Sept. 9, 1941. J. K. DUNCAN 2,255,206

APPARATUS FOR PROVIDING UNIFORMLY GRADED FIBROUS MATERIALS

Filed July 13, 1938 5 Sheets-Sheet 1

Fig. 1.

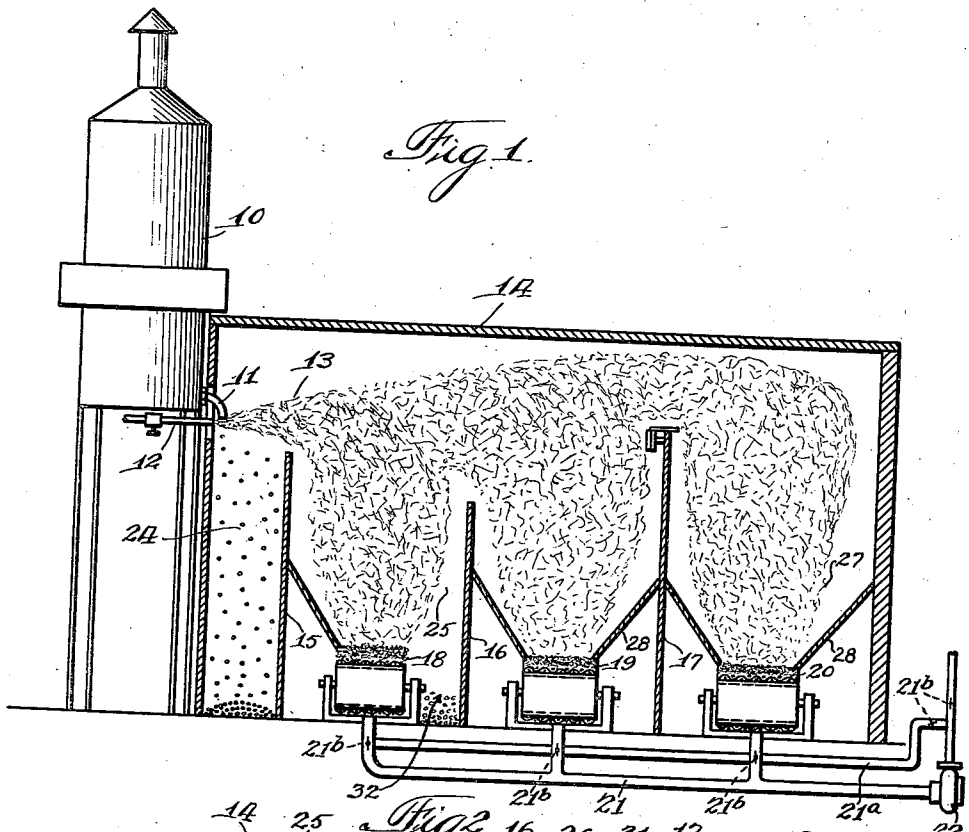
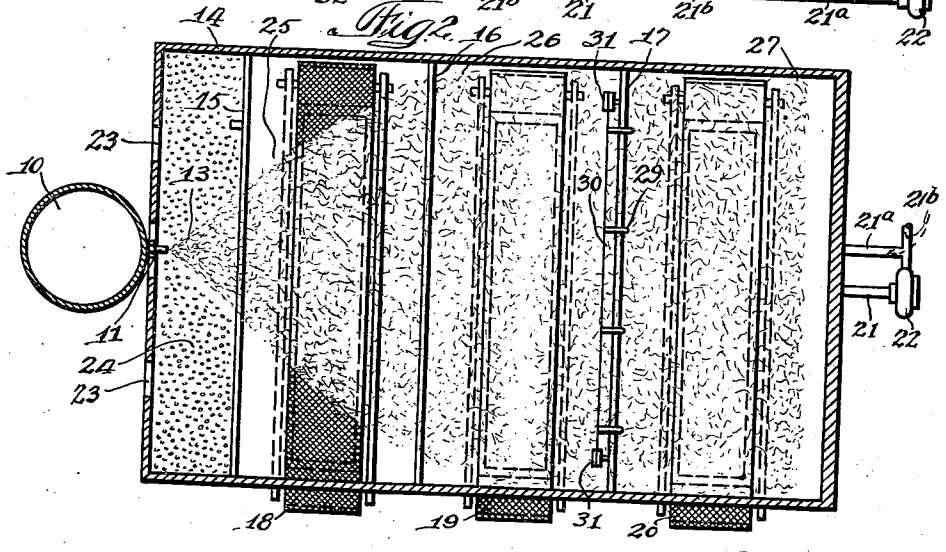


Fig. 2.



