March 13, 1962 R. IBING ETAL 3,024,908

DEVICE FOR CLASSIFYING GRANULAR MATERIAL

Filed Jan. 9, 1958 2 Sheets-Sheet 1

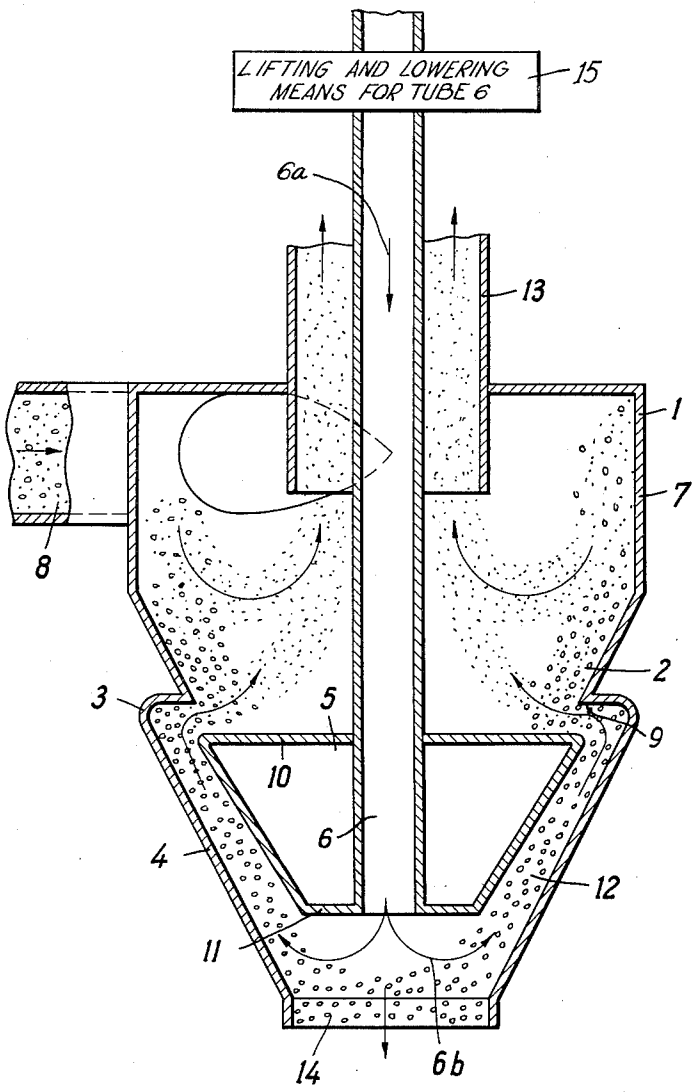


Fig. 1

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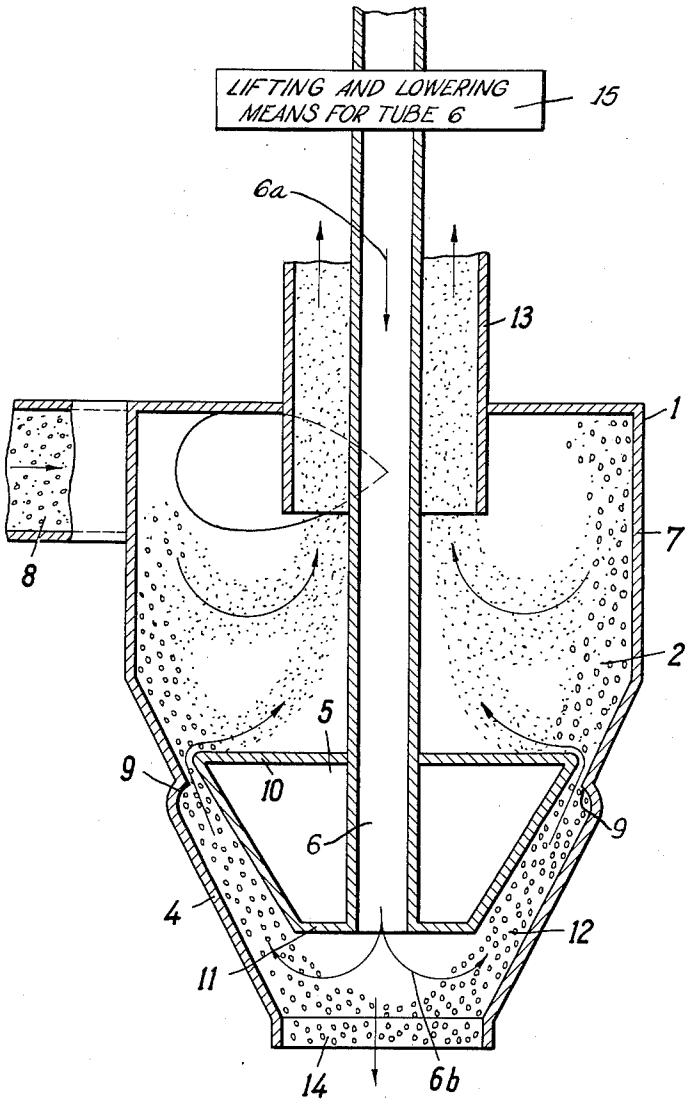


