Nov. 5, 1963 W. SAUERMANN 3,109,807

GASEOUS CURRENT SEPARATOR

Filed Nov. 23, 1960

FIG. 1

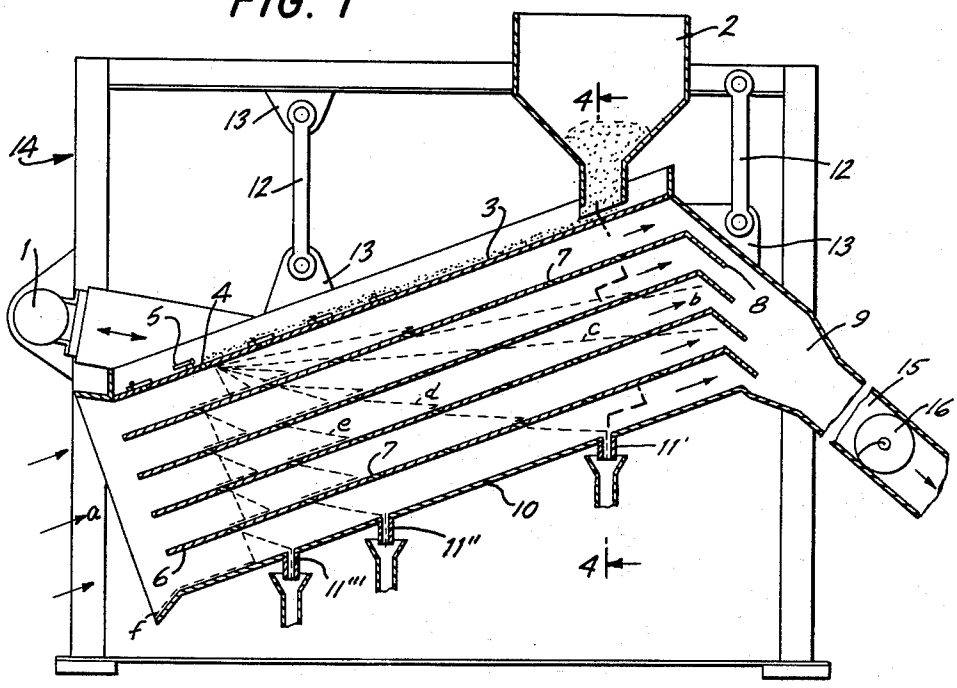


FIG. 2

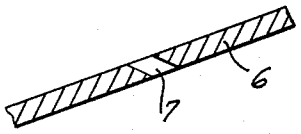


FIG. 3

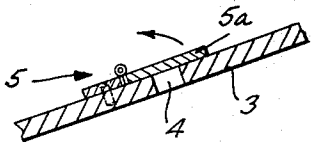
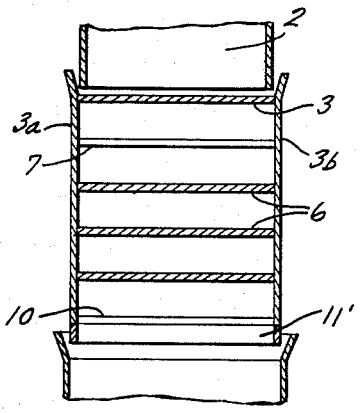


FIG. 4



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3,109,807

GASEOUS CURRENT SEPARATOR

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The present invention relates to grain classifying structure of the gaseous current type.

Thus, there are certain industries where graular material is collected without any consideration being given to the size of the particles of the granular material, and for further processing it is necessary to separate the granular material into classes of different size ranges, respecively.

It is the object of the present invention to provide an apparatus which will efficiently separate such granular material into classes of various size ranges.

Another object of the present invention is to provide an apparatus of the above type which will classify the granular material according to its size in a manner which is not influenced to any substantial degree by the particular configuration of the particles of the material.

A further object of the present invention is to provide a structure of the above type which is inexpensive and at the same time capable of operating reliably with a minimum of maintenance.