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Filed July 13, 1938 5 Sheets-Sheet 2

Fig. 3.

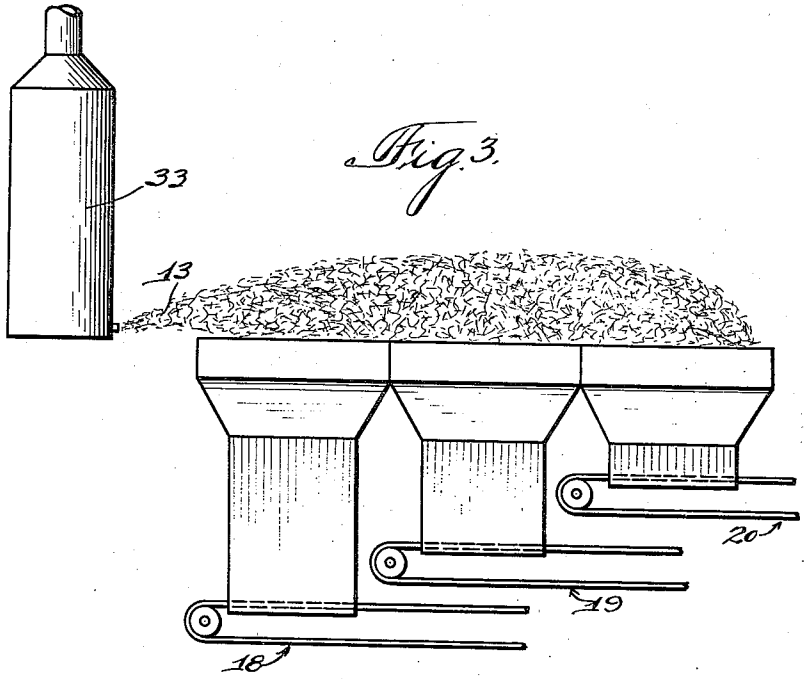
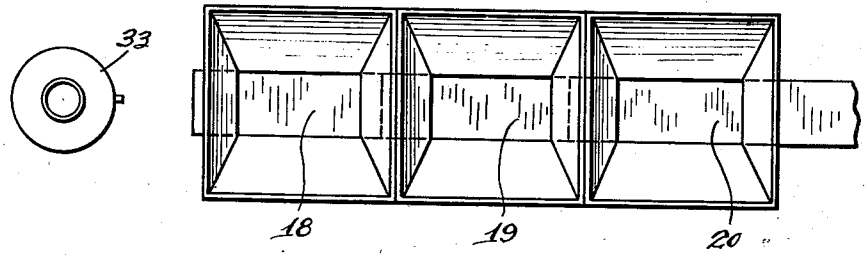


Fig. 4.



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APPARATUS FOR PROVIDING UNIFORMLY GRADED FIBROUS MATERIALS

Filed July 13, 1938 5 Sheets-Sheet 3

Fig. 5.

