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AND SEPARATING MINERAL FIBER

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2 Sheets-Sheet 1

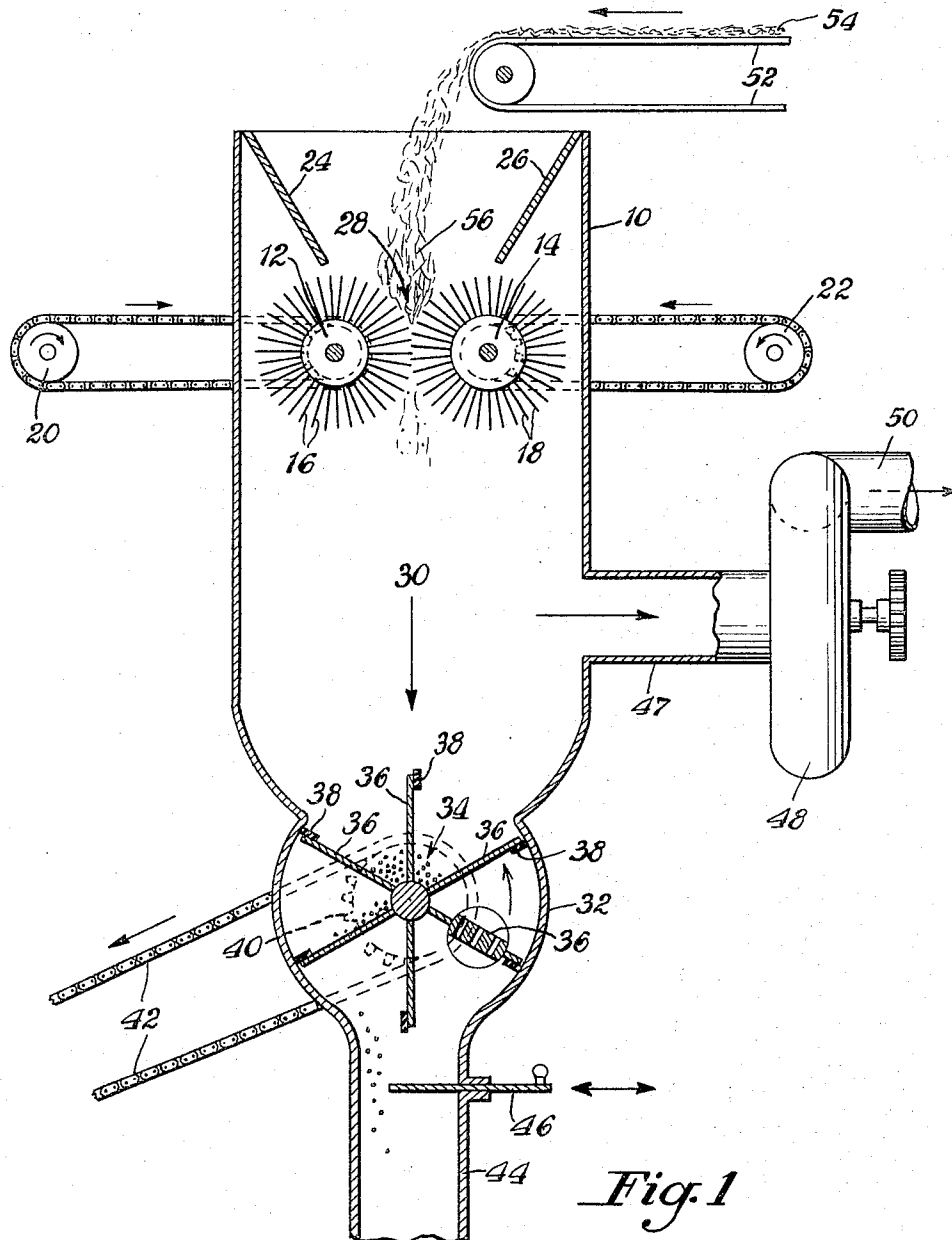


Fig. 1

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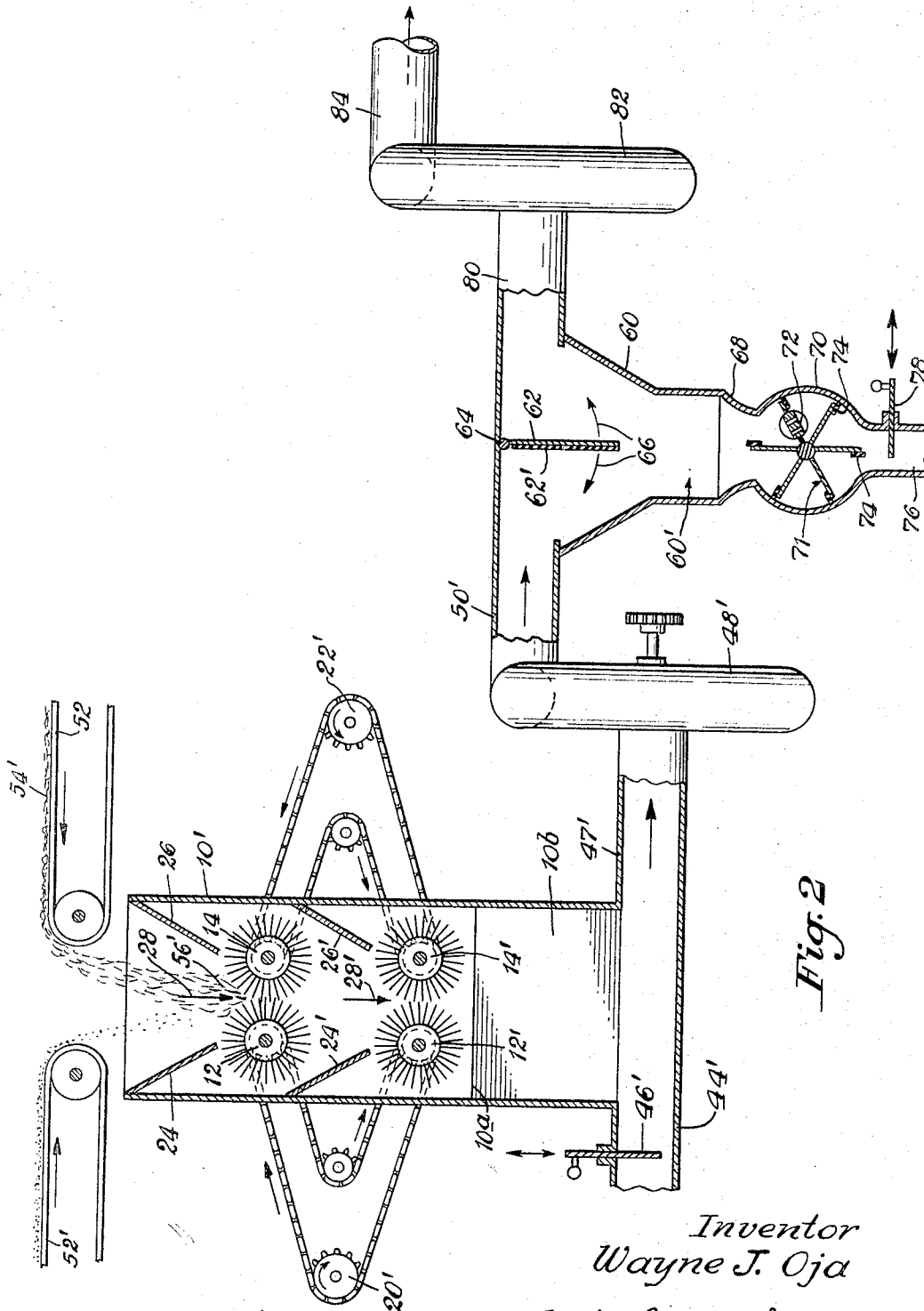


Fig. 2

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METHOD AND APPARATUS FOR DE-SHOTTING AND SEPARATING MINERAL FIBER

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The present invention relates to the preparation for use of de-shotted synthetic mineral fiber.