With the above objects in view the invention includes in a grain classifying apparatus which is capable of classifying granular material into various size ranges, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls. The top wall of the gas guide is formed with at least one opening and the bottom wall of the gas guide is formed with a plurality of openings passing through this bottom wall and distributed longitudinally therealong. A support means supports the gas guide of the invention with one of its open ends at an elevation higher than the other of its open ends and the granular material which is to be classified is dropped onto the top wall so as to move downwardly therealong to the opening of the top wall and so as to fall through this opening into the gas guide to fall toward the bottom wall thereof. When a stream of gas flows upwardly along the interior of the gas guide from its other toward its one end. This stream of gas will engage the granular material falling from the opening of the top wall toward the bottom wall and will distribute this material along the bottom wall with the material of smallest grain size located nearest to the upper end of the bottom wall and the granular material being of gradually larger grain size toward the lower end of the bottom wall, so that granular material of various size ranges will respectively drop through the openings of the bottom wall.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a partly schematic, sectional, side elevation of an apparatus according to the present invention;

FIG. 2 is a longitudinal sectional fragmentary view on a large scale of a partition of the invention showing in particular one of the openings passing therethrough;

FIG. 3 is a fragmentary longitudinal sectional elevation of part of the top wall of the gas guide of the invention showing one possible embodiment of a closure means cooperating with an opening of this top wall; and

FIG. 4 is a transverse sectional view of the structure of FIG. 1 taken along line 4–4 of FIG. 1 in the direction of the arrows.

Referring now to FIG. 1 it will be seen that the entire structure is carried by a support means which includes a suitable framework **14**. As may be seen from FIG. 1 the framework supports in the manner described below an elongated tubular gas guide which includes the top wall **3**, the bottom wall **10**, and the opposite side walls **3***a* and **3***b* (FIG. 4). The elongated gas guide has opposite open ends, and the support means **12**—**14** supports the gas guide in an inclined position with one of its open ends at a higher elevation than the other of its open ends. Thus, the framework **14** and the gas guide itself carry suitable brackets **13** to which rods **12** are pivotally linked as shown in FIG. 1, and these rods **12** not only support the gas guide but permit the same to be vibrated longitudinally. A vibrating means **1**, diagrammatically shown in FIG. 1, is operatively connected with the gas guide to longitudinally vibrate the same, this vibrating means **1** having any suitable form such as, for example, that of a motor carrying an eccentrically positioned weight which will produce the vibrations upon operation of the motor. The brackets **13** which are fixed to the gas guide may be located at opposite sides thereof, and there may be four rods **12** two at each side of the gas guide respectively pivotally connected both with the framework **14** as well as with the gas guide to support the latter for swinging forward and rearward movement in response to the vibrations derived from the vibrating means **1**.

The side walls **3***a* and **3***b* of the gas guide are closed, while the top wall **3** and the bottom wall **10** are formed with openings, and these openings extend completely across the top and bottom walls. Thus, it will be seen that the top wall **3** is formed with a plurality of openings **4** distributed along the top wall **3** and passing through the latter, each of these openings **4** extending completely across the top wall **3** between the side walls **3***a* and **3***b*. A closure means **5** cooperates with each of the openings **4** to optionally close or open the latter according to the will of the operator. As is indicated in FIG. 3, this closure means may take the form of a hinge fastened by suitable screws to the wall **3** and having a swingable cover member **5***a* which is turnable from the closed position indicated in FIG. 3 in a counterclockwise direction, as indicated by the arrow of FIG. 3 to an open position. With this arrangement a selected one of the openings **4** can be uncovered while the remaining openings remain closed, and thus the operator can select the point along the wall **3** through which the granular material is to be dropped into the interior of the gas guide.

A supply means is provided for supplying granular material to be classified, and this supply means is in the form of a stationary hopper **2** carried by the framework **14** and having a lower discharge end located closely adjacent to the top wall **3**. It will be noted that the discharge end of the hopper has a width equal to the width of the top wall **3** so that the granular material is uniformly distributed across the top wall **3** to move downwardly along the latter to the selected opening **4** which has been opened by the operator and to drop through this opening **4** into the interior of the gas guide of the invention.