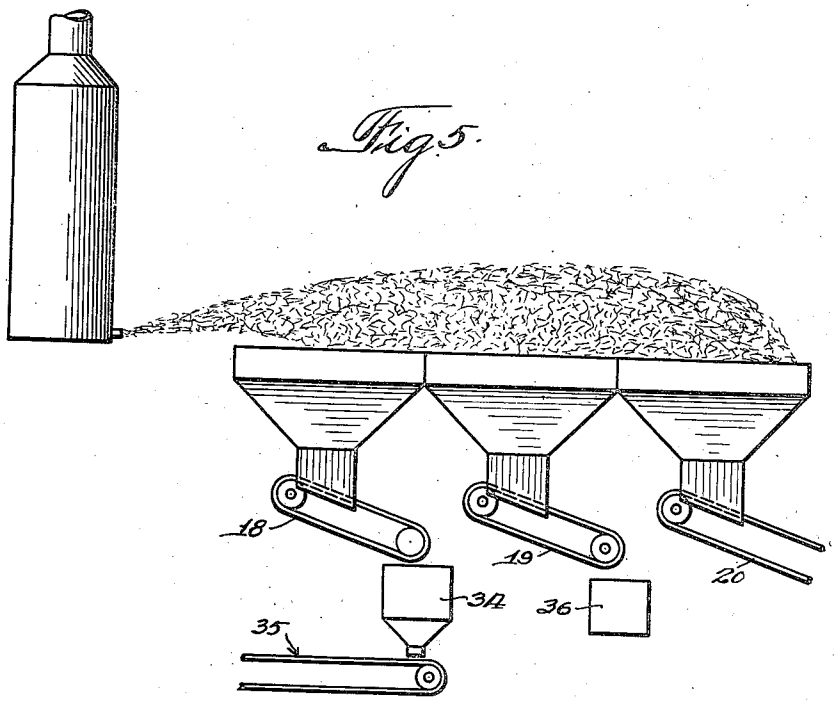
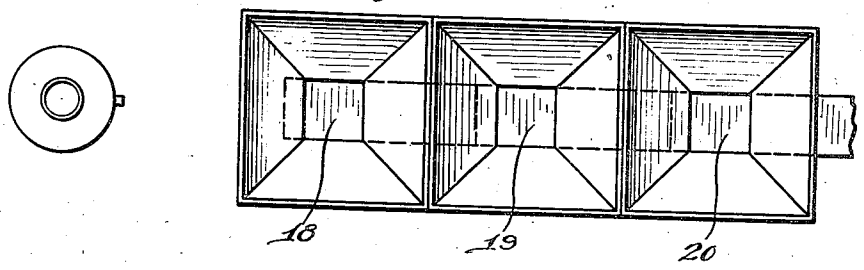


Fig. 6.



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APPARATUS FOR PROVIDING UNIFORMLY GRADED FIBROUS MATERIALS

Filed July 13, 1938 5 Sheets-Sheet 4

Fig. 7.

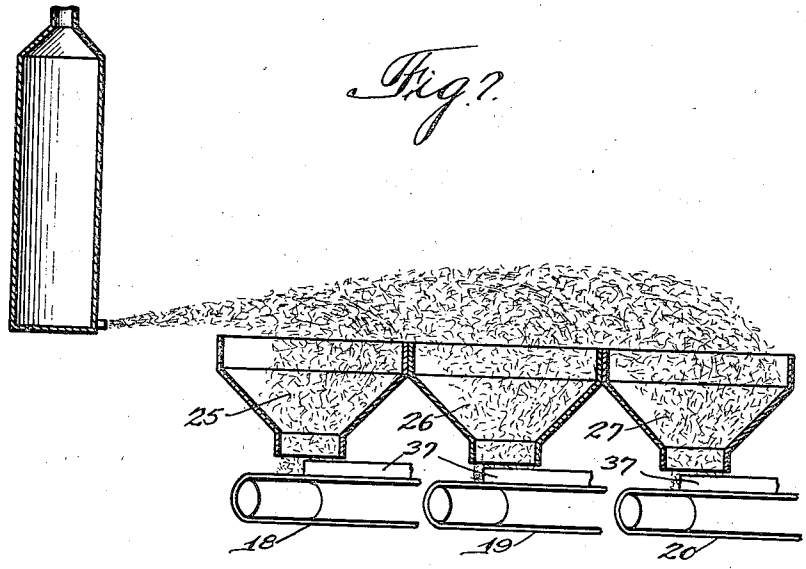
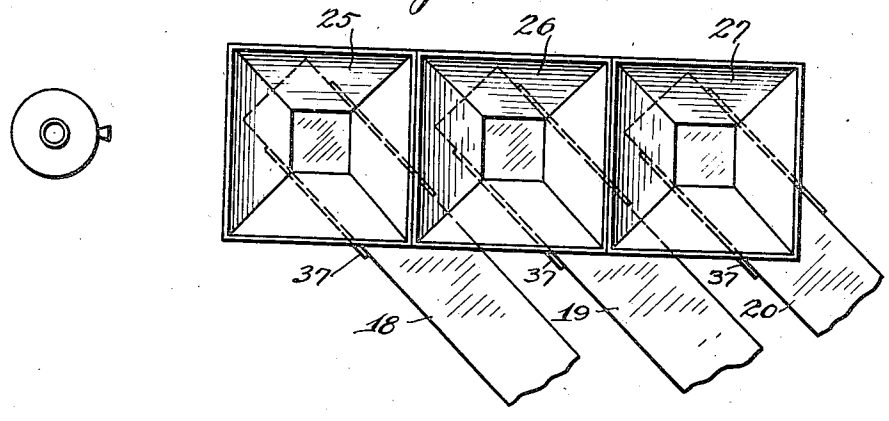


Fig. 8.



