Nov. 18, 1958 D. F. HAYS 2,860,776

CLASSIFYING APPARATUS

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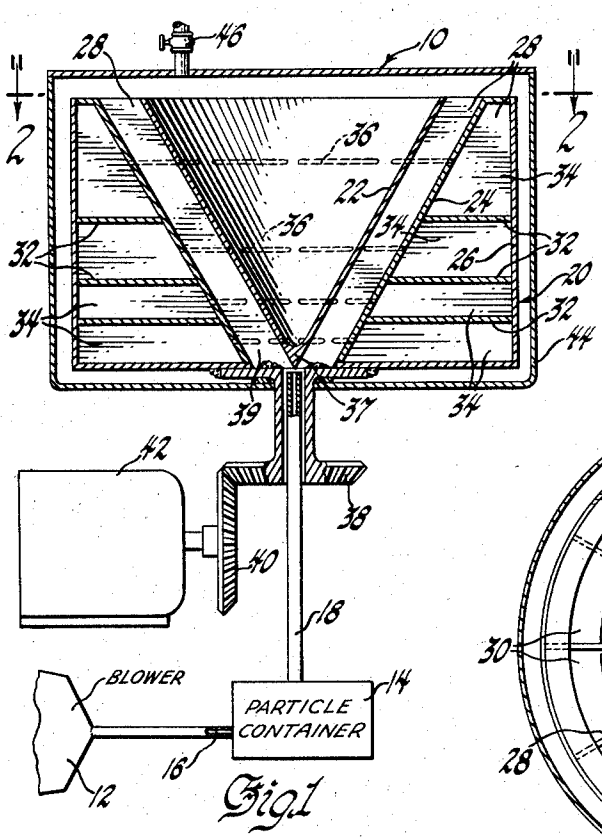


Fig. 1

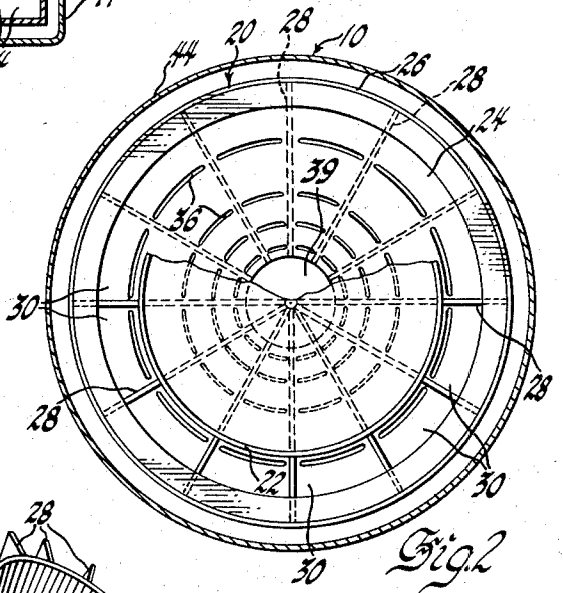


Fig. 2

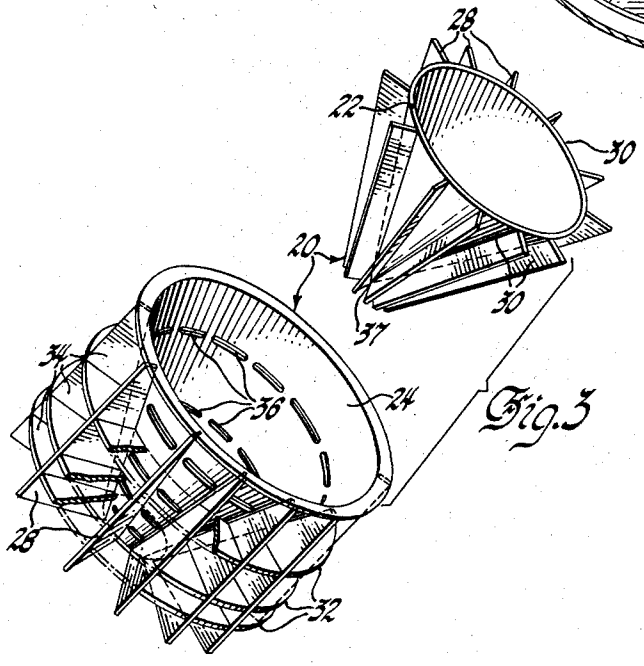


Fig. 3

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This invention relates to devices for classifying solid particles, and more particularly to such a device capable of separating a mixture of particles into a plurality of sizes, size ranges or densities during a single period of operation of the device.

Many industries are based or at least dependent upon certain desired properties of different particle sizes of the same material. In such industries it is necessary to separate a powdered material, for instance, into a number of batches, each batch containing particles of a different size. Other industries may require the separation of particles having similar sizes, but different densities.