Synthetic mineral fiber is produced by blowing a molten mineral composition to attenuate particles thereof as elongated fiber. The leading mass usually cools and solidifies as "shot" at the forward end of the fiber trailing behind it. Many commercial uses of the fiber require separation of fiber and shot. One manner of removing shot is to tumble the fiber in a drum. This breaks off shot from many but not all of the fibers, and also breaks the fibers. This method is commercially valuable in spite of its incompleteness in de-shotting, because it rolls the broken fiber into nodules. The nodules are more easily shipped and handled than the fibers themselves.

Many users of such mineral fiber receive nodulated fiber shipped from a distant point, and for many uses, the nodulated fiber must be denodulated. For example, the formation of mineral fiber felts by dewatering a slurry of fibers, requires a procedure to denodulate or individualize the fibers. Even so, some shot, usually the smaller sizes, is present in denodulated fiber.

The present invention involves apparatus useful not only to de-shot newly formed fiber, thus avoiding nodulation, but also to denodulate and further de-shot fiber which has been nodulated.

It is the general object of the invention to provide an air-suspension of de-shotted synthetic mineral fiber.

It is a particular object of the invention simultaneously to denodulate and de-shot nodulated mineral fiber.

It is also a particular object of the invention to de-shot newly formed shot-bearing mineral fiber and provide an air-suspension of de-shotted fiber with avoidance of nodulation.

The invention may be carried out in a variety of ways involving modifications or adjustments, depending upon the raw material fed to the apparatus.

In essence, the process is a combing action by a high-speed rotor or rotary brush, having a multiplicity of radially projecting elements, much like a rotary brush, the ends of which in rotation overlap the path of the ends of similar projections on a companion rotor, turning slowly to feed material into the nip of the two rotors. The extent of overlap of the projections may be varied according to the severity of the action required.

When shot-carrying fiber, not nodulated, is de-shotted, one set of such differential speed rolls is sufficient. When nodulated fiber is to be de-shotted, two or more sets are preferred, one feeding to the next. In the case of two sets, the first set is adjusted primarily to denodulate with coincidental de-shotting, and the next set is adjusted to continue the de-shotting and denodulating.

The invention also includes means to separate removed shot from the fibers from which the shot has been removed, so that the fiber portion may be conveyed in an air stream for suitable disposition. The separation of removed shot and the fiber is effected in one way or another by deflecting an air stream containing the separable fractions of the shot and fiber.

Exemplary forms of the apparatus are shown in the accompanying drawings, in which:

FIG. 1 represents more or less diagrammatically a housing containing one set of two rotary brushes and connected to a shot-trap.

FIG. 2 is a modified form of the housing of FIG. 1 provided with a second set of rotary brushes and connected by a conduit to a blower which is connected to a shot-trap.

FIG. 1 represents a simple form of the apparatus to explain it in principle and in some detail. Numeral 10 represents a housing in which are mounted two rotors 12 and 14 indicated by their cylindrical rolls. The rolls are parallel and are adjustably spaced apart to predetermine contact or a desired overlap of their projecting elements, respectively, 16 and 18, which may be rigid pins or lugs, wire bristles, natural bristles or stiff bristles of synthetic material, such as nylon or Dacron. Roll 12 is constructed for slow speed, say 5 r.p.m., and roll 14 for high speed, say 960 r.p.m. Driving means 20 and 22 are indicated for the respective rotors 12 and 14.

When the rotor 12 is 12-inches in outside diameter, and the projections are wire bristles, the latter may be steel wire 0.0140-inch in diameter, and 3.25-inches long. When the companion rotor 14 is 12-inches in diameter, the bristles may be steel wire 0.0118-inch in diameter and 2.75-inches long. The length of the rotors may vary according to the desired capacity of the unit. Such projections may have overlapping paths of $\frac{1}{8}$ -inch for non-nodulated shot-carrying fiber. The adjustment of the rolls compensate for wear at the ends of the bristles, and for operating requirements.