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APPARATUS FOR PROVIDING UNIFORMLY GRADED FIBROUS MATERIALS

Filed July 13, 1938 5 Sheets-Sheet 5

Fig. 9.

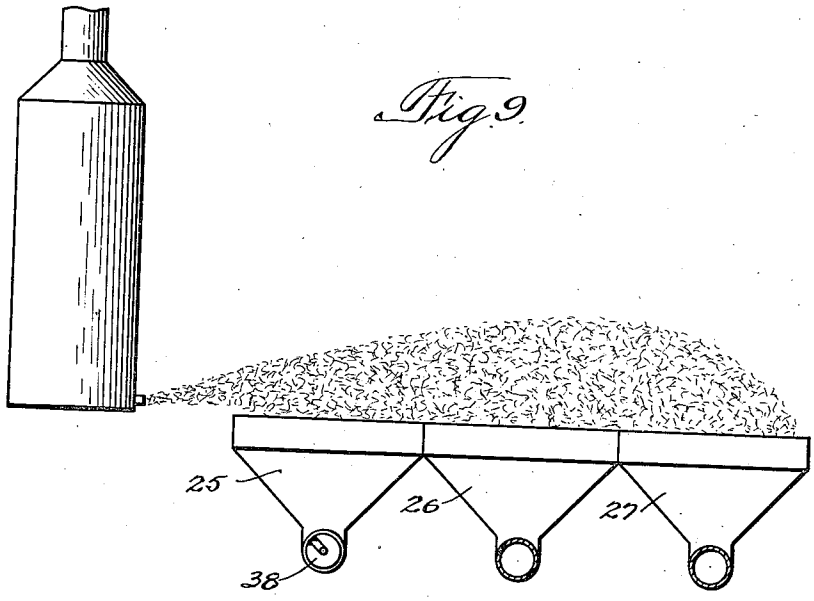
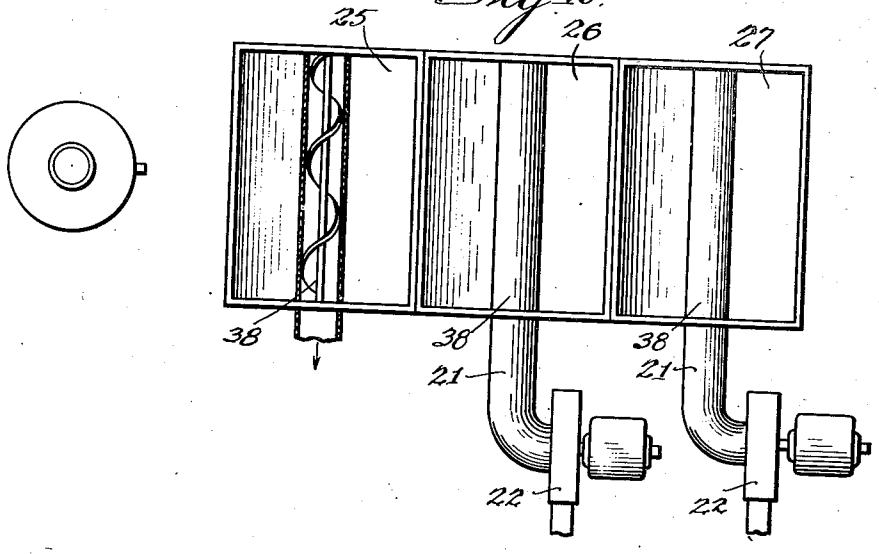


Fig. 10.



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Patented Sept. 9, 1941 2,255,206

UNITED STATES PATENT OFFICE

2,255,206

APPARATUS FOR PROVIDING UNIFORMLY GRADED FIBROUS MATERIALS

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Application July 13, 1938, Serial No. 219,067

4 Claims. (Cl. 209—135)

This invention relates to a method for producing and classifying fibrous materials, and more specifically relates to a method for the collection and separation of particles according to their various sizes, shapes, masses, or densities.

This invention has for an object the provision of a new method whereby a heterogeneous mixture of particles of varying sizes may be readily classified into several groups according to the masses of the particles.

