a pressure, which discharges through the spout 65 carrying with it the individualized fibers resulting from the rotor rubbing the fluff and clots around the interior, the discharge taking place through the screen 40. By reason of the crescent-form of the space within the nozzle housing, the air suspension is stream-lined, and the stream does not impinge on wall obstructions in such manner as again to induce clotting. As a result, the nozzle discharges fibers free from clots and at a high concentration in air. This carries the fiber sufficiently far into the chamber so that it spreads and disperses. The dispersion is highly uniform for effecting uniform deposition. The axial length of the mill may be varied as desired. The mill described is relatively short and where a wide web is desired, a plurality of mills may be alined across the width of the web to increase the rate of production and improve the felt formation. In the case described where the chamber width is 10 feet, three mills of the character described suffice to give uniform dispersion and deposition across the width of the chamber.

Referring to the crescent-shaped space to which the discharge spout is connected, it is clear that the space increases in cross-section from each horn to the spout. But, since the smaller arc of the crescent is perforate, and is the source of a stream of air leaving the cylindrical housing of the mill, it follows that the crescent chamber serves to reduce the cross-sectional area of the stream leaving the perforate area to the cross-sectional area of the spout. This effects an increase in velocity of the fiber-air stream as it leaves the perforate area and thus the suspended fibers tend to move apart. This lessens the tendency to clot.

The foregoing shows how the device is employed in gravity deposition chambers wherein there are no pneumatic forces effecting the felt of the fibers. As a result, the mat deposited has a very low density. Nevertheless the device may be employed in processes wherein pneumatic forces assist in depositing the fiber in felt formation, so as to control the impact of fibers on striking, and thus to increase the density of the initial felt as the impact increases.

In Fig. 6 the numeral 70 represents a hammer-mill of the kind described, equipped with a crescent-like collector 71 connected to the straight nozzle 72. The nozzle 72 discharges its stream of fiber 73 into a rectangular space between two parallel endless screens 75 at the top and 76 at the bottom, suitable side walls between them being present, but not disclosed. The upper screen 75 runs over a roll 77 just above the nozzle 72, and over another roll 78 at the opposite end. The conveyor 76 is longer than the conveyor 75 so that operations may be performed on the bat 79 carried thereby and discharged therefrom. The screen 76 passes over a roll 81 on the underside of the nozzle 72, and at the other end passes over a roll 82. Suitable mecha-

nism (not shown) is provided to move the endless screens 75 and 76 at the same linear rate away from the upper and lower edges of the nozzle 72, thereby to form between them the bat 79. The bat is formed by the screens filtering the fibers from the air which escapes through the screens and into collecting boxes 84 and 85, respectively, above the felting stretch of the screen 75 and below the felting stretch of the screen 76. These boxes serve to collect any fines of material which may go through the screen and the air from the boxes is exhausted through the conduits 86 and 87.

The conduit 86 and 87 may be so connected into the stream which feeds air to the hammer-mill 70 by way of its inlet 89, that the fines are recirculated and captured on recirculation by the bat 79. This recirculation may be accomplished in several ways, and in connection with another type of felting, such a recirculation system is indicated in Fig. 7.

Fig. 7 represents felting on a screen by differential pressure resulting from discharging the individualized fibers at super-atmospheric pressure onto a felting screen, the underside of which is subjected to sub-atmospheric pressure. This necessitates a condition of atmospheric pressure at the felting area of the screen, thus permitting the felting to be effected on the screen at atmospheric pressure without the requirement for enclosing walls or a hood. By the expedient for providing the greater capacity at the suction side, the screen may be made to draw in air from the atmosphere, as will be clear with reference to the description below.

First there is a supply 100 of fibrous material, such as pulp sheets, lags, or wood chips, fed to a refiner 101 which converts it to defiberized form suitable for felting when adequately dispersed for such action. Fiber in dry form is represented as a supply 102, from which a feed control 103 delivers it to an endless feed belt 104 carrying it into a hopper opening 105 in a suction conduit 106. The suction conduit 106 leads to a blower 107, which in operation disperses the fiber into a fast moving stream in a conduit 108 leading to a cylindrical dispersing mill 109 of the type already described and having therein a rotor 110 with hammers 111. The mill 109 has a nozzle crescent 112 and a spout 113 therefor of the character previously described, so located on the mill as to direct a stream of individualized fibers 114 downwardly toward an endless felting screen 115.

