

Oct. 12, 1943.

W. N. SMITH

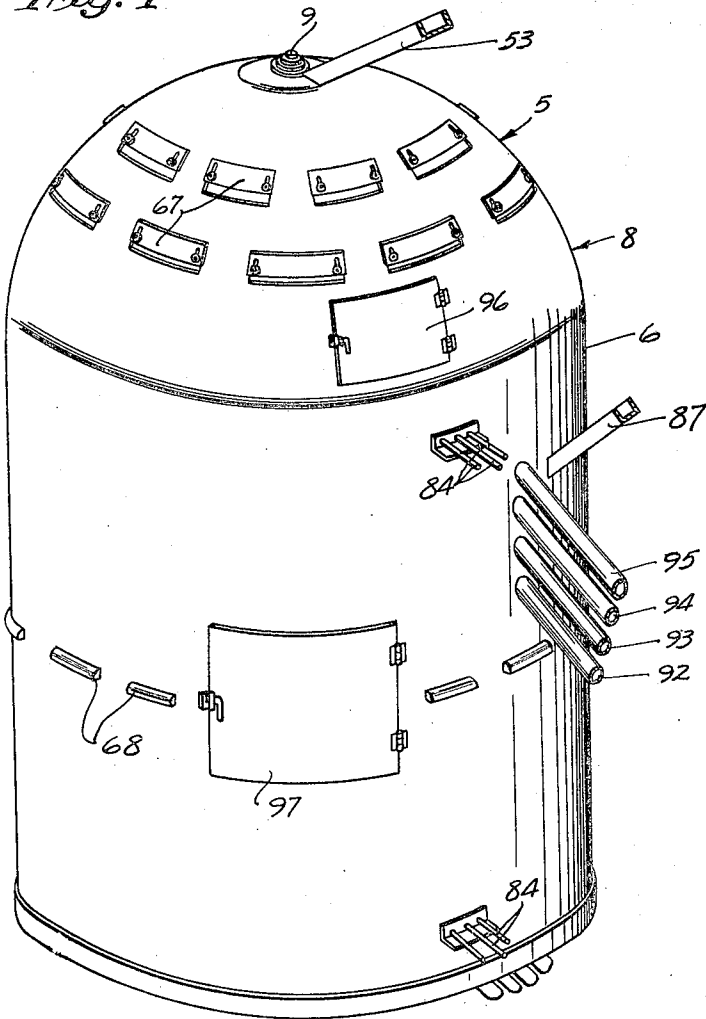
2,331,850

GRANULAR MATERIAL CLASSIFIER OR PURIFIER

Filed Nov. 27, 1940

5 Sheets-Sheet 1

Fig. 1



Inventor
William N. Smith
By his Attorneys
Muehans Muehant

Oct. 12, 1943.