For nodulated mineral wool the best results have been obtained with rigid pins on the two rotors, so arranged that the ends of the pins on each rotor have a clearance of $\frac{1}{4}$ -inch from the face of the roll of the opposite rotor. The rigid pins are spaced on their rotors circumferentially on $\frac{1}{2}$ -inch centers, and in the axial direction on 1-inch centers. By staggering the rows the pins at the nip are on $\frac{1}{2}$ -inch centers in both directions. Nodulated wool fed to such rotors is completely denodulated and de-shotted, and a fluffy mass of long fibers is produced.

FIG. 1 shows baffles 24 and 26 forming a hopper-like entrance over the nip 28 of the rotors. Because the rotors 12 and 14 may be horizontally moved toward and away from each other, spaces between them and the housing walls may let pass fugitive material fed into the housing. But, the baffles perform an additional function, especially for the high-speed rotor. By obstructing the upward path of the windage from the high-speed rotor, the latter acts as a blower to discharge a stream of air from the nip to act as a vehicle for the fiber and shot also discharged.

The bottom of the housing 10 has a shot-trap. The shot-trap functions to receive shot moving by its inertia in a path out of which the lighter weight fibers suspended in air are deflected by means changing the course of a moving air suspension. In FIG. 1, the shot-trap receives shot discharged from the nip of the two rotors in a direction aimed at the opening of the shot-trap. The fiber-moving from the rotors with the shot is deflected by a vehicular air stream ineffective to deflect the shot.

It has been found that some deflectable fibers escape deflection and enter the shot-trap with the shot. Accordingly, the shot-trap is constructed to carry such fugitive fibers in a reverse path out of the shot-trap and into the deflected path of the remaining fibers.

In order to accomplish this, the shot-trap is provided with foraminous means in which fiber and shot may collect within the trap, such means being so associated in the apparatus that air passes through the foraminous means at a velocity selectively to move the fibers into said reverse direction and to leave the shot. In order to avoid accumulation of shot on said foraminous means continuous removal of shot from the foraminous area is effected, thus to maintain a substantially constant passage of air through the shot-trap.

In FIG. 1, the bottom of the housing 10 opens at 30

into the top of a cylindrical housing 32 in which is a rotor 34 with foraminous vanes 36 tipped with rubber scrapers 38 as sealing means. The rotor is driven by an outside sprocket 40 having driving chain 42. The housing 32 opens into a conduit 44 which has an adjustable damper 46.

Housing 10 above the opening 30 of the shot-trap opens into a conduit 47 at a sharp angle, such as 90° to the extent of housing 10. Conduit 47 leads to the inlet of a fan blower 48, which in operation draws air into the housing 10 from its top and into it through the shot-trap, and delivers an air-suspension of fiber through outlet conduit 50. The damper 46 is adjusted to effect the desired lifting of the fugitive fibers from the vanes, as the latter slowly rotate to drop the retained shot into discharge conduit 44. It is to be understood that the high speed rotor also acts as a fan to move air down in the housing.

In operation, a conveyor belt 52 carries material 54 to be treated, dropping it as a supply of fiber 56 in the nip 28. The fast rotor 14 picks fibers from it, while the slow rotor holds and feeds fiber to the fast roll, thus preventing any static portion in supply 56.

FIG. 2 shows a modified form of the housing of FIG. 1 equipped with a second set of rotors and of baffles. The retained parts in FIG. 2 are numbered as in FIG. 1 and the added duplicating parts are designated by prime numbers, being rotors 12' and 14' and baffles 24' and 26'. The second set of baffles 24' and 26' function like the first set 24 and 26, especially to effect a blower action for the lower high-speed rotor.