With this construction if a stream of a gas such as air moves upwardly along the interior of the gas guide the granular material falling through the selected opening **4** will be distributed longitudinally along the interior of the gas guide and will thus be distributed along the bottom wall **10**. The distribution of the granular material along the bottom wall **10** will necessarily be according to grain size. Thus, extremely small and therefore extremely light particles will be suspended in the stream of gas and will simply be carried out of the gas guide through the upper

end thereof. At the upper end of the bottom wall **10** will be located relatively small particles while the largest particles will be located at the bottom end of the gas guide and will fall out of the bottom end thereof, and in between these extremes the granular material will be arranged with the size of the particles gradually increasing from the upper toward the lower end of the gas guide.

The bottom wall **10** is formed with a series of openings also extending completely across the bottom wall **10** as well as through the latter and distributed longitudinally thereon, and these openings respectively communicate with the relatively short tubular outlets **11'**, **11''**, and **11'''** shown in FIG. 1, these outlets directing material into chutes, respectively, which causes the material to be conveyed to desired locations. As is apparent from FIG. 1, the smallest range of sizes will drop through the outlet **11'**, the intermediate range of sizes will drop through the outlet **11''**, and the largest range of sizes will drop through the outlet **11'''**. Of course, there will be a still larger range of sizes which will simply fall through the lower open end of the gas guide, while a range of sizes even smaller than that which falls through the outlet **11'** will be carried off with the stream of air or other suitable gas.

In practice, grain classifiers of the above type are never 100% efficient. That is, in actual practice it never happens that only grains of a particular range of sizes are classified into one group. There is always to some extent some granular material of the next lower and next higher size ranges located in each particular range of sizes although of course the major part of the granular material of each size range conforms to the range of sizes of the particular size range. Thus, it will be found that with the structure of the invention as described above although the granular material dropping, for example, through the outlet **11''** will for the most part have a range of sizes intermediate the size range of the granular material falling through the outlets **11'** and **11'''**, nevertheless some of the material falling through the outlet **11''** will be of the same size range as the material falling through the outlet **11'** and some will also be in the same size range as the material falling through the outlet **11'''**. One of the principal reasons for this undesirable result resides in the fact that eddy current and turbulence in the stream of gas prevents the distribution of the granular material along the bottom wall with the uniformity which is desired.

According to a further feature of the invention, the structure of the gas guide of the invention is such that laminar gas flow is maintained so as to provide an exceedingly efficient uniformity of distribution of the material along the bottom wall **10** and thus the extent to which granular material in any one size range will have the size of the next lower and next higher size ranges will be very greatly reduced certainly far beyond what has been experienced in known apparatus up to the present time. Thus, with the structure of the invention there are arranged within the gas guide a plurality of partitions **6** located one above the other and spaced from each other as well as from the top and bottom walls **3** and **10**, and these partitions **6** are carried by the side walls **3***a* and **3***b*, as indicated in FIG. 4. The partitions **6** are parallel to each other, as well as to the top and bottom walls **3** and **10**, as is apparent from FIG. 1. Each of the partitions **6** is formed with a plurality of openings **7** passing therethrough and distributed therealong, and each opening **7** extends completely across the partition, as is apparent from FIG. 4. As is most clearly shown in FIG. 2, each opening **7** is inclined oppositely to the inclination of the gas guide. It will be noted that the openings **7** are uniformly distributed along each partition.

At the upper open end of the gas guide there is a conduit means **9** which communicates with this open end of the gas guide to convey the gas away from the latter, and a portion **15** of the conduit means **9** is provided with a fan

or blower **16** which creates the stream of gas flowing upwardly into the gas guide through the open lower end thereof as indicated at *a* in FIG. 1. To the upper ends of the partitions **6**, at the upper open end of the gas guide, are fixed a plurality of guide vanes **8** which are parallel to each other and extend into the conduit **9** in the manner indicated in FIG. 1, so that these vanes **8** maintain the laminar flow in the gas, which may be air, flowing into the conduit **9**. As was pointed out above, the finest smallest particles will simply be suspended in the stream of gas and will be carried along with the stream of gas through the discharge conduit **9**, and this conduit may lead to a conventional separator in which the dust-like particles are separated from the gas stream.