Probably the most general method that has been used in the past for the separation of particles of a heterogeneous mixture into groups according to size has been screening. Screening, however, is not always applicable to such mixtures which consist entirely of, or contain a large proportion of, fibrous material, such as wood fibers, asbestos fibers, or other mineral fibers, No method has been developed up to the present time which is entirely satisfactory for classifying such materials, which for certain purposes is often desirable.

The process for the manufacture of rock wool from a molten vitreous material at the present time comprises passing a small stream of the molten substance into a stream of gas, such as steam or air, in such a manner that the molten material is pulled out and solidifies in the form of fine fibers. It is desirable in the manufacture of rock wool for insulating purposes to make a product of standard uniform density, depending upon the use to which the product is to be put. The density of the rock wool material produced by the commonly accepted methods, as above indicated, will depend largely upon the relative size of the fibers in the material and the proportion of "beads" or "shot" contained in the final product. No method has thus far been developed wherein it is possible to produce rock wool fibers of uniform consistency and size without having included therein some beads of vitreous material which have not been drawn out into fibers. A satisfactory method is thus desirable for the separation of the beads or shot from the rock wool either during or after the manufacturing process. It is also desirable to separate fibers of different sizes in order to produce a uniform product. Due to the nature of the material, the classification of such fibrous substances and the separation of particles in the resulting product by sifting or screening are usually impossible.

It is also desirable to classify certain other particles according to their shapes and sizes, particularly fibrous materials, such as asbestos fibers, wood fibers, and the like. Due to the nature of such materials it has been impracticable to do so in the past.

An object of this invention is to provide a method of separating fibers from other particles that may be contained within a fibrous mixture.

A further object of this invention is to provide a method for the classification of fibrous substances into fibers of various sizes and densities.

A further object of this invention is to provide a method for the production of a rock wool of uniform fibrous structure.

A still further object of this invention is to provide a method for the separation of beads or shot from rock wool during the process and manufacture.

A further and additional object of this invention is to provide a continuous method for the production of a uniform rock wool which is substantially free of beads and suitable for insulation purposes.

Other objects of this invention will be evident from the following description and claims.

To illustrate the invention, suitable drawings are provided, in which

Figure 1 represents, diagrammatically, a cross section of a preferred embodiment of apparatus suitable for carrying out the present invention;

Fig. 2 represents a plan view of the structure shown in Fig. 1 wherein like numerals represent like parts;

Fig. 3 represents, diagrammatically, a variation in a method for collecting the fibers wherein the conveyor belts travel in the same direction as the fibers;

Fig. 4 represents a plan view of the structure shown in Fig. 3;

Fig. 5 represents, diagrammatically, a further variation in a method for collecting the fibers and particulate material in accordance with this invention;

Fig. 6 represents a plan view of the structure shown in Fig. 5;

Fig. 7 represents, diagrammatically, a further variation in a method for collecting the fibers wherein the belt conveyors run at an angle to the direction of the movement of the fibers;

Fig. 8 represents a plan view of the structure shown in Fig. 7;

Fig. 9 represents, diagrammatically, a screw conveyor means for collecting the fibers in accordance with a modification of this invention;

Fig. 10 represents a plan view of the structure shown in Fig. 9.

In general, the method of the present inven-

tion comprises introducing a stream of fibrous particles (or a fluid capable of forming particles or fibers) into a stream of a rapidly moving and expanding gas in an open space whereby the particles are suspended, removing the particles from suspension by the force of gravity or by suitably controlled forces acting perpendicularly to the direction of the movement of the particles at varying distances from the point of introduction into the flowing stream, and collecting the particles in separate zones to obtain uniformly graded masses of fibers. In general, in the flowing gaseous stream the larger and heavier particles are the first to settle out, while the finer particles become collected at some further distance from the point where the material is introduced into the rapidly moving and expanding gas.

For a more complete understanding of this invention an example is specifically described in the following. It is to be understood, however, that it is not intended that the invention be limited in any manner by the example given, since it is presented for illustrative purposes only.

Attention is now directed to Fig. 1 and Fig. 2, which are diagrammatic views of an apparatus suitable for preparing rock wool and classifying the various fibers as they are produced. Molten rock or other vitreous material is contained in a cupola 10 which is heated by any suitable means (not shown). The molten material is discharged through opening 11 into a stream of atomizing gas, such as steam or air, introduced by pipe 12 and according to the conventional practice for preparing mineral wool by this method. The fibers and other particles 13 thus produced are discharged into a large enclosed chamber 14, within which are erected a plurality of substantially vertical partitions 15, 16, and 17, transverse to the direction of the movement of the gaseous stream. The partitions preferably extend across the entire width of the chamber 14.