Fig. 2

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3,024,908 DEVICE FOR CLASSIFYING GRANULAR MATERIAL

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This invention relates to a classifier for classifying or separating granular material into different particle sizes or grades of grain, and it more particularly refers to such classifiers in which a reseparation or resegregation of the coarser parts of the charge is carried out by the employment of streams of supplementary air impinging on the material. The purpose of such after-treatment is to obtain as finely as possible a separation of the various grades of the solids. Generally this is effected by a counter current of the supplementary air being blown into the material as it descends in spirals down the walls of the classifier chamber. However, since the solids slide down in close contact with the inner wall of the chamber, they can not be fully entrained since the air is unable to penetrate the material clinging to the wall, but would rather pass through the free parts of the passages which are not filled up with solids. The result is that the coarse parts of the solids, when they finally leave the classifier, contain grains of too small a size, while the fine parts contain grains of too large a size. If one wishes to obtain a fine product of absolutely even constituents, the classifier must be set so narrow that much of the fines will leave the classifier together with the coarser parts of the material.

Another disadvantage of the known classifiers consists in that the streaks which are produced in the material all over the inner walls of the classifier on account of its uneven distribution are apt to cause differentiating resistances and varying loads.

The main object of the invention, therefore, is the removal of these disadvantages particularly by a method which substantially consists in detaching the material from the walls of the classifier by blowing the separating or supplementary streams of air through the solids in a direction from the wall of the classifier chamber toward the inside thereof. In this way the air is forced to penetrate the material right through the whole of the substance.

Another object of the invention is to provide means for carrying out the aforesaid method, through which the supplementary air will be directed into and through the classifier in a manner in which it will pass through the scarf-like or streaky flow of the material, penetrating right through it and carry with it the finer parts of the material only.

A further object is the provision, for the purpose, of an adjustable free annular space or nozzle for instance intermediate a centrifugal and a classifying chamber, in which the material is separated from the walls of the device and so brought into a position in which the counter currents of air can readily pass between the descending scarf of material and the outer wall of the main nozzle and penetrate right through it. A cone, preferably an inverted cone, may be used to assist in forming the said nozzle and to render its free passage adjustable.

With these and other objects in view the invention consists in the provision, apart from the aforedescribed method, of an air operated classifier of which two modifications are diagrammatically illustrated in the accompanying drawings by way of example. In these drawings:

FIG. 1 represents a vertical section through a classifier

in accordance with the invention comprising an upper and a lower chamber with an annular nozzle therebetween,

FIG. 2 is an illustration similar to FIG. 1 of a modified form of the invention.

Referring to FIG. 1, the classifier or separator comprises a centrifugal chamber 1 having a closed top and a cylindrical wall 7 which extends downwardly into an inverted conical chamber 2. The material to be treated is blown under considerable force through a tangentially disposed charging tube 8 near the top of the vessel 1 and, in consequence, is precipitated against the wall 7 in a tangentially directed stream and slides down in the shape of a spirally fashioned liner until it reaches the annular free space or nozzle 3. This nozzle is formed by the lower rim 9 of the inverted conical chamber 2 and flares out again to approximately the same diameter as the cylindrical chamber 1, when again it takes the shape of an inverted truncated cone 4.

Positioned within the inverted conical chamber thus formed is an axially displaceable cone 5 the peripheral walls of which are of substantially the same inclination as those of the conical chamber 4. The said cone 5 is closed at its top and bottom by plates 10 and 11 respectively. It is fastened to the lower end of an air inlet tube 6 by means of which it may be raised and lowered by any known or convenient means indicated by a block 15, whereby the cross section of the passage 12 between the two conical walls 4 and 5, and the annular nozzle 3 can be increased or decreased as may be required by the nature of the material passing therethrough.

A stream of supplementary separating air is admitted through the tube 6 from the top of the classifier in a downward direction as indicated by the arrow 6*a*. At the bottom end of the tube it is reversed as shown by the arrows 6*b*, whereupon it is drawn up through the annular conical passage 12, the nozzle 3 and the chambers 2 and 1, to eventually escape by the discharge tube 13 at the top of the classifier.

As will be seen from FIG. 1, the charge which enters at 8 is composed of all sizes of grains, coarse, medium, fine, and, as aforesaid, slides down in spirals along the inner cylindrical wall 7 of the centrifugal chamber 1 and the inclined wall of the conical chamber 2. At the free annular space of the ring-nozzle 3 the stream of material leaves the wall and drops onto the top 10 of the cone 5. While falling through this space it is caught up by the counter currents of air 6*b* which move upwardly in the direction of the arrows. On its way to the discharge tube 13 the air penetrates the material and thereby entrains the fine particles of the charge and carries them through the discharge tube 13 into a cyclone or other collector not shown. The coarse particles leave the separator by the bottom opening 14 to be collected separately.