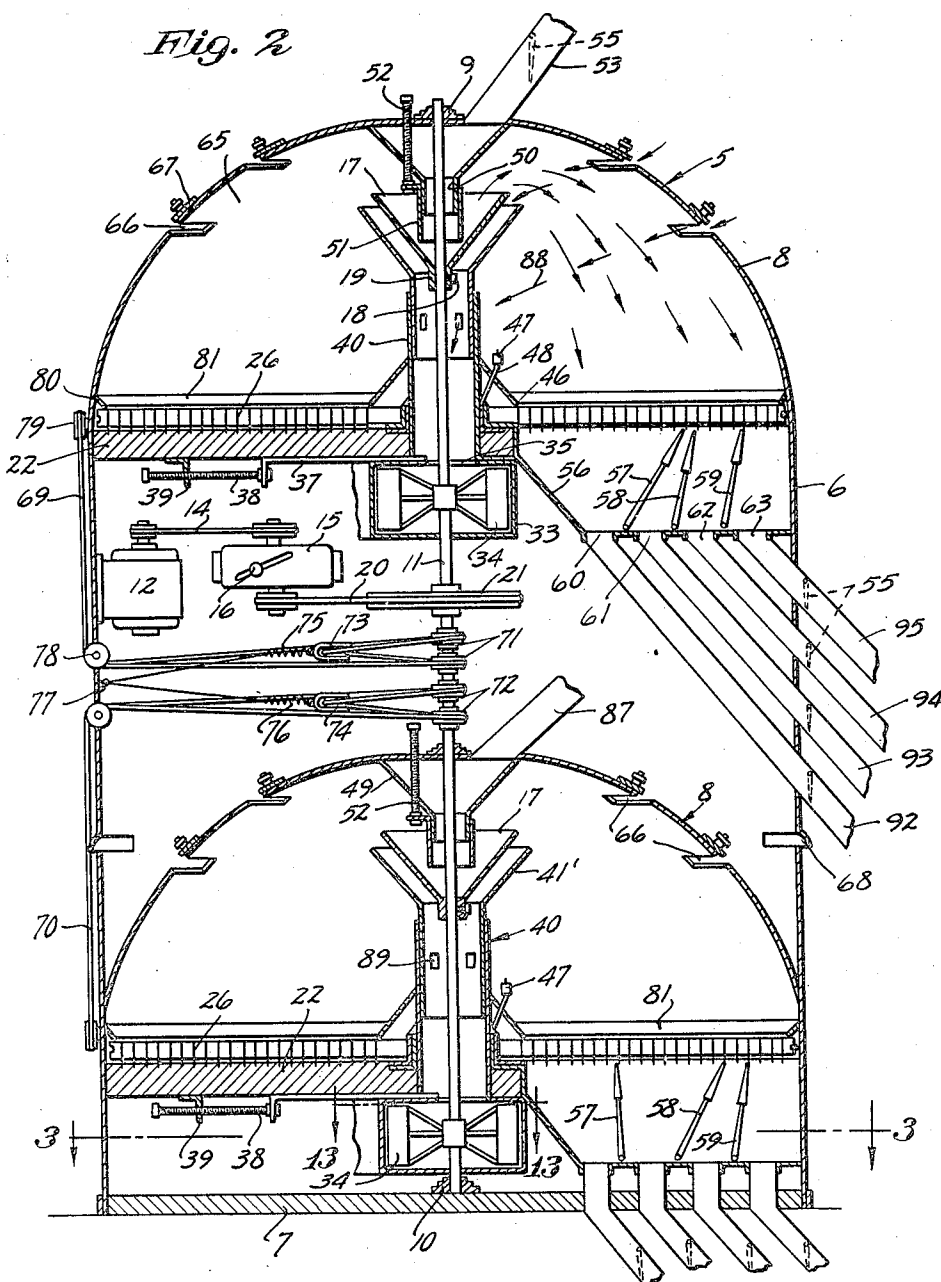
W. N. SMITH

2,331,850

GRANULAR MATERIAL CLASSIFIER OR PURIFIER

Filed Nov. 27, 1940

5 Sheets-Sheet 2



Inventor
William N. Smith
By his Attorneys
Muchant & Merchant

Oct. 12, 1943.

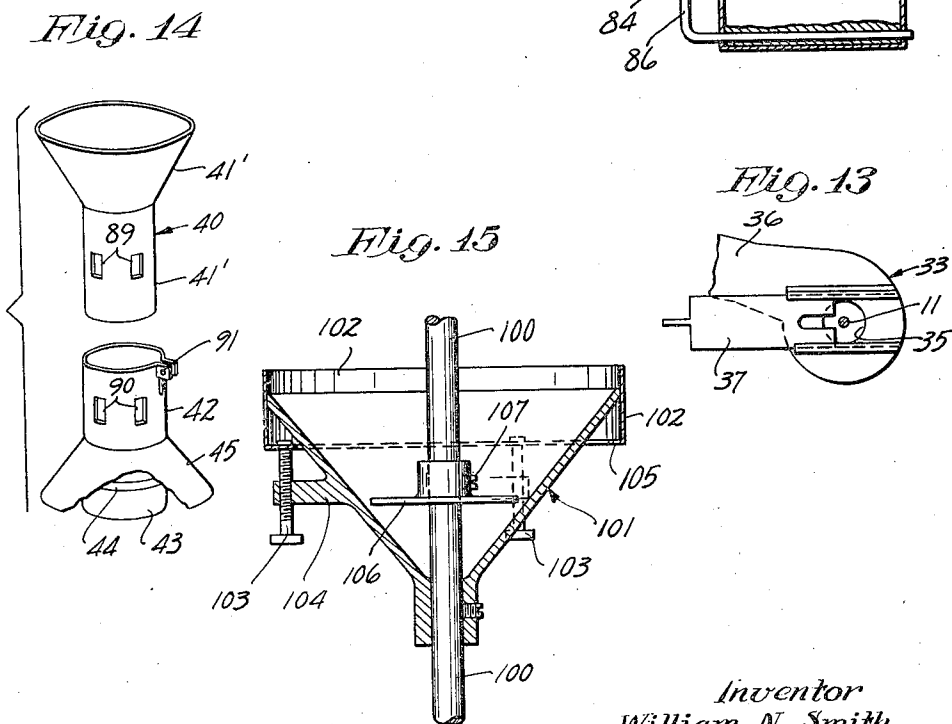
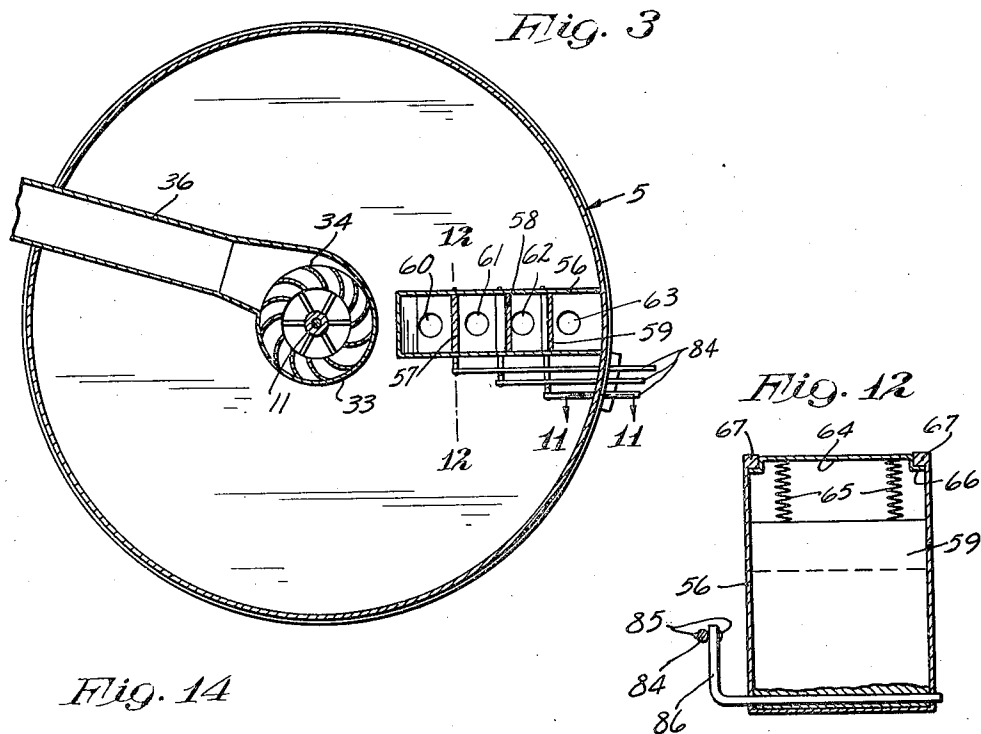
W. N. SMITH