As may be seen from FIG. 1, all of the relatively fine small granular particles which flow along the path indicated by the dotted line *c* or along a more horizontal path will be carried off with the stream of gas through the conduit means **9** to the separator. The stream of gas flowing from the region *a* up to the upper open end of the gas guide at the region *b*, will provide one range of sizes of the granular material between the paths indicated by the dotted lines *c* and *d*. As is apparent from the line *d* the material is advanced upwardly along the several partitions and drops down through the next lower opening **7** to be moved again upwardly in between the next pair of lower partitions, etc., and thus there will be a particular size range which will fall through the outlet **11'**. In the same way a second range of sizes will be located between the paths *d* and *e* shown in dotted lines in FIG. 1, and the particles in this range of sizes will fall through the outlet **11''**, while the next larger range of sizes will in a very similar way fall through the outlet **1'''**, and of course particles of even larger size will drop out of the lower open end of the gas guide as indicated at *f*.

The various size ranges can be regulated by selecting the opening **4** through which the material is to drop into the gas guide of the invention. The inclination of the openings **7** permit these openings to extend generally in the direction of the gas stream so that there is a minimum change in the direction of movement of the granular material as it moves through the openings **7**.

The arrangement of the several partitions **6** with their openings **7** not only maintains the gas flow laminar, in addition the dropping of the granular material toward the bottom wall **10** is repeatedly interrupted and the material repeatedly falls through the openings **7** to be repeatedly subjected to the several layers of the gas stream, so that in this way irrespective of the shape of the particles, that is to say, irrespective of whether the particles are circular, cubicle, or somewhere in between these extremes, they will nevertheless be grouped according to the size ranges and the configuration of the particles themselves will not have any influence on their classification so that the location in any one size range of particles from the next higher or next lower size range resulting from the particular configuration of the particles is also greatly diminished with the structure of the invention. Furthermore, the provision of the partitions with the openings **7** divides the stream of granular material falling through the selected opening **4** into several substreams of different size ranges before the granular material reaches the bottom wall **10**, so that in this way also the efficiency of the classification is enhanced.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of grain classifying structures differing from the types described above.

While the invention has been illustrated and described as embodied in vibratory grain classifying structures, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully

reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic of specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an apparatus for classifying granular material into classes of different size ranges, in combination, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls, said top wall being formed with a plurality of openings at predetermined points along said top wall through which granular material to be classified drops into the tubular gas guide and said bottom wall being formed with a plurality of openings distributed along said bottom wall and passing therethrough; a plurality of conduit means communicating respectively with said openings in said bottom wall for receiving respectively thereto granular material of different sizes; means for creating a gas flow within said elongated tubular gas guide in direction from one of its open ends to the other of its open ends; support means supporting said tubular gas guide in an inclined position with said one of its open ends located at the lower elevation than said other of its open ends; and supply means located above the said top wall of said gas guide adjacent said other end thereof for supplying through at least one of the openings in said top wall into the tubular gas guide granular material to be classified, so that when a gas flows up through said gas guide from said one toward said other open end thereof the granular material dropping through said opening of said top wall will be distributed by the gas along said bottom wall to fall according to predetermined size ranges through said openings of said bottom wall, respectively.

2. In an apparatus for classifying granular material into classes of different size ranges, in combination, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls, said top wall being formed with a plurality of openings at predetermined points along said top wall through which granular material to be classified drops into the tubular gas guide and said bottom wall being formed with a plurality of openings distributed along said bottom wall and passing therethrough; a plurality of conduit means communicating respectively with said openings in said bottom wall for receiving respectively thereto granular material of different sizes; means for creating a gas flow within said elongated tubular gas guide in direction from one of its open ends to the other of its open ends; support means supporting said tubular gas guide in an inclined position with said one of its open ends located at a lower elevation than said other of its open ends; and supply means located above said top wall of said gas guide adjacent said other end thereof for supplying to at least one of the openings in said top wall into the tubular gas guide granular material to be classified, so that when a gas flows up through said gas guide from said one toward said other open end thereof the granular material dropping through said opening of said top wall will be distributed by the gas along said bottom wall to fall according to predetermined size ranges through said openings of said bottom wall respectively; and vibrating means operatively connected to said gas guide for longitudinally vibrating the same.