Numerous devices have been employed to affect such separation or classification of a mixture of particles. These devices often functioned on either the centrifuge or the gravity separation principles. Unfortunately, however, most of these devices have operated as batch machines in that only one particle size or density could be separated during one period of operation of the machine. This required either that the same machine be loaded and run under particular conditions to separate each desired size or density of particle or that a battery of machines be available, each to separate particles of given weight.

It is now proposed to provide a device for classifying solid particles in which both the centrifuge and the gravity separation principles are employed concurrently. The structure of the proposed device is such that a number of particle sizes, size ranges or densities may be separated during the same period of operation of a single machine. Furthermore, the structure is such that the operation of the device is essentially the same no matter what overall range of particle sizes or densities is to be classified. The proposed device is also more efficient than those now used due to the novel arrangement of parts therein for insuring movement of the particles in the proper directions and through the shortest distances.

The proposed device in its preferred form comprises a pair of inverted hollow cones nested in spaced relation and adapted to be rotated as a unit. The outer cone has an open vertex through which particle-laden air is forced so that the air passes upwardly through the space between the cones. The cones are then rotated so that the particles are thrown towards the outer cone and forced along the conical surface thereof by the component of centrifugal force parallel to such conical surface until such particles may pass through slots in the conical surface. The slots are spaced vertically along the surface of the outer cone, and the above separation takes place at successively higher slots with decreasing particle weight.

In the drawings:

Figure 1 is a side elevational view partly in cross-section of a particle classifying device embodying the invention.

Figure 2 is a cross-sectional view taken along the plane of line 2—2 of Figure 1 and looking in the direction of the arrows, with portions thereof broken away.

Figure 3 is an exploded perspective view showing portions of the structure shown by Figures 1 and 2 and further illustrating the details of internal construction.

Referring to the drawings in more detail, a device 10 for classifying particles and embodying the invention comprises means for supplying fluid under pressure such as a blower 12 connected to a particle container 14 by means of a conduit 16. A stationary conduit and support 18 may extend from the container 14 to the particle classifying means 20.

The particle classifying means 20 comprises an inner cone 22, an outer cone 24, and a housing 26. Vertical vanes 28 extend from inner cone 22 to housing 26, forming passages 30 between the inner cone 22 and the outer cone 24. Vertically spaced horizontal rings 32 extend from outer cone 24 to housing 26, intersecting vertical vanes 28 and forming chamber 34 therewith. Horizontal slots 36 are provided in cone 24 to provide access to each of the chambers 34. The above elements of the classifying means 20 may be formed separately and secured together or formed integrally so that access may be had to chamber 34 and so that they may be rotated as a unit by any means such as gears 38 and 40 driven by motor 42.

A stationary enclosure 44 having vent 46 may be provided for classifying means 20, and this is desirable for the sake of cleanliness and safety.

In operation, a fluid such as air is passed by means of blower 12 through the particle container 14, so that the particles may be agitated thereby and suspended in the air. The particle-laden air then passes through conduit 18 to the vertex 37 of inner cone 22. While classifying means 20 is rotated, the particle-laden air is then passed between cones 22 and 24 through the opening 39 of cone 24 and upwardly through passages 30 between vanes 28. On entering the rotating passages 30, the particles are acted upon by centrifugal force as well as the upward force of the air, which causes the particles to be thrown outwardly against outer cone 24, the heavier particles being thrown outwardly nearer the opening 39 thereof and the lighter particles farther away therefrom. It will be noted that the vanes 28 prevent the particles from moving circumferentially with respect to outer cone 24 through a distance greater than the distance between vanes 28.

The component of centrifugal force parallel to the surface of cone 24 will cause the particles thrown against cone 24 to travel upwardly along the surface of cone 24 until they reach one of the slots 36 at which time they will pass through that slot due to the component of centrifugal force normal to the cone 24. Thus, all particles forced outwardly to cone 24 below any given slot in one of the passages 30 will enter the given slot and collect in the chamber 34 to which the slot provides access. Thus, the particles will be separated according to weight in the chambers 34, with the heavier particles separating out in the lower chambers. The particles may subsequently be removed from chambers 34 in any suitable manner.

The vent 46 may be opened to any desired degree in order to control the flow of the air through the device 10.

From the foregoing specification and drawings, it can be seen that there has been provided a novel device for classifying small solid particles by which a number of sizes or densities of particles may be separated during a single operation of the device.

What is claimed is:

1. A device for classifying small solid particles, comprising in combination fluid means for agitating and suspending said particles and rotating means for classifying said particles, said classifying means comprising a hollow inverted inner cone, a hollow outer coaxial cone surrounding said inner cone and disposed in spaced relation thereto, a coaxial cylindrical housing surrounding said

outer cone and disposed in spaced relation thereto, said cones and said housing being secured together and adapted to be rotated as a unit, radial vanes extending from the outer surface of said inner cone to the inner surface of said outer cone and thence in the same direction from the outer surface of said outer cone to said housing, said vanes dividing vertically and radially the spaces between said cones and between said outer cone and said housing, vertically spaced horizontal rings extending from said outer cone to said housing, said rings dividing the space between said outer cone and said housing into adjacent horizontal annular chambers, said chambers being divided radially by said vanes, and horizontal slots in said outer cone between said rings providing access of said particles to each of said chambers.