2,331,850

GRANULAR MATERIAL CLASSIFIER OR PURIFIER

Filed Nov. 27, 1940

5 Sheets-Sheet 3



Inventor
William N. Smith
By his Attorneys
Muchant & Muchant

Oct. 12, 1943.

W. N. SMITH

2,331,850

GRANULAR MATERIAL CLASSIFIER OR PURIFIER

Filed Nov. 27, 1940

5 Sheets-Sheet 4

Fig. 4

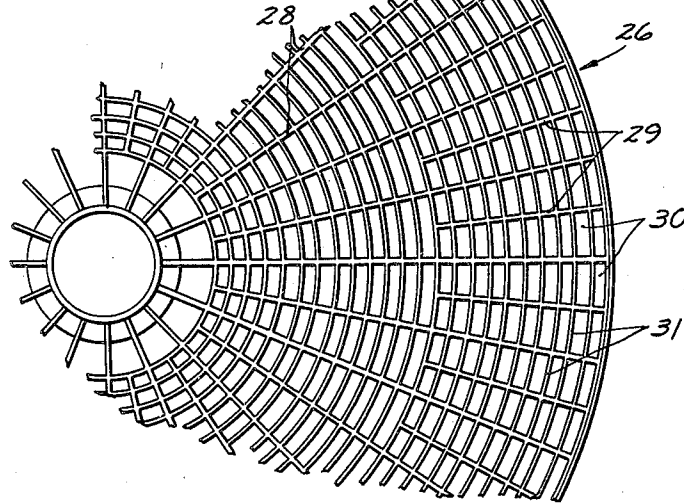


Fig. 7

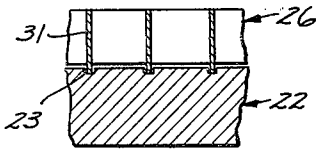


Fig. 5

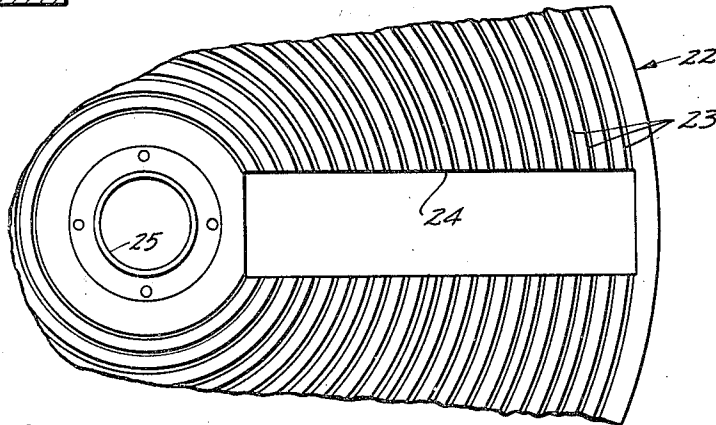
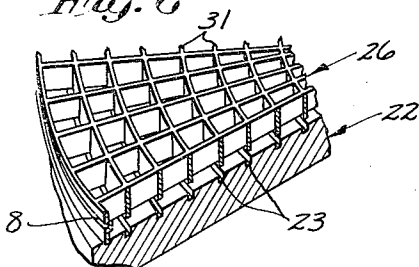


Fig. 6



Inventor
William N. Smith
By his Attorneys
Murdoch & Murdoch

Oct. 12, 1943.