3. In an apparatus for classifying granular material into classes of different size ranges, in combination, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls, said top wall being formed with at least one opening through which granular material to be classified drops into the tubular gas guide and said bottom wall being formed with a plurality of

openings distributed along said bottom wall and passing therethrough; a plurality of conduit means communicating respectively with said openings in said bottom wall for receiving respectively thereto granular material of different sizes; means for creating a gas flow within said elongated tubular gas guide in direction from one of its open ends to the other of its open ends; support means supporting said tubular gas guide in an inclined position with said one of its open ends located at a lower elevation than said other of its open ends so that when a gas flows through said gas guide from said one toward said other open end thereof the granular material dropping through said opening of said top wall will be distributed by the gas along said bottom wall to fall according to predetermined size ranges through said openings of said bottom wall, respectively; and a plurality of partitions arranged one above the other between said top and bottom walls and spaced from each other as well as from said top and bottom walls, said partitions being carried by said side walls and each partition being formed with a plurality of openings passing therethrough and distributed therealong so that the granular material falling through said opening of said top wall will fall through the openings of said partitions to reach said bottom wall, said partitions maintaining the flow of gas upwardly through said gas guide laminar.

4. In an apparatus for classifying granular material into classes of different size ranges, in combination, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls, said top wall being formed with at least one opening through which granular material to be classified drops into the tubular gas guide and said bottom wall being formed with a plurality of openings distributed along said bottom wall and passing therethrough; a plurality of conduit means communicating respectively with said openings in said bottom wall for receiving respectively thereto granular material of different sizes; means for creating a gas flow within said elongated tubular gas guide in direction from one of its open ends to the other of its open ends; support means supporting said tubular gas guide in an inclined position with said one of its open ends located at a lower elevation than said other of its open ends so that when a gas flows through said gas guide from said one toward said other open end thereof the granular material dropping through said opening of said top wall will be distributed by the gas along said bottom wall to fall according to predetermined size ranges through said openings of said bottom wall, respectively; and a plurality of partitions arranged one above the other between said top and bottom walls and spaced from each other as well as from said top and bottom walls, said partitions being carried by said side walls and each partition being formed with a plurality of openings passing therethrough and distributed therealong so that the granular material falling through said opening of said top wall will fall through the openings of said partitions to reach said bottom wall, said partitions maintaining the flow of gas upwardly through said gas guide laminar, each of said openings of said partitions extending transversely between said side walls and being inclined oppositely to the inclination of said gas guide.

5. In an apparatus for classifying granular material into classes of different size ranges, in combination, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls, said top wall being formed with at least one opening through which granular material to be classified drops into the tubular gas guide and said bottom wall being formed with a plurality of openings distributed along said bottom wall and passing therethrough and through which granular material of different size ranges is adapted to fall, respectively; means for creating a gas flow within said elongated tubular gas guide in direction from one of its open ends to the other of its open ends; support means supporting said tubular gas guide in an inclined position with said one of its open

ends located at a lower elevation than said other of its open ends so that when a gas flows through said gas guide from said one toward said other open end thereof the granular material dropping through said opening of said top wall will be distributed by the gas along said bottom wall to fall according to predetermined size ranges through said openings of said bottom wall, respectively; a plurality of partitions arranged one above the other between said top and bottom walls and spaced from each other as well as from said top and bottom walls, said partitions being carried by said side walls and each partition being formed with a plurality of openings passing therethrough and distributed therealong so that the granular material falling through said opening of said top wall will fall through the openings of said partitions to reach said bottom wall, said partitions maintaining the flow of gas upwardly through said gas guide laminar; conduit means communicating with said one end of said gas guide for conveying gas away from the latter; and a plurality of guide vanes respectively fixed to the upper ends of said partitions at said one end of said gas guide and extending into said conduit means for maintaining laminar flow therein.