The apparatus of FIG. 2 is especially useful for denodulating the nodules 54' fed by conveyor 52. The overlap of rotors 12 and 14 may be as much as $\frac{3}{16}$ -inch in order to comb fibers from the supply 56' of nodules in nip 28' as the primary action. The combed fibers with nodules and some coincidentally removed shot are tangentially delivered to the nip 28' of rotors 12' and 14'; where the overlap may be as little as $\frac{1}{16}$ -inch to continue denodulating and de-shotting.

Rotors 12 and 12' may be driven at the same speed by driving means 20', say 5 r.p.m., and rotors 14 and 14' at the same speed by driving means 22', for example 765 r.p.m., a slower speed than in FIG. 1 being permitted because of the duplicate sets of rotors. The relative speeds given are not important or critical, it being noted that the desired results have been secured with speeds of 1 r.p.m. and 3600 r.p.m. with the apparatus of FIG. 1 and FIG. 2.

In operating the apparatus of FIG. 2, a portion of the discharge from the nip of rotors 12 and 14 strikes the peripheries of rotors 12' and 14' laterally of the nip. That which strikes the fast roll 14' may be hurled tangentially toward the rotor 12' or the baffle 24'. As a result, this material eventually lands on the feeding roll 12' and is fed into the path of rotor 14' at the nip.

The apparatus of FIG. 2 differs from that of FIG. 1 in that the shot-trap is removed from the housing having the rotors. The housing 10' of FIG. 2 tapers at the bottom to the line of a discharge conduit 47'. The lines 10^a indicate where the far wall begins to angle inwardly from the vertical to form sloping wall 10^b. An inlet 44' to the housing is located opposite the conduit 47' and may be an extension of the conduit. It contains a control damper 46' for entry of air. Conduit 47' is connected to the inlet of a fan blower 48' which discharges through conduit 50' into a suitable deflecting chamber 60 including a shot-trap.

One form of such chamber 60 is shown having a baffle 62 pivoted at 64 in the path of the discharge from conduit 50', which may be adjusted in arcuate positions indicated by arrows 66. The baffle 62 may be surfaced with a soft material 62' such as a soft rubber pad, or a canvas sheet, or the like. Below the baffle 62 is a pit 60' into which shot drops. The pit 60' terminates in a hop-

per 68 discharging to a shot-trap having a rotary valve casing 70 with a slow rotor 71 having perforated vanes 72 provided with rubber sealing tips 74. Casing 70 discharges into conduit 76 having a damper 78. Chamber 60 has a discharge conduit 80 to carry off the fibers which go around the baffle 62. To effect this the conduit 80 leads to the intake of an exhaust fan 82 with outlet 84, which fan may be operated at greater capacity than the exhaust fan 48' so that air from the atmosphere is drawn into the discharge conduit 76. The damper 78 may be adjusted to control the amount of air passing through the perforations of the vanes 72 for constant operating speeds of the two exhausters 48' and 82.

In FIG. 2, a second conveyor 52' is shown, which may be used, not only to discharge mineral fiber, but other material which is to be mixed with the mineral fiber, such as another kind of fiber. One example is a powdered material, such as a thermosetting resin, which can be deposited with the fiber in a felt, which is then subjected to heat to thermoset the resin as a binder for the fibers.

The apparatus of FIG. 1 is particularly suitable for installation in plants producing the mineral fiber with attached shot, thus displacing the de-shotting nodulation which imperfectly de-shots the fiber. The recovered shot may be reprocessed in the melt, thus effecting economies.

The apparatus of FIG. 2 is particularly suitable for those to whom nodulated fiber is shipped with residual shot not removed by the nodulation, thus producing shot as waste material.

Although the operations described result in de-shotting, no statement made nor any appended claim is to be considered as committing applicant to any theory as to the functions involved.

Accordingly, the invention is not only in the apparatus but in the method of de-shotting, as set forth in the appended claims.