Under the screen 115 and below the discharging spout 113 is a suction box 116 connected to the suction end of a blower 117 for handling a greater volume of air than the blower 107, and hence drawing in air from the atmosphere about the stream of fibers 114.

The blower 117 discharges via conduit 118 into a down-draft cyclone or concentrator 120, provided with a clean-air discharge conduit 121 having adjustable controlling damper 122 and having a bottom outlet conduit 123 for the controlled amount of remaining air, and all the solids entering the cyclone via conduit 118. Said conduit 123 discharges into the said opening 105 of the suction conduit 106, where atmospheric pressure obtains.

Where an ingredient other than the fiber is to be included in the formed felt 125, it may be fed into the suction conduit 106 at any place. As an example, there is shown a supply of binder powder, such as thermosetting resin powder, fed

by a feed control 127 to an endless conveyer belt 128, which discharges it through a hopper-like opening 129 into conduit 106.

In operation, a dispersion of fiber is continuously formed and discharged from the dispersion mill 109 under highly favorable conditions for uniformly felting it to a dry felted sheet, which may be three to four inches in thickness as indicated at 131, as carried away from its place of formation. It may be densified as by compression rolls 132 and 133, the latter being under the screen and supporting the return stretch of the screen, which, however, makes a shorter turn over idler roll 134. Adjacent the idler roll 134 is a pick-up roll 135 which carries the compressed felt 136 to a conveyor belt 137 passing over adjacent idler 138.

From the foregoing it is to be understood that the invention broadly provides a continuous stream of individualized fibers at high concentration in air or other gas, for various uses, primarily felting into mats or bats at a high rate of production with resulting high quality in formation because of the tendencies to minimize clotting of the fibers.

Numerous adaptations of the process and modifications and changes of the apparatus may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. A dispersion mill for discharging substantially individualized fibers in suspension in a gas, comprising a cylindrical housing, a rotor substantially coaxial with the housing, said housing being imperforate over approximately three-quarters portion of its arcuate extent and perforate over the remaining portion for the discharge of a gaseous stream from within the housing, said perforate portion having small holes for effecting individualization of fibers into said stream in operation of the mill, and collecting means over said perforate portion forming a chamber having in cross-section a crescent-like form, said chamber being extended in a direction substantially radial to the rotor axis as a discharge nozzle.

2. A nozzle-bearing dispersion mill for discharging an air-suspension of substantially individualized fibers comprising a cylindrical mill housing having discharge perforations over approximately a quarter portion of its periphery for the discharge of a gaseous stream from within the housing, a nozzle housing mounted on said mill housing, a discharge spout carried by the nozzle housing and extending in a direction generally radial to said mill housing, said nozzle housing providing forked conveyance passageways for discharging said stream from the perforated area of the mill housing to said spout, said passageways together forming an open crescent in cross-section with horns tapering inwardly of the nozzle housing from the spout and being defined by smoothly curved inner walls of the nozzle housing, said cylindrical outer wall portions of the mill housing.

3. The method which comprises distributing substantially individualized fibers into a moving stream of air over a fiber-distributing area extending substantially crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-

laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fiber to clot, and discharging the fiber-laden stream from said nozzle and simultaneously expanding said stream at the point of discharge from said nozzle, whereby to lessen the velocity of the moving fibers and thereby on the average further separating each fiber from the other fibers.

4. The method which comprises distributing substantially individualized fibers into a moving stream of air over a fiber-distributing area extending substantially cross-wise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fibers to clot, discharging the fiber-laden stream from said nozzle and simultaneously expanding said stream at the point of discharge from said nozzle, whereby to lessen the velocity of the moving fibers and thereby on the average further separating each fiber from the other fibers, and collecting and felting the separated fibers in the form of a felted fiber body.