W. N. SMITH

2,331,850

GRANULAR MATERIAL CLASSIFIER OR PURIFIER

Filed Nov. 27, 1940

5 Sheets-Sheet 5

Fig. 8

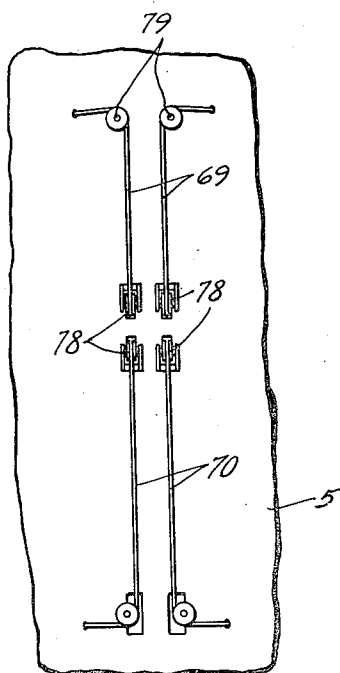


Fig. 10

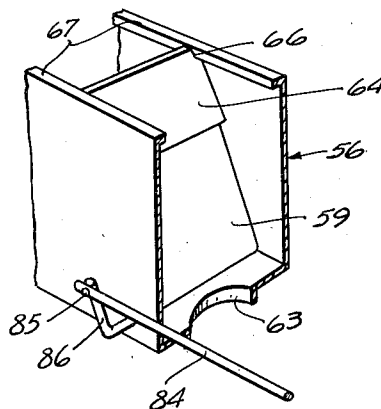


Fig. 11

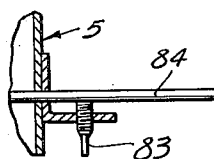
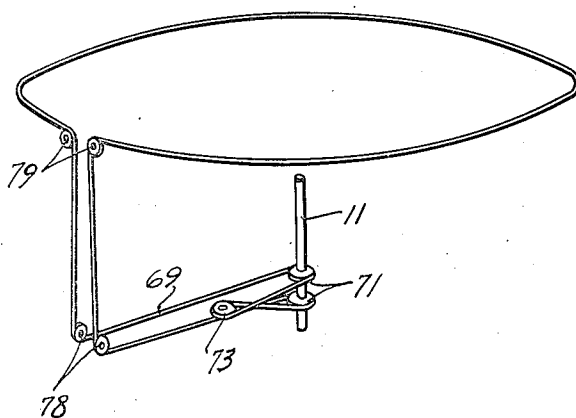


Fig. 9



Inventor
William N. Smith
By his Attorneys
Thurman & Merchant

UNITED STATES PATENT OFFICE

2,331,850

GRANULAR MATERIAL CLASSIFIER
OR PURIFIER

William N. Smith, Great Falls, Mont.

Application November 27, 1940, Serial No. 367,477

37 Claims. (Cl. 209—145)

This invention relates to improvements in apparatus employing centrifugal force and the force of gravity for separating and classifying any aggregate granular solid stock into groups according to the specific gravity of the constituent particles and more specifically to apparatus of this character providing means for enabling the operator to discharge one or more groups independently while the apparatus is in operation, and an important object of my invention is to provide a device of this character which, while applicable to the segregation of any mixture of granular solids into its component groups of characteristic specific gravity, is especially adapted to use in a mill devoted to processing wheat into flour, for separating and recovering predetermined grain constituents.

The present device may be used in the milling process to replace the machine known as the "Middlings purifier." Although the device works on entirely different principles from a purifier, it far surpasses the same in efficiency, capacity, and economy of operation. When used in place of a purifier for preparing middlings stock for grinding, the device removes the small bran particles, or "bee wings" from the middlings so thoroughly and consistently that these impurities may be sent directly from the device to the bran bin. The middlings from the device, being free from bran impurities and classified for grinding by their specific gravity, may be more thoroughly ground by the reduction rolls, thereby promoting greater mill capacity and a higher degree of purity in the flour produced.

The device operates on a fraction of the power required by a purifier and has the added advantages of minimum wear of moving parts. The device has no silk, eccentric bearings, sieve hangers, or conveyors requiring maintenance. The middlings stocks passing through the device are treated with a small fraction of the air ordinarily used in a purifier so that the moisture loss in the stocks is smaller, a factor which is favorable to the quality and quantity of flour produced.

The device may also be used in the first stages of the mill process as a grader, by passing to the device the aggregate mixture of middlings from a given break with the exception of the first scalp. This aggregate mixture is segregated by the device according to the specific gravity of the middlings present and sent directly to the reduction rolls. The bran particles and flour recovered from the inner rings of the device are then sent to the standard re-bolt sections in the mill. These sections send the overs of their scalping

cloths direct to the bran bin. The use of the device in this manner conserves the large bolting area ordinarily allotted to this work in the break bolting machines and provides for direct discard of the re-bolt scalps to feed, an advantage which is not otherwise possible.

The device may also be used in the mill process for the distinct recovery of the wheat germ. When the mill stocks containing the wheat germ are prepared by corrugated rolls for germ recovery, the device will remove the germ from these stocks in its whole unbroken state. The device will also recover flattened germ from last stage mill stocks which in standard practice are discarded into feed.