In the modified form of the device which is shown in FIG. 2, the nozzle 3 is positioned somewhat lower so as to be located within the passage 12 of the conical bottom chamber 2. Also in this case the charge of fine and coarse material will be dislodged from the wall of the cone 5 at rim 9, so that the supplementary air, passing downward through the tube 6 and returning upwards through the passage 12 as indicated by the arrows 6*b*, will be able to penetrate the material for a longer duration subjecting the streaming-down material to a more intensified separation before the coarser parts eventually leave the classifier at its bottom discharge opening 14, while the fines are being separated and carried up to the discharge tube 13 at the top of the device as in the embodiment first referred to.

The invention is not limited to the devices shown and described but may be altered to suit convenience or re-

quirements within the scope and meaning of the now following claims.

What we claim is:

1. A classifying device for separating discrete particles of different sizes in fines and heavies, comprising a classifying casing of generally circular cross section, tube means for supplying the particles tangentially into said chamber whereby the particles are caused to move in spirals down an inner wall of said casing, said casing defining two mutually superimposed and substantially parallel inverted conical chambers at the lower end of said casing, an inverted cone mounted in the lower of the said conical chambers forming an air passage between the lower conical chamber and said inverted cone, means for raising and lowering said cone in reference to said conical chamber, said casing including a peripherally widened wall portion defining a free annular passage between said two conical chambers and approximately at the level of the top of said cone, means for supplying supplementary separating air upwardly through said annular passage, said supplementary air penetrating downwardly moving discrete particle flow in a direction from the circumference of said annular passage toward the interior of said casing, the top of the casing including a discharge opening for the escape of the supplementary air including the fines entrained therein during the penetration by said air of the particles in said free annular passage.

2. A classifying device for separating discrete particles of different sizes in fines and heavies, said device comprising a classifying casing of circular cross section, tube means for feeding particles tangentially into said casing whereby the particles are caused to move in spirals down the inner wall thereof, said casing defining a cylindrical chamber at the upper end of the casing and two mutually superimposed and substantially parallel inverted conical chambers at the lower end thereof, and also including a peripherally widened wall portion defining an annular nozzle at approximately the level at which the wall portions forming said superimposed conical chambers meet, a vertically movable air tube disposed substantially coaxial with the central longitudinal axes of said cylindrical and conical chambers, an inverted frusto-conical member at the end of said air tube surrounding the same and defining an annular passage between said member and the casing wall portions defining said lower chamber, said air tube feeding downwardly directed separating air into the lower conical chamber to be diverted upwardly therein, a discharge tube at the top of said cylindrical chamber for the escape of the separating air after it has been drawn up through said annular passage and said annular nozzle therein to penetrate the particle flow in a direction from the casing wall toward the interior of said casing and to carry with it the fines entrained thereby to the outside of the classifier through said discharge tube.

3. A classifier as set forth in claim 2, in which said annular nozzle is formed by the lower conical chamber having a greater maximum diameter than the minimum diameter of the upper conical chamber so as to constitute a constriction between the two superimposed conical chambers at the level of junction thereof, and by the top level of said inverted cone being arranged below the level of said constriction.

4. A classifier as set forth in claim 2, in which the inverted cone is formed by a hollow body of truncated cone shape having closed top and bottom surfaces, the top surface of said cone having a larger diameter than the diameter of the upper conical chamber at the level at which the upper conical chamber is joined to the lower conical chamber.

5. A device for classifying discrete particles of different sizes in fines and heavies, comprising a casing of substantially circular cross section, said casing having a closed top wall, an inlet tube for the particles near the top of said casing for tangentially feeding said particles into the casing whereby the particles are caused to move along a spiral path down the inner wall of the casing, said casing defining a cylindrical chamber at its upper end, an inwardly inclining upper conical chamber at the lower end of said cylindrical chamber for the continuation of the flow of the particles downwardly and a lower conical chamber continuing said upper conical chamber, the upper end of said lower chamber having a larger diameter than the lower end of the upper chamber, an inverted truncated cone mounted within said lower conical chamber having its walls substantially parallel thereto to define an annular passage between the cone and the respective casing wall portions, said cone extending at its upper end into said upper conical chamber, said cone having a diameter at its top which is larger than the inner diameter of said upper conical chamber at the level of its junction with the lower conical chamber to define an annular nozzle between the lower part of said upper conical chamber and the upper rim of said cone to permit a free fall of particles onto the top of said cone, an inlet tube for the admission of supplementary separating air extending from the top of the casing through said cylindrical and conical chambers and the cone for directing supplementary air downwardly into the lower conical chamber and then from below the cone through said annular passage and said annular nozzle in an inward direction above the top level of the cone whereby the supplementary air penetrates the flow of free falling particles and entrains fine particles suspended therein, a discharge tube at the top of the casing for withdrawal of the supplementary separating air and the fine particles entrained therein, and discharge means for discharging heavies at the bottom of the casing.

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