At the bottom of the compartments formed by the partitions, belt conveyors 18, 19, and 20 may be placed for the continuous or intermittent removal of the material settling to the bottom of each compartment. The belts of the conveyors 18, 19, and 20 may be porous, and, as shown, suction means 21 and 22 are provided for producing suction under the porous belt of the said conveyor. This means preferably comprises a suction fan 22 of some known design and suitable connections 21. The fan 22 may be constructed so that it will force air in the opposite direction through the belts 18, 19, and 20 by means of suitable connections 21*a* and dampers 21*b*. Consequently, air may be blown into the chamber 14 through certain of the porous belts and removed by suction from others in order to set up any desired non-turbulent current of air within the chamber 14. The outlet of the suction fan 22 may be equipped with a suitable dust collecting means (not shown). Suitable openings 23 in chamber 14 are provided to permit the entrance of air to the chamber if desired.

In the operation of this machine the molten rock is fiberized in a rapidly moving and expanding gas, and the resulting spray of solidified fibers and particles is discharged into the chamber 14 near the top. There is a continuous flow of the gas over the top of the chamber due to the continuous removal of the gas through the porous belts of conveyors 18, 19, or 20 by means of the suction fan 22. The heavy beads or shot inadvertently produced during the atomizing may either settle out at once into the first compartment 24 or may be projected against the partitions 15, 16, or 17 by the stream of gas. The successively lighter materials or fibers will settle out successively in compartments 25 and 26, and the finest material is collected in compartment 27. Flanges 28 attached to the partitions and the side walls of chamber 14 guide the material to the belt conveyors in each compartment. A space 32, if desired, may be left between the belt conveyor and the side of the partitions against which the beads strike in order that the beads may not collect on the belt conveyor. The beads thus collected may be removed intermittently or continuously by any suitable means.

The resulting rock wool is thus collected in various grades on conveyor belts 18, 19, and 20, and it may be continuously or intermittently removed from the chamber 14 thereby. The rock wool collected on conveyor 18 may consist of comparatively fine fibers and may have an apparent density of about 12 pounds per cubic foot under certain operating conditions. A dense rock wool of this type is suitable for use in high temperature insulation such as is used for insulating furnaces and the like. The wool collected in compartments 26 and 27 is substantially lighter in weight per cubic foot, often having an apparent density of from only 1½ to 3 pounds per cubic foot. This lightweight insulation material is most suitable for low temperature insulation such as is used in houses or in packing for refrigerators, or under high humidity conditions.

Under certain conditions fibers may collect on the tops of the partitions during settling. These fibers may be removed intermittently or continuously by any suitable means. In a preferred form of this invention fingers 29 attached to endless wire 30 may be employed for this purpose. The fingers 29 are pulled along the upper edges of partition 17, for example, by rotation of pulleys 31. Motion may be imparted to the pulleys 31 by any suitable means, such as an electric motor (not shown).

A large number of modifications are possible in the above-described apparatus. For example, many other types of fibers and particles may be classified and graded according to their size by the general method illustrated above. Suitable materials that may be classified by this method may be asbestos fibers, wood fibers, sand particles, ceramic particles, abrasive particles, metal filings, and the like. It is not necessary that the particles be introduced into the gas stream in the molten condition as is shown in the above modification. For example, a heterogeneous mixture of fibers and other solid particles may be introduced into the gaseous stream by a suitable type of screw conveyor or merely by flowing through a suitable constriction.

It is not necessary that air be used as the fluid for suspending the particles or fibers. For example, steam or other inert gases may also be used. It is not necessary for carrying out this invention that the enclosed chamber 14 be employed. It is usually desirable, however, in order to prevent dust and very fine particles from escaping into the surrounding air.

The classification of the particles may be controlled, if desired, by any of several different methods. Thus, various grades can be produced by raising or lowering the several partitions within the chamber. Also, the rate at which the particles and the fluid are introduced into the

chamber will affect to a degree the classification of particles obtained. It may be desirable in some cases to provide suction or pressure on the belts of conveyors 18, 19, and 20 in order to regulate the size of particles settling into the respective compartments or to regulate further the density of the mass settling upon the belt conveyors. An advantage in having a suction means provided on conveyor belt 18 is to restrict and, in some instances, prevent the fibrous material from entering into space 32 wherein fall the glass beads.

