Aug. 4, 1964 T. R. GOULD ETAL 3,142,869

PROCESS AND APPARATUS FOR OPENING AND CLEANING FIBROUS MATERIAL

Filed May 4, 1961

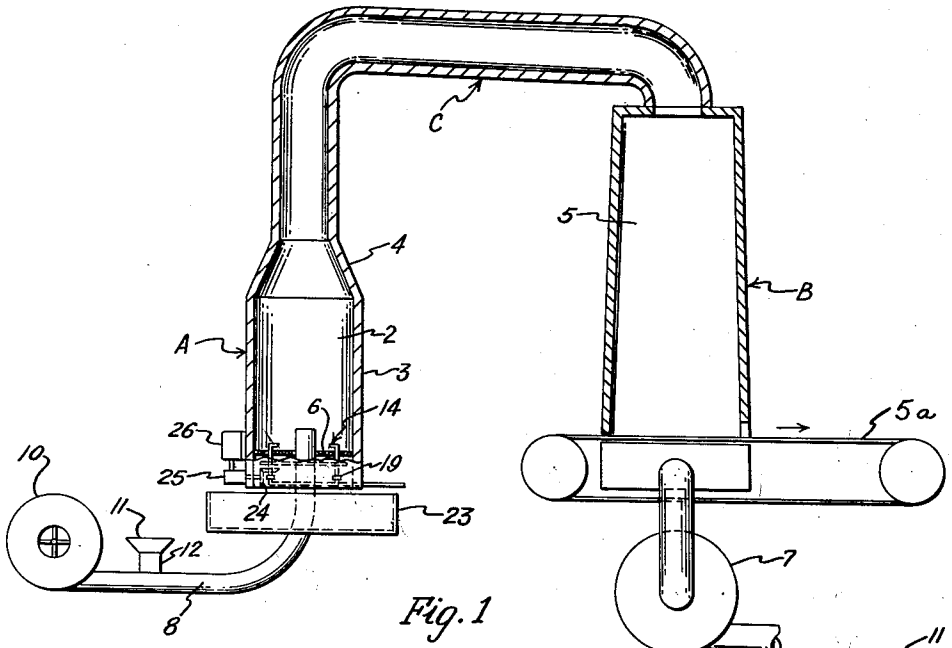


Fig. 1

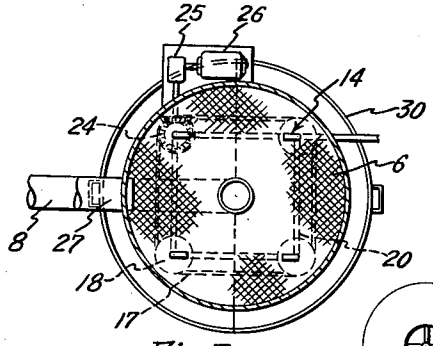


Fig. 3

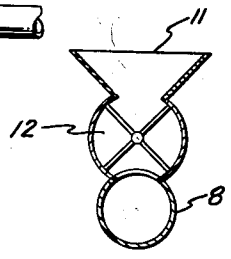


Fig. 4

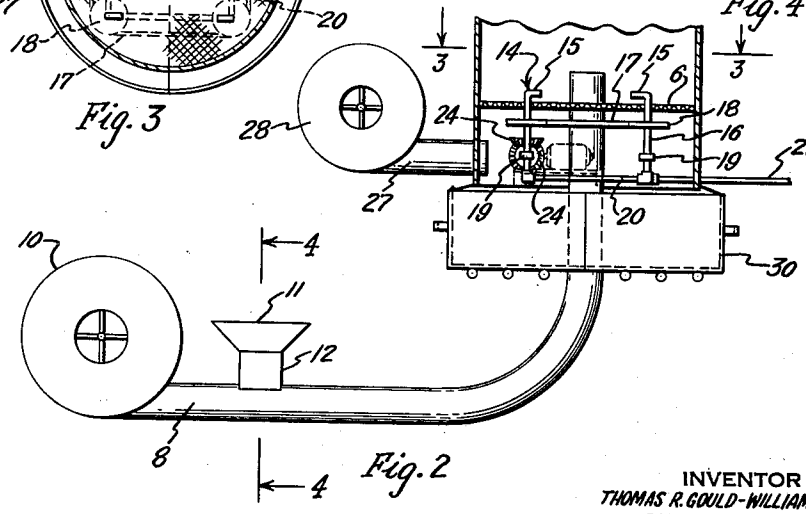


Fig. 2

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United States Patent Office 3,142,869 Patented Aug. 4, 1964

3,142,869

PROCESS AND APPARATUS FOR OPENING AND CLEANING FIBROUS MATERIAL

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Filed May 4, 1961, Ser. No. 107,787
10 Claims. (Cl. 19—205)

This invention relates to process and apparatus for opening and cleaning a fibrous material containing unwanted particles, separating the fibers from the unwanted particles, and felting the fibers into light weight batts.