As will presently more fully appear, the approximately semi-spherical or dome-like form of the casing is a highly important feature of the invention, as is also the production, within the casing, of a shower of material to be classified and the outside of which shower closely conforms to the shape of and is closely adjacent the inside of the dome-shaped casing. In the preferred embodiment of the invention herein illustrated, the stock to be classified is fed into a spinning cup-like element which projects the material in an annular shower that quite closely follows the inside of the dome-like casing, and particles of different specific gravity follow different trajectories and are classified at the bottom of the casing according to their spacing from the axis of the spinning cup-like element. I have found that greatly improved results are obtained by making the casing closely conform to the shape and size of the outside of the shower of material, and that a semi-spherical dome-like shape of selected radius and diameter most nearly meets the requirement; but as a further important feature of the invention I provide means for somewhat modifying the shape and size of the shower produced by different kinds and grades of material so as to enable the operator to adjust the shape and size of the shower to most nearly conform to the shape and size of the interior of the casing. In accordance with the present illustration of the invention, this modifying of the shape and size of the shower of material is accomplished by varying the speed of the rotary cup-like element or by varying the effective height of the cup or a combination of both.

Another important object of the invention is the provision of improved and novel means for maintaining the classification of the material according to the trajectories described thereby

and the removing of such material according to its classification.

The above and other important objects and advantages of the invention, and the means for accomplishing the same, will be made apparent from the following description, claims, and appended drawings.

In the drawings:

Figure 1 is a general perspective view of a two-unit device in accordance with the present invention.

Figure 2 is a general transverse vertical sectional view taken through Figure 1 and showing the interior mechanism of the device.

Figure 3 is a horizontal sectional view taken through Figure 2 approximately on the line 3—3 and looking downwardly in the direction of the arrows.

Figure 4 is a fragmentary top plan view of the revolving collector.

Figure 5 is a similarly fragmentary top plan view of the stationary grooved table showing the stock discharge opening therein.

Figure 6 is an enlarged fragmentary perspective view showing the revolving collector associated with the stationary grooved table, with the collector slightly elevated out of engagement with the table.

Figure 7 is a similarly enlarged fragmentary vertical sectional view showing operative association of the collector and table.

Figure 8 is an enlarged fragmentary side elevational view showing portions of the dual drive located on the exterior of the casing of the device.

Figure 9 is a schematic diagram of the portion of the drive mechanism for the upper revolving collector.

Figure 10 is an enlarged fragmentary perspective view of the collector chamber showing one of the three selector valves therein and a portion of its operating mechanism.

Figure 11 is an enlarged fragmentary horizontal sectional view taken through Figure 3 approximately on the line 11—11 and looking downwardly in the direction of the arrows and showing the means for locking a selector valve in a selected position.

Figure 12 is an enlarged transverse vertical sectional view taken through Figure 3 approximately on the line 12—12.

Figure 13 is a top plan view of the balancer fan showing its valve in open position.

Figure 14 is a group perspective view of the adjustable air sleeve assembly showing the parts in unassembled relation.

Figure 15 is a view chiefly in vertical section illustrating a modified form of centrifugal delivery cup.

Referring in detail to the drawings, the numeral 5 generally designates the device which in this instance comprises a vertical cylindrical casing 6 which supports and encloses two identical working units, the lower end of the casing being closed by a base 7 and the top by a hollow hemispherical top 8; the top and the base having, respectively, upper and lower bearings 9 and 10 for the ends of the cone shaft 11 which is positioned concentrically in the casing and is the operating shaft for both the upper and lower working units. These units are driven by a single electric motor 12 mounted vertically on the side-wall of the casing between the units and having its shaft pulley connected by a belt 14 to the vertical shaft of the speed control 15 having a

manual control lever 16 which enables the operator to regulate the speed of the feed cone 17 which is locked on the cone shaft 11 at the desired height thereon by a set-screw 18 in the feed cone hub 19, the speed control 15 having the shaft connected by a belt 20 to the cone shaft pulley 21. A double or two-unit device is here illustrated to point out the savings of floor space, driving mechanism, and power requirement possible with the present device, the stated objects and advantages of the invention being attainable in a greater or less degree with a single unit arrangement.

The above briefly indicated variable speed device may take various forms and may be any one of the many commercially well-known variable speed mechanism such as found on the market. For example, it might be of the form of variable speed pulley mechanism such as disclosed in the now public property Patent No. 179,746 issued to W. A. Wales of date July 11, 1876. However, in this machine, wherein a fountain-like shower of the commingled materials is centrifugally projected within an approximately semi-spherical dome, a variable speed mechanism of some kind is highly important because for maximum efficiency the outer layer of the shower should be made to follow very closely the concave interior of the dome. By this operation there will be left very little, if any, clear air space between the precipitated stock and the interior of the dome.