While belt conveyors are shown in the specific example given in the description, it is not contemplated that this is the only means by which the material may be removed from the compartments. Figs. 3 to 10 show diagrammatically various modifications whereby the material collected in the bottom of the compartments may be removed therefrom. Referring now to Figs. 3 and 4, the fibers 13 may be discharged in a gaseous stream from any suitable container 33 by any desired method. The fibers may be collected in compartments, as before described, but may be removed by a plurality of conveyor belts 18, 19, and 20 which convey the material from the chamber 14 (shown in Fig. 1) in a direction substantially parallel to that in which the fibers are introduced into the chamber.

Figs. 5 and 6 show diagrammatically a modification wherein the conveyor belts are inclined from a horizontal plane with further means for collecting the material from the conveyor belts. For example, the material from conveyor belt 18 may be discharged into a hopper or compartment 34, which in turn may discharge to a conveyor belt 35. If desired, the conveyor belt 19 may discharge the material into a suitable hopper or granulator 36 directly.

Referring now to Figs. 7 and 8, a method is shown for the removal of the fibrous material at an angle to the direction in which the fibrous material is introduced into the chamber 14 (shown in Fig. 1). The fibrous material is collected in compartments 25, 26 and 27, as heretofore described, and may be discharged from the compartments onto the conveyor belts 18, 19, and 20. Suitable guides 37 may be installed in connection with the conveyor belts in order to retain the fibrous material on the belt.

Figs. 9 and 10 represent diagrammatically a means whereby the material collecting in the compartments 25, 26, and 27 may be removed by a screw conveyor 38. If desired, a suitable suction means 21 and 22 may be applied to the screw conveyor, which in general may have the same function as the suction means applied to the belt conveyors hereinabove described. Various other arrangements for effecting the removal of the material from the compartments will readily occur to those skilled in the art.

It is preferable that a turbulent flow of the gaseous suspension through the top of the chamber be minimized or prevented; otherwise the finer particles will be carried back, while still in suspension, and settle in the first compartments. The turbulent flow may be minimized by providing a means for continuously removing the gas from the chamber by a suitable method, preferably near the end opposite that in which the suspension is introduced. It is not necessary that the gas be removed from the bottom of compartment 27 as shown in the preferred embodiment of this invention. For example, the gas may be removed by a suitable means through any suitable openings in chamber 14 in order to reduce turbulent flow of the gaseous suspension.

While in the embodiment of this invention as shown there are substantially four separations made, it is not contemplated that this invention shall be limited thereby, and any number of compartments may be employed for separating products of varying sizes and densities.

While several particular embodiments of this invention are shown above, it will be understood, of course, that the invention is not to be limited thereto since many modifications may be made, and it is contemplated, therefore, to cover any such modifications as fall within the true spirit and scope of this invention as defined by the appended claims.

I claim:

1. In an apparatus for producing mineral wool, the combination of an enclosed chamber, a plurality of substantially perpendicular partitions adjacent to the bottom of the chamber forming a plurality of compartments therein, means for introducing a gaseous suspension of mineral wool fibers into the top of the chamber in a flowing stream transverse to and over the top of the partitions, means for collecting said fibers in the compartments, separate conveyor means for removing said fibers from the compartments, and suction means applied to said conveyor means for removing the gas from said enclosed chamber through the separate compartments at controllable predetermined rates.

2. In an apparatus for producing mineral wool, the combination of an enclosed chamber, a plurality of substantially perpendicular partitions adjacent to the bottom of the chamber to form a plurality of compartments, means for introducing a gaseous suspension of mineral wool fibers into the top of the chamber in a flowing stream transverse to and over the top of the partitions, means for separately collecting said fibers in accordance with their selected sizes and densities in each of said compartments, means for separately removing said fibers from each compartment, and a plurality of suction and blowing means associated with said fiber removing means for the removal or introduction of air into said chamber adjacent the base of a plurality of the compartments.

3. The apparatus recited in claim 1, including means for the removal of fibers settling on the upper edges of said partitions.

4. The apparatus recited in claim 2, including means for the removal of fibers settling on the upper edges of said partitions.

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