In many normal manufacturing procedures, fibrous materials are formed by converting a stream of molten raw material into fibers. The fibrous materials, formed in this nature, have a serious disadvantage in that a considerable quantity of unfiberized particles, commonly identified as shot, dust and the like, become intermixed in the fibrous materials and are carried into the final product. Numerous attempts have been made to remove or reduce the quantity of unfiberized particles in the fibrous materials, but in general, these attempts have not been greatly successful. This is particularly true in the mineral wool industry wherein the conventional systems of fiberization for converting the stream of molten raw material into fiber often produce fiber wherein considerable quantities of unfiberized particles are intermixed in the final mineral wool felt. Where mineral wool felts are involved, they cannot be subjected to relatively rough treatment since, because of the brittleness of the fiber, rough treatment would cause the mineral wool fibers to be broken or destroyed.

It is a primary object of this invention to provide process and apparatus for the opening, cleaning and felting of a fibrous material to eliminate or greatly reduce the unwanted particles present in the fibrous material.

The foregoing object is attained by the process and apparatus of the instant invention wherein a mass of fibrous material is fed into an aeration chamber wherein the fibrous material to be opened, cleaned and felted is subjected to a completely pneumatic opening and cleaning action. The apparatus for opening, cleaning and felting the fibrous material comprises an aeration chamber, opened at both ends, with a foraminous member extending generally in a transverse direction adjacent one opened end thereof and a duct means connected to the other opened end thereof and wherein the duct means at its other end is connected to a felting chamber or zone for felting the opened and cleaned fibers. The fibrous material to be opened and cleaned is fed into the aeration chamber between the foraminous member and the duct means wherein the fibrous material is subjected to a plurality of pneumatic agitations. Means are provided for inducing a flow of volume air passing through the aeration chamber from the one end thereof through the foraminous member to the duct means so that the opened and cleaned fibers will flow with the volume air through the duct means to the felting chamber or zone.

The invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the following detailed description of a preferred embodiment of the invention and the accompanying drawings in which:

FIG. 1 is a side elevational view of the cleaning and felting equipment, parts being in section;

FIG. 2 is an enlarged elevational view of the lower section of the aeration chamber of FIG. 1, illustrating a modification of the invention, parts being in section;

FIG. 3 is a horizontal sectional view on the line 3—3 of FIG. 2, looking in the direction of the arrows;

FIG. 4 is a vertical sectional view through the rotary valve feeder, taken on the line 4—4 of FIG. 2.

The present apparatus comprises an opening and cleaning aeration section or zone A and a felting section or zone B, the sections being connected by a duct C through which cleaned air-borne fibers are carried from the aeration zone to the felting zone.

The aeration chamber 2, in this form of the invention, is constructed for the rapid treatment of fibrous material and in particular fibrous clumps of mineral wool, having intermixed therewith unwanted shot-like particles, to open the clumps of mineral wool and separate the heavier shot-like particles from the fiber and to remove the separated fibers and heavier particles from the chamber. To this end, the aeration chamber 2 is preferably formed with a smooth-walled cylindrical body 3, from 5 to 10 feet high, and which, in the embodiment illustrated in FIG. 1, is approximately 6 feet high, of uniform cross-sectional area and supported on a suitable base structure, not shown. The chamber proper terminates in a connecting section 4, which may be frustoconical in shape, leading to the entrance end of duct C, which is preferably of smaller cross-sectional area than the chamber 2. A transverse screen 6 extends across the chamber in a plane substantially perpendicular to the longitudinal axis of the body 3 and is secured to the side walls thereof. The screen 6, formed of relatively open mesh woven wire cloth, of from 3 x 3 to 4 x 4 mesh, is positioned well below the top of the chamber proper, providing not less than about 4 feet of aeration chamber height between the screen 6 and the connecting section 4. The other end of the chamber 2, below the screen, is open to the adjacent atmosphere.

The felting section B includes a felting tower 5 and a suitably driven foraminous conveyor 5a, on the upper surface of which the mineral wool fibers are deposited and compressed to the desired density to form mineral wool batts. Between the upper and lower reaches of the felting conveyor, there is provided a suction box for drawing air downwardly through the upper reach of the conveyor, the box being evacuated by suction fan 7. The suction so provided facilitates the felting of the fibers on the conveyor but serves a particular function in the present apparatus by the transfer of the suction from the fan 7 through the duct C to aeration section A, creating an up-flow of volume air through the screen 6 and aeration chamber 2. This air flow, after it moves through the screen 6, removes light fibrous material separated from the clumps of mineral wool introduced into the aeration chamber and conveys this light fibrous material through duct C to the felting section B. The felting tower and equipment are diagrammatically illustrated since their details are well known.