Supported by the casing sidewalls is the circular stationary grooved table 22, each working unit having one of these acting as the bottom of the unit. The construction of the grooved table is shown in Figures 5, 6 and 7. The concentric grooves 23, for example, $\frac{1}{8}$ inch wide by $\frac{1}{8}$ inch deep run the full circumference of the table at 1 inch intervals except for the rectangular radially extending discharge opening 24, through which the stock is discharged. A stationary sleeve and flange bearing 25 constitutes the hub of the grooved table and supports the revolving collector 26, (see Figures 4, 6 and 7), by its hub bearing 27. The revolving collector 26 comprises master radial spokes 28, which are rigidly fastened to the hub bearing 27 and shorter sub-spokes 29 which are disposed between the master spokes and provide uniformity of the size of the pockets 30, between all spokes and all of the circular rings 31 which are connected to the various spokes. The circular rings extend $\frac{1}{8}$ of an inch below the lower edges of all of the spokes and extend about $\frac{1}{8}$ of an inch into the grooves 23 of the stationary table as shown in Figure 7.

Mounted on the underside of the table is the balancer fan case 33, which contains the turbine type fan runner 34, fastened on the cone shaft 11. The intake port 35 of the fan case, is at the top and the discharge port 36, is on one side. The aperture of the intake port 35 is controlled by the slide valve 37 by the screw 38 working in the bracket 39 secured to the bottom of the table.

An adjustable air sleeve 40, consisting of an upper member 41, which telescopes into a lower member 42 is held stationary in an upright position by the lower member 43, fitting into the table bearing 25, to the depth of the flange 44 on the air sleeve. The flange 44 on the lower air sleeve member rests on the top of the bearing 27, with a small clearance between the bottom of the lower skirt 45 and the revolving collector 26 as indicated by the numeral 46 in Figure 2. The lower skirt 45 is arranged to deflect light mate-

rial falling on it radially outwardly to the spaces between the innermost and the next collector ring 31, there being twenty-three such rings shown. A drip oil cup 47 is provided to pass oil down through the tube 48 to the bearings 25 and 27.

The conical stock hopper 49 mounted at the apex of the top 8 of the casing 5 terminates in a short nipple 50 over which a vertically adjustable sleeve 51 of slightly larger diameter slides. The altitude of the sleeve 51 is adjusted by the screw 52 which passes through the hopper 49 and is threaded through the top 8 adjacent the top cone shaft bearing 3. A hopper intake spout leads into the hopper. The portion of the opening 54 that is not used by the delivery spout must be covered to provide an air seal. All spouting leading into and out of the casing 5 must be equipped with air check valves 55 as shown in Figure 2, in this case swinging gate valves 55 which are opened only by passage of stock through the spouting so equipped. Flowing stock opens the valve 55 and passes under it without allowing a large amount of air to pass through with the stock.

Figure 10 shows the details of the collector chamber 56 and selector valves 57, 58 and 59. The collector receptacle or chamber is mounted directly under the rectangular opening 24 in the stationary table and comprises a rectangular metal box having four openings 60, 61, 62 and 63 in its bottom, separated by the three selector valves 57, 58 and 59. Figure 12 shows the construction of the selector valves. The upper telescoping member 64 is supported by springs 65 which keep the upper member in a fully elevated position when the valve is set forward or behind the vertical position. The shoulders 66 of the upper member 64 slide under the rails 67 along the open top of the box, the rails keeping the upper member 64 at a uniform altitude when the selector valve is set either in a vertical or sloping position.

An important part of each working unit of the device is a dome-shaped top 8 and in the case of the upper unit this top also serves as the top of the casing 5. The purpose of this shape of top is to restrict to the minimum the inactive air space in the air chamber 65 between the fountain of falling stock and the dome top. Air is admitted to the air chamber 65 through the ports 66 in the dome top 8 having adjustable covers 67. Air is admitted into the top 8 of the lower unit in the same manner after the air has first passed through the circumferentially spaced ports 68 in the sidewalls of the main casing of the device.

The revolving collector 26 of the two working units are driven from the cone shaft 11 by the upper and lower pairs of belts 69 and 70 which pass over pairs of pulleys 71 and 72 on the shaft 11 and through tighter pulleys 73 and 74 having springs 75, 76 anchored to the casing 5 and 77.

The belts 69 pass out of the casing 5 around pulleys 78 and around upper pulleys 79 and into the groove 80 in the rim of the revolving collector. This belt groove 80 is protected from falling stock by a narrow metal flange 81 which projects inwardly over the outside ring 31 of the revolving collector from the dome top 8. The lower belts 70 similarly operate the collector of the lower working unit.

Figure 1 illustrates stock being delivered to the top working unit by the spout 53. The stock forces its way under the air check valve 55 and

flows into the stock hopper 49. The stock is directed down around the cone shaft 11 by the adjustable sleeve 51 to a depth in the feed cone 17 determined by the setting of the screw control 52. A desirable degree of slip is provided for between the stock and the surface of the feed cone 17 as the rotary motion of the feed cone 17 is transmitted to the stock. This slip causes an even spread of the stock over the inner surface of the feed cone. Centrifugal force exerts a horizontal radially outward pull on the stock in the feed cone 17 which operates desirably in causing the stock to press outwardly on the sides of the feed cone and thereby adopt the rotary motion of the feed cone. Centrifugal force is further involved in causing the stock to take a spiral route up along the sides of the feed cone to the upper end thereof from which the stock finally discharges in a fountain like formation indicated by the arrows 82 in Figure 2. The particles in the aggregate stock having the greatest specific gravity are thrown in greatest distance away from the feed cone 17. All lighter particles are similarly projected proportionately smaller distances away from the feed cone. All particles eventually fall in related spaces defined between adjacent circular rings 31 of the revolving collector 26 and onto the surface of the grooved table 22. While the circular rings 31 maintain the radial position of the groups of particles of different specific gravities, all of the spokes 28 and 29 push all of the stock on the surface of the grooved table around to the discharge opening 24. The circular rings 31 which extend below the lower edges of all of the spokes, run submerged in stock in the grooves 23 in the table 22 thereby forming a stock seal between the circular rings and the grooves which prevents the stock in a heavily loaded space from running under the adjacent rings to a neighboring space on either side that may be lightly loaded.