5. The method which comprises distributing substantially individualized fibers into a moving stream of air over a fiber-distributing area extending substantially crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fibers to clot, discharging the fiber-laden stream from said nozzle and simultaneously expanding said stream at the point of discharge from said nozzle, whereby to lessen the velocity of the moving fibers and thereby on the average further separating each fiber from the other fibers, and collecting and felting the separated fibers in the form of a felted fiber body by allowing the fibers to settle by gravity onto a collecting area.

6. The method which comprises distributing substantially individualized fibers into a moving stream of air over a fiber-distributing area extending substantially crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fibers to clot, discharging the fiber-laden stream from said nozzle in a generally horizontal direction into a settling chamber and simultaneously expanding said stream at the point of discharge from said nozzle, whereby to lessen the velocity of the moving fibers and thereby on the average further separating each fiber from the other fibers, and collecting and felting the separated

fibers in the form of a felted fiber body by allowing the fibers to settle by gravity onto a collecting area.

7. The method which comprises distributing substantially individualized fibers into a moving stream of air over a fiber-distributing area extending substantially crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fibers to clot, discharging the fiber-laden stream from said nozzle in a generally horizontal direction into a settling chamber and simultaneously expanding said stream at the point of discharge from said nozzle, whereby to lessen the velocity of the moving fibers and thereby on the average further separating each fiber from the other fibers, and collecting and felting the separated fibers in the form of a felted fiber body by allowing the fibers to settle by gravity onto a conveyer moving across the bottom of said settling chamber.

8. The method which comprises distributing substantially individualized fibers into a moving stream of air over a fiber-distributing area extending substantially crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fibers to clot, discharging the fiber-laden stream from said nozzle and simultaneously expanding said stream at the point of discharge from said nozzle, whereby to lessen the velocity of the moving fiber from the other fibers, dispersing an aqueous mist of liquid containing adhesive into the separated fibers whereby to wet the fibers with said adhesive-containing liquid, collecting and felting the wet adhesive bearing separated fibers in the form of a felted fiber body by allowing the fibers to settle by gravity onto a collecting area, and drying the resulting felted body to set the adhesive.

9. The method which comprises distributing substantially individualized fibers into a moving stream of air at superatmospheric pressure over a fiber-distributing area extending substantially crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fiber to clot, discharging the stream of fiber-laden air from said nozzle into a region of lower pressure whereby the stream expands, and collecting the individualized fibers as a felt prior to any substantial clotting of the fibers.

10. The method which comprises distributing substantially individualized fibers into a moving stream of air at superatmospheric pressure over a fiber-distributing area extending substantially

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crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fiber to clot, discharging the fiber-laden stream into a region of lower pressure and onto moving endless screening means and thereon forming a felt prior to any substantial clotting of the fibers.

11. The method which comprises distributing substantially individualized fibers into a moving stream of air at superatmospheric pressure over a fiber-distributing area extending substantially crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fiber to clot, applying sub-atmospheric pressure to one side of endless moving screening means, and discharging the fiber-laden stream from said nozzle onto the resulting suction-area of said screening means prior to any substantial clotting of the fiber, whereby to form a felt on said screening means.

12. The method which comprises distributing substantially individualized fibers into a moving stream of air at superatmospheric pressure over a fiber-distributing area extending substantially crosswise of the stream, collecting the fiber-laden air moving from said area and conducting it to a discharge nozzle of substantially uniform cross-sectional area and simultaneously increasing the velocity of the fiber-laden air on all the lines of

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travel from said area to said nozzle by gradually constricting the cross-section of the stream as it moves from said area to said nozzle, whereby the increased velocity minimizes tendencies of the fiber to clot, discharging said fiber-laden stream from said nozzle onto one face of moving endless screening means prior to any substantial clotting of the fibers, applying sub-atmospheric pressure to the other side of said screening means in a manner to draw in all the air from said nozzle and additional air from the atmosphere, whereby to form a felt on said screening means at a region of the screen substantially at atmospheric pressure.

THURE C. DUVALL.

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Number	Country	Date
422,226	Great Britain	Jan. 8, 1935
425,271	Great Britain	Mar. 11, 1935
608,252	Great Britain	Sept. 13, 1948
889,625	France	Oct. 11, 1943