I claim:

1. Apparatus for removing shot from the ends of nodulated and non-nodulated mineral fiber comprising at least one pair of parallel cylindrical rotors on parallel axes, each rotor of the pair having an inner cylindrical axial roll spaced from a corresponding axial roll of the other rotor, each rotor of the pair having a brush-like multiplicity of radially projecting elements extending from its roll, the ends of said elements of the pair providing overlapping cylindrical paths of revolution which paths form an obstructed nip, means to rotate one of said rotors of the pair in a feeding direction into the nip of the pair at a relatively slow speed to serve as a rotary holder and feeder for the material fed to the pair for forming a supply ahead of the nip, means to rotate the other rotor of the pair in the opposite direction at a relatively greater speed to pick individual fibers from the said supply, to detach shot from fibers and to discharge fibers and shot from the exit end of the said nip generally in a tangential direction, and means to carry the fibers of the discharge in air in one direction away from the shot moving by inertia in another direction.

2. Apparatus according to claim 1 in which said last-mentioned means draws a current of air in a direction angular to and out of the path of the shot and fiber moving from said nip whereby to move the moving fiber out of the path of the moving shot, said means including a conduit for conveying the resulting air-suspension of de-shotted fiber.

3. Apparatus for removing shot from the ends of mineral fiber comprising a housing, at least one pair of parallel cylindrical rotors on parallel axes within said housing, each rotor having an inner cylindrical axial roll spaced from a corresponding axial roll of the other rotor, each rotor having a brush-like multiplicity of radially projecting elements extending from its roll, the ends of said elements of the pair providing overlapping cylindrical paths of revolution which paths form an obstructed

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nip, means to rotate one of said rotors of the pair in a feeding direction into the nip of the pair at a relatively slow speed to serve as a rotary holder and feeder for the material fed to the pair for forming a supply ahead of the nip, means to rotate the other rotor of the pair in the opposite direction at a relatively greater speed to pick individual fibers from said supply, to detach shot from fibers and to discharge shot and fibers from the exit end of said nip generally in a tangential direction, means to draw air into said housing in said feeding direction and through the rotors including conduit means connected to said housing at a region beyond the discharge end of said nip to convey away the fibers discharged from said nip in a direction angular to that of the moving shot, and a shot trap beyond said region from the rotors and in the path of the shot, said shot-trap being a rotary valve having shot-retaining foraminous vanes for admitting air in a direction opposing that of the moving shot.

4. The method of removing shot from the ends of synthetic mineral fiber which comprises picking shot and fibers substantially individually by the combing action of a relatively high speed first brush rotor from a supply of such shot-carrying fiber fed into the entry nip of a relatively low speed second brush rotor intermeshing with said first rotor, and by said first rotor hurling the picked fibers and shot in a general direction away from said supply, whereby shot is broken from the fibers, and sweeping in an air stream the deshot fibers in a direction out of the path of the moving shot, thereby providing an air-suspension of de-shotted fiber.

5. The method of removing shot from the ends of synthetic mineral fiber which comprises picking shot and fibers substantially individually by the combing action

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of a relatively high speed first brush rotor from a supply of such shot-carrying fiber fed into the entry nip of a relatively low speed second brush rotor intermeshing with said first rotor, and by said first rotor hurling the picked fibers and shot in a general direction away from said supply, whereby shot is broken from the fibers, conveying the hurled material in a stream of air, and sweeping in an air stream the de-shotted fibers in a direction out of the path of the moving shot, thereby providing an air-suspension of de-shotted fiber.

6. The method of treating shot-carrying mineral fiber in nodulated and non-nodulated forms which comprises continuously feeding such mineral fiber toward and into the nip of two combing rotors positioned such that the projections thereof overlap and obstruct the nip, rotating said rotors into said nip at different speeds, whereby the faster rotor combs fibers from the material held by the slower rotor, the speed of said faster rotor being such as to hurl the combed material from the exit of the nip in a current of air, whereby the combined actions of the rotors effect detachment of shot from fiber, and separating the shot and the fiber by sweeping the fiber in a stream of air out of the path of the shot which path is continued by the greater inertia of the shot.

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