As the segregated stock falls through the table discharge opening 24 into the collector chamber 56, the stock of any selected space or combination of spaces is guided to the discharge ports 60, 61, 62 and 63 in the bottom of the collector chamber by setting of the selector valves 57, 58 and 59. When the desired positions of the selector valves are achieved, they are anchored in position by the set screws 83 mounted as shown in Figure 11 and engaging the connecting rod 84 corresponding to the particular valve which is connected at 85 to a crank 86 connected with the valve.

The selector valves in the upper unit are shown set for the delivery of the stock from the four outermost spaces into discharge opening 63, from four inner spaces to discharge opening 62, from a single inner space into the discharge opening 61, and from the fourteen innermost spaces to the discharge opening 60. For comparison the valves in the lower unit are set differently from those of the upper unit and the lower unit is shown without stock which it would receive through the spout 87.

The small arrows 88 indicate the path of the air through the stock entering the air chamber 65 of the upper unit from the outside. These air currents, produced by the balancer fan 34, operate as follows:

The air entering the chamber 65 through the ports 66 in the dome top 8, pass through the falling fountain of stock, and the major portion of this air passes downwardly through the funnel 41

of the air sleeve 40 and passes through the space between the funnel 41' of the air sleeve 40 and the feed cone 17. A very small adjusted amount of air is drawn into the air sleeve 40 through the ports 89 and 90 when registered. The ports are regulated as to size by elevating and twisting the upper member 41 in the lower member 42. When the desired adjustment is found the two sleeve members are locked in position by the draw screw arrangement 91, which spans a split portion of the lower member 42. The air drawn down through the air sleeve and around the cone shaft 11 is sucked through the intake port 35 and into the balancer fan casing 33. The size of the intake port 35 is regulated by the valve 37 operated by the screw 38 as already indicated.

The air passing through the stock in the air chamber 65 in the manner described, is of relatively small volume and of low velocity so as to eliminate formation of dead-air space, and counteracts the outward flow of air in the air chamber 65 otherwise caused by the rotation of the feed cone 17 and the falling fountain of the stock, so that the falling of the stock particles in fountain formations are governed in their trajectories solely by their own specific gravity and the speed of rotation of the cone 17, and the fan 34 will draw practically no material from the air chamber 65. The fan 34 exhausts through its port 35 into the room in which the device operates or out of the building if desired.

The action of the balancer fan 34 in the present device is not to be confused with the action of the fans in aspirators and sieve purifiers of various designs, which invariably draw large volume, high velocity air currents up through the stocks they treat for the purpose of drawing the light material up and out of the heavy material. In the present case, it is to be noted that the air is instead drawn down through the stock to the fan. This is exactly the reverse of standard practice for air currents in machines of other design.

Achievement of the proper trajectory of the fountain of stock in the air chamber 65 is important. Proper trajectory of the projected stock is that under which the heaviest particles of stock in the aggregate mixture travel to within one circular space of the full radius of the table and complete their outward flight and fall free straight downwardly under the uninfluenced force of gravity for a safety margin of about three inches, in the present embodiment, before striking on the grooved table.

Achievement of proper trajectory of the stock requires the proper altitude of the feed cone 17 on the cone shaft 11, the proper speed of rotation of the feed cone 17, and the proper degree of pitch of the walls of the feed cone. These factors vary for different kinds of stocks being segregated. For middlings stock in a flour mill, the feed cone should have a 43 degree pitch with the diameter of the top of the feed cone twenty percent of the diameter of the revolving collector. The elevation of the upper edge of the feed cone above the surface of the revolving collector must be substantially forty percent of the diameter of the revolving collector. The rim velocity of the feed cone of the illustrated embodiment in inches per minute, should be one hundred times the diameter of the revolving collector in inches. The speed of the revolving collector must be regulated to approximately one hundred and five feet, rim velocity, per minute.

Referring to Figure 1 of the drawings, the

numerals 92, 93, 94 and 95 designate the delivery spouts leading from the discharge openings 60, 61, 62, and 63 of the upper working unit. The corresponding delivery spouts of the lower working unit pass out directly under the casing 5. The window 96 is provided in the dome top 8 and the window 97 in the sidewall of the casing 5 to provide access to motor and speed control device. The selector valve control rods 84 and their locking screw arrangements 83 are shown on the outside of the casing 5. The upper and lower balancer fan discharge pipes 37 are shown projecting through the casing 5.