The raw or uncleaned clumps of mineral wool are introduced into aeration chamber 2, preferably axially thereof, through the duct or conduit 8, extending upwardly through the screen 6 and above the screen for a suitable distance, for example, 6" to 12", sufficient to prevent any clumps of mineral wool on the screen from interfering with the supply through the duct 8. The mineral wool is conducted through the duct 8 by air pressure supplied by the blower 10 and is supplied to the duct by means of the hopper 11 and rotary valve 12. The mineral wool, which may be supplied either directly from the conveyor leading from the fiberizing equipment or from a stored supply where the material is metered out as by a picker roll, is deposited from a conveyor (not shown) into the hopper 11, from which it is fed by the rotary sealing valve 12 into the path of the air stream from blower 10 through the conduit 8.

The opening and cleaning devices include a series of fluid jets for creating small strong blasts of fluid against the mineral wool on or adjacent the screen. Thus, as

illustrated particularly in FIG. 3, there are provided several jets 14 comprising a series of 4 jets symmetrically spaced about the open upper surface of the screen. The jet nozzles 15 extend horizontally across the screen in close proximity thereto, preferably about one inch above the screen. It is preferable to rotate the jets so as to avoid any tendency of the mineral wool to collect in bunches on the screen or in pockets not contacted by the fluid jet blasts. As shown the jets are mounted on hollow shafts 16, extending through the screen and mounted on suitable bearings (not shown) beneath the screen. The shafts carry sprocket gears 18 and rotary joints 19 connected with a piping manifold 20 for supplying compressed air from the supply pipe 22. The shafts 16 are driven by chain 17, passing around gears 18, bevel gears 24, gear box 25 and motor 26. The openings in the jets are small, preferably from ⅛ inch to ¼ inch in diameter, and the fluid in one form of the invention comprises air under pressure from 20 to 100 pounds per square inch. The jets are rotated at a low rate of speed, up to 30 revolutions per minute being sufficient to keep the tufts of mineral wool on all portions of the screen agitated and subject to the volume air passing through the screen.

The jets 14 may be formed by small piping connected together to form the horizontal nozzles as shown. It will be understood each jet pipe may comprise two opposed nozzles pointed in opposite directions and that they may be of rounded configuration to avoid entanglement with the fiber clumps on the screen.

In the form of the invention shown in FIG. 1, the air flow provided by the suction fan 7 is sufficiently powerful to create a reduction of pressure in the chamber 2, since the only air supplied under pressure to chamber 2 is that passing through duct 8 to supply the raw fiber and the small volume of air discharged through the jets 14. A substantial proportion of the volume air is thus drawn upwardly through the screen 6. Shot and other heavy particles fall through the screen 6 and may be collected in any suitable receptacle, shown as a pan 23 placed below the screen and so constructed as not to interfere with the passage of air into the lower portion of the aerating chamber, beneath the screen 6.

In FIG. 2, there is illustrated another form of the invention wherein there is provided a supplemental supply of air, added to the lower portion of chamber 2, beneath screen 6, by duct 27 supplied with compressed air from blower 28. With this supplemental supply of compressed air, the bottom of chamber 2 is closed so that the air supplied through duct 27 passes upwardly through the screen 6. The unwanted particles separated from the fibrous material are collected in a receptacle comprising two half sections 30, each slidable beneath the chamber 2, in sealed relation thereto and movable away from beneath the aeration chamber for removal of the collected heavy particles which pass through the screen 6.

In the operation of the equipment, the raw uncleaned mineral wool is supplied on a suitable conveyor directly from the fiberizing zone or from a supply of previously formed mineral wool. The mineral wool is supplied to the hopper 11 at a uniform rate and transferred to the conduit 8 by the rotary valve 12 where it is picked up by the air current and discharged upwardly into the aeration chamber. In the construction illustrated in FIG. 1, the suction fan 7 functions to create a strong up-draft of volume air entering through the screen 6 and passing upwardly through the aeration chamber. This volume air surrounds the incoming material and is immediately available to remove from the aeration zone, and to carry to the felting zone, the lighter, cleaner fiberized materials. The term, volume air, is that air passing through the aeration chamber 2 and the duct C to the felting zone. The heavier clumps fall downwardly upon the screen 6 where they are buffeted by the blasts of air from jets 14. The combined action of the volume air and jets serves to break up any clumps of the partially suspended mineral wool and to cause the adhering heavier particles to be shaken from the fibers. The cleaned fibrous materials are removed by flowing with the volume air upwardly through the aeration chamber and duct to the felting zone where they are formed into the desired density of cleaned mineral wool batts. The unfiberized heavier particles drop downwardly by gravity through the screen 6.