6. In an apparatus for classifying granular material into classes having predetermined size ranges, in combination, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls, said top wall being formed with a plurality of openings passing therethrough and distributed therealong and said bottom wall also being formed with a plurality of openings passing therethrough and distributed therealong; a plurality of closure means respectively cooperating with said openings of said top wall for selectively closing all except a selected one of said openings of said top wall; means for creating a gas flow within said elongated tubular gas guide in direction from one of its open ends to the other of its open ends; support means supporting said gas guide in an inclined position where one of said open ends thereof is at a lower elevation than said other of said open ends thereof; and supply means located over said top wall of said gas guide adjacent said other end thereof for supplying to the upper surface of said top wall granulated material to be classified, whereby the granular material will move by gravity downwardly along said top wall until the granular material reaches the selected top wall opening which is open and falls therethrough into said gas guide, whereby when a stream of gas flows upwardly along the interior of said guide from said one toward said other open end thereof, the gas will distribute the granular material along said bottom wall according to various size ranges which will respectively fall through said openings of said bottom wall.

7. In an apparatus for classifying granular material into classes having predetermined size ranges, in combination, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls, said top wall being formed with a plurality of openings passing therethrough and distributed therealong and said bottom wall also being formed with a plurality of openings passing therethrough and distributed therealong; a plurality of closure means respectively cooperating with said openings of said top wall for selectively closing all except a selected one of said openings of said top wall; means for creating a gas flow within said elongated tubular gas guide in direction from one of its open ends to the other of its open ends; support means supporting said gas guide in an inclined position where one of said open ends thereof is at a lower elevation than said other of said open ends thereof; supply means located over said top wall of said gas guide adjacent said other end thereof for supplying to the upper surface of said top wall granulated material to be clasified, whereby the granular material will move by gravity downwardly along said top wall until the granular material reaches the selected top wall opening which is open and falls therethrough into said gas guide, whereby when a stream of gas flows upwardly along the interior of said guide from said one toward said other open end thereof, the gas will distribute the granular material along said bottom wall according to various size ranges which will respectively fall through said openings of said bottom walls; a plurality of partitions located one above the other, spaced from each other as well as from said top and bottom walls, and extending along the interior of said gas guide between said top and bottom walls thereof, said partitions being carried by said side walls and each partition being formed with a plurality of openings passing therethrough and distributed therealong so that the granular material which drops through the selected opening of said top wall will fall through said openings of said partitions before reaching said bottom wall, each of said openings of said partitions extending transversely between said side walls of said gas guide and being inclined oppositely to said gas guide; conduit means communicating with said one end of said gas guide for conveying gas from the latter; a plurality of guide vanes respectively fixed to the ends of said partitions at said one end of said gas guide and extending into said conduit means, said parations maintaining a laminar gas flow in said gas guide and said vanes maintaining the laminar gas flow into said gas guide and said vanes maintaining the laminar gas flow into said conduit means; and vibrating means cooperating with said gas guide for longitudinally vibrating the latter.

8. In an apparatus for classifying granular material into classes having predetermined size ranges, in combination, an elongated tubular gas guide having opposite open ends, closed side walls, and top and bottom walls, said top wall being formed with a plurality of openings passing therethrough and distributed therealong and said bottom wall also being formed with a plurality of openings passing therethrough and distributed therealong; a plurality of closure means respectively cooperating with said openings of said top wall for selectively closing all except a selected one of said openings of said top wall; support means supporting said gas guide in an inclined position where one of said open ends thereof is at a lower elevation than the other of said open ends thereof; supply means located over said top wall of said gas guide adjacent said other end thereof for supplying to the upper surface of said top wall granulated material to be classified, whereby the granular material will move by gravity downwardly along said top wall until the granular material reaches the selected top wall opening which is open and falls therethrough into said gas guide, whereby when a stream of gas flows upwardly along the interior of said guide from said one toward said other open end thereof, the gas will distribute the granular material along said bottom wall according to various size ranges which will respectively fall through said openings of said bottom wall; a plurality of partitions located one above the other, spaced from each other as well as from said top and bottom walls, and extending along the interior of said gas guide between said top and bottom walls thereof, each partition being formed with a plurality of openings passing therethrough and distributed therealong so that the granular material which drops through the selected opening of said top wall will fall through said openings of said partitions before reaching said bottom wall; and means cooperating with said gas guide for creating therein a stream of gas flowing longitudinally through said gas guide from said one toward said other open end thereof in opposition to the direction in which the granular material tends to move by gravity along said partitions and bottom wall.

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