2. A device for classifying small solid particles, comprising in combination fluid means for agitating and suspending said particles and rotating means for classifying said particles, said classifying means comprising a hollow inner cone, a hollow outer coaxial cone surrounding said inner cone and disposed in spaced relation thereto, a coaxial cylindrical housing surrounding said outer cone and disposed in spaced relation thereto, said cones and said housing being secured together and adapted to be rotated as a unit, radial vanes extending from said inner cone to said outer cone and thence in the same direction from said outer cone to said housing, said vanes dividing vertically and radially the spaces between said cones and between said outer cone and said housing, vertically spaced horizontal rings extending from said outer cone to said housing, said rings dividing the space between said outer cone and said housing into adjacent horizontal annular chambers, said chambers being divided radially by said vanes, and openings in said outer cone between said rings and providing access for said particles to each of said chambers.

3. A device for classifying small solid particles, comprising in combination fluid means for agitating and suspending said particles and rotating means for classifying said particles, said classifyng means comprising a hollow inverted inner cone, a hollow outer coaxial cone surrounding said inner cone and disposed in spaced relation thereto, a coaxial cylindrical housing surrounding said outer cone and disposed in spaced relation thereto, said cones and said housing being secured together and adapted to be rotated as a unit, vertically spaced horizontal rings extending from said outer cone to said housing, said rings dividing the space between said outer cone and said housing into adjacent horizontal annular chambers, and horizontal slots in said outer cone between said rings providing access for said particles to each of said chambers.

4. A device for clasifying small solid particles, comprising in combination fluid means for agitating and suspending said particles and rotating means for classifying said particles, said classifying means comprising a hollow inverted inner cone, a hollow outer coaxial cone surrounding said inner cone and disposed in spaced relation thereto, a coaxial cylindrical housing surrounding said outer cone and disposed in spaced relation thereto, said cones and said housing being secured together and adapted to be rotated as a unit, said outer cone having horizontal slots therein providing access for said particles to said housing, and said housing having means associated with said slots for collecting separately the particles passing through each horizontal row of said slots.

5. A device for classifying small solid particles, comprising in combination fluid means for agitating and suspending said particles and rotating means for classifying said particles, said classifying means comprising a hollow inverted inner cone, a hollow outer coaxial cone surrounding said inner cone and disposed in spaced relation thereto, means surrounding said outer cone for storing classified particles, said cones and said storing means being secured together and adapted to be rotated as a unit, said outer cone having openings therein providing access for said classified particles to said storing means.

6. In a device for classifying small solid particles, the combination of a single pair of telescoped inner and outer conical walls rotatable about the common axis thereof as a unit and defining a conical chamber therebetween, said chamber being disposed obliquely to said axis of rotation of said walls and intersecting said axis at the lower end thereof, said chamber being open at both ends thereof to receive a stream of particle-laden fluid through the bottom end thereof at said axis and to discharge said fluid at the top end thereof, said outer conical wall having a plurality of vertically spaced horizontal slots therein to receive said particles when said chamber is rotated while said particle-laden fluid is passing upwardly therethrough.

7. In a device for classifying small solid particles, the combination of only a single pair of cooperating inner and outer walls rotatable as a unit and defining an annular chamber of increasing diameter, said chamber being disposed obliquely to the vertical axis of rotation of said walls and meeting said axis at the lower end thereof, said passage being open at both ends thereof to receive a stream of particle-laden fluid through the end thereof having the smaller diameter and to discharge said fluid at the end thereof having the larger diameter, said outer wall of said passage having a plurality of vertically spaced openings therein to receive said particles when said passage is rotated while said particle-laden fluid is passing upwardly therethrough.

8. In a device for classifying solid particles, the combination of only a single pair of spaced conical inner and outer walls rotatable as a unit and defining an annular passage therebetween, said passage being disposed obliquely to the vertical axis of rotation thereof and including said axis at one end thereof, said passage being open at both ends thereof to receive a stream of particle-laden fluid through the bottom thereof and to discharge said fluid at the top thereof, said passage being divided by radial walls disposed in the plane of said axis, said outer wall defining said passage having a plurality of vertically spaced horizontal slots therein receiving said particles when said passage is rotated while said particle-laden fluid is passing upwardly therethrough.

9. In a device for classifying solid particles, the combination of a single pair of cooperating conical inner and outer walls rotatable as a unit and defining a conical passage therebetween, said passage being disposed obliquely to the vertical axis of rotation thereof and meeting said axis at one end thereof, said passage being open at both ends thereof to receive a stream of particle-laden fluid through the bottom thereof and to discharge said fluid at the top thereof, said passage being divided by radial walls in the plane of said axis, said outer wall defining said passage having a plurality of vertically spaced horizontal slots therein to receive said particles when said passage is rotated while said particle-laden fluid is passing upwardly therethrough.

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