With the construction shown in FIG. 2, the function of the aeration chamber is the same but due to the pressure of the air supplied by blower 28 beneath the screen 6 there is a much greater flow of air upwardly through the screen and through the chamber 2. There is accordingly greater turbulence among the fibrous tufts in the chamber and greater lifting effect. The result is that the clumps of mineral wool are more quickly opened and the fibers separated from their adhering unwanted heavier particles and carried to the felting zone. A greater volume of fibrous materials can thus be processed.

Due to the uniform cross-sectional area of the aeration chamber 2 and to the placing of the upwardly directed open end of conduit 8 in the lower portion of the aeration chamber, any materials light weight enough to be borne upwardly by the volume air passing through the screen 6 will in general be carried away immediately through the duct C to the felting zone. This continuous removal of the lighter materials from the aeration zone assures that the volume of unopened clumps on the screen 6 will not be excessive. The jets 14 and the volume air passing upwardly through the screen are thus able to clean and open the heavier, tougher fibrous clumps remaining, without clogging the screen. The movement of the heavier clumps of fiber over the upper surface of the screen, under the influence of the air blasts from the jets, facilitates the detachment of shot and heavier particles from the screen and the discharge of these materials through the screen.

While the invention has been described in rather full detail, it will be understood that these details need not be strictly adhered to and that various changes and modifications may suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What we claim is:

1. Apparatus for opening, cleaning and felting a fibrous material containing unwanted particles comprising, an aeration chamber, said aeration chamber extending in a vertical direction, a felting zone, duct means for conducting air and cleaned fibers from said aeration chamber to said felting zone, foraminous means extending generally in a horizontal direction across a lower portion of said aeration chamber, means for introducing the fibrous material containing unwanted particles into said aeration chamber between said foraminous means and said duct means with the heavier clumps of said fibrous material falling onto the surface of said foraminous means closest to said duct means, means for supplying a plurality of generally horizontally directed fluid streams across said aeration chamber adjacent said surface of said foraminous means closest to said duct means to open and clean said heavier clumps of fibrous material so as to separate the fibers from the unwanted particles, means for producing a flow of volume air passing through said foraminous means and into and through said aeration chamber, said volume air serving to transport cleaned fibers from said aeration chamber through said duct means to said felting zone while said unwanted particles pass downwardly through said foraminous means, and means for felting said cleaned fibers so transported into said felting zone.

2. The apparatus recited in claim 1 wherein said foraminous means comprises a screen.

3. The apparatus recited in claim 1 wherein one end of said aeration chamber is open to the surrounding atmosphere and means are provided in said felting zone for creating said upward flow of volume air through said foraminous means, said aeration chamber and said duct means to said felting zone.

4. The apparatus recited in claim 1 and means for introducing a supply of fluid under pressure into said aeration chamber on the side of said foraminous means farthest removed from said duct means, and means in said felting zone for inducing the flow of said fluid through said foraminous means, said aeration chamber and said duct means into said felting zone, said flow of said fluid carrying therewith the cleaned fibers from said fibrous material.

5. The apparatus recited in claim 1 wherein said means for supplying said fluid streams comprises a plurality of jets, and means for rotating said jets about substantially vertical axes.

6. The apparatus recited in claim 5 wherein the pressure of the fluid emanating from jets is of the order of 20 to 100 pounds per square inch gauge.

7. The apparatus recited in claim 6 wherein said foraminous means comprises a wire mesh cloth, between 3 x 3 and 4 x 4 mesh.

8. The apparatus recited in claim 7 wherein said aeration chamber extends above said screen vertically to a height of at least approximately four feet.

9. A process of opening, cleaning and felting a fibrous material having mixed therein unwanted particles in an aeration zone which extends in a generally vertical direction and has adjacent the lower end thereof a foraminous member adapted generally to support heavier clumps of said fibrous material comprising, introducing said fibrous material into said aeration zone with the heavier clumps

of said fibrous material falling onto the upper surface of said foraminous member, subjecting said heavier clumps of fibrous material on said foraminous member to a plurality of pneumatic agitations moving generally in a horizontal direction to open and clean said heavier clumps of said fibrous material so as to separate the fibers from the unwanted particles, passing a flow of volume air through said foraminous member into and through said aeration zone, moving said volume air through said aeration zone into a felting zone at a velocity sufficient to carry said clean fibers therewith, removing said unwanted particles from said aeration zone, and felting said fibers in said felting zone.

10. The process as defined in claim 9 wherein said pneumatic agitations comprise a plurality of rotating fluid blasts directed generally in planes extending substantially parallel to the plane of said foraminous member.

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