Not only is the means for variable speed of the centrifugal cup or projector desirable for purposes already noted, but to adjust the machine for various kinds of stock or materials to be separated. In practice I have found that the speed must be properly adjusted in accordance to the fineness, coarseness, or specific gravities of the commingled materials in order, so to speak, to fit the fountain-like or umbrella-like shower to the interior of the dome and thereby acquire the highest possible efficiency in the separating actions.

In a 1,500 barrel flour mill, the present device, in a five foot diameter one unit model replaces two "Nordyke purifiers" of the 40" x 76" size. The device can take over the entire load of No. 1 middlings from these two standard purifiers and in addition to doing a superior job of grading these middlings for grinding, the device makes a direct discard to feed of an extremely high percentage of all the free bran particles, or "bee wing," contained in the original middlings. My device does this superior work with an expenditure of 1/4 horse-power as compared with a total of 6 horse-power required by the two purifiers mentioned. Air is used by the device at the rate of 100 cu. ft. per minute compared with 2,160 cu. ft. per minute used by the said two purifiers. Unlike the standard purifiers, my device has no silk, eccentric bearings, sieve hangers, brushes or conveyors to wear out, replace, and maintain.

While the preferred embodiment of the invention is shown and described herein, it is to be understood that I do not wish to limit the application of the invention to the precise structural details thereof, except as may be required by the scope of the subjoined claims.

In Fig. 15 I have illustrated a modified or improved form of centrifugal stock delivery cup and in this view the power-driven vertically disposed shaft 100 may be assumed to be a substitute for the shaft 11 of the above described machine. In this structure the cup 101 is shaped much like the cup 17 but is provided at its perimeter with a vertically adjustable annular rim 102. This rim 102 is made adjustable and adapted to be secured in various adjustments by suitable means, such as screws 103 that work with threaded engagement through lugs 104 on the exterior of the cup. Preferably the upper ends of these screws 103 are swivelled to an internal flange 105 on the lower edge of the annular rim 102. Obviously, the above described variation of "the speed of discharge of material under the action of centrifugal force" due to vertical adjustments of the annular rim 102 will vary the shape and diameter of the outer surface of the projected shower of material and can be very advantageously employed for the purpose of making the shape of the shower of material properly conform to the shape of the semi-spherical dome under varying conditions of cup speed and material characteristics. Experience has

shown that the best results are obtained when the umbrella-like shower is so projected there will be little or no dead air space between the outer surface thereof and the inner surface of the dome. Adjustments of this annular rim or collar 102 serves to vary the speed of discharge of the material under the action of centrifugal force and serves to adapt the cup for the best delivery of different kinds of materials.

When the cup is made conical and with a small diameter lower portion, I found that some kinds of material will tend to bank up and remain at the bottom of the cup, and to prevent this I have provided a cup with a vertically adjustable disc-like plate or false bottom 106. This false bottom 106 is rigidly secured to the rotary shaft 100 in the properly set adjustments by suitable means such as a set-screw 107.

When grain is delivered into the cup it will fall onto the disc or false bottom 106 and by centrifugal force will be immediately discharged radially outward against the interior wall of the cup, thereby overcoming any tendency of the stock to accumulate at the bottom of the cup and insuring an even discharge of the material from the cup. The vertical adjustments of the annular rim or collar of the cup adapts the cup for the proper discharge of various different kinds of materials and adjusts the rate of discharge for the speed that is given to the rotation of the cup.

In the specification I have used to describe the character of the projected shower such terms as "approximately semi-spherical" and "umbrella-shaped shower," the latter term, of course, meaning substantially the shape of an opened umbrella. These terms are used in a liberal sense to describe a shower such as produced by the rotation of a cup or discharge head arranged to rotate on a vertical axis. An important feature is the provision of a dome or casing that is arranged to substantially fit or follow the exterior of the shower produced by such a discharge cup or centrifugally acting discharge head. With such a dome and such a shower produced within the same, there will be no air pockets or air chambers outside of the shower in which air eddies or conflicting vortexes will be produced and which would tend to break up the uniformity of the projected shower.

This application is being filed as a continuation-in-part of my pending application for "Granular material classifier or purifier," filed December 7, 1939 under S. N. 308,068 and allowed May 31, 1940.

In actual practice we have found this improved machine highly desirable and very efficient for the separation of many different kinds of materials. The machine has been found to work exceptionally well in the cleaning and grading of wheat and other grains.

What I claim is:

1. A device of the character described, said device comprising a closed vertical casing, a vertical rotary shaft supported in said casing, a stationary table across said casing below the top of the casing and traversed by said shaft, a rotary collector immediately above said table, rotating means for rotating said collector independently of said shaft, said collector comprising radially and circumferentially spaced pockets bottomed by the upper surface of said table, an air conduit spacedly surrounding said shaft and traversing said collector and said table, a suction fan having its intake connected to the lower end of said

air conduit, a centrifugal material projecting cup fixed to said shaft within the open upper end of said air conduit for projecting particles deposited in said cup to differently radially spaced ones of said pockets of said collector in accordance with the specific gravity of the particles, and air inlets in said dome-shaped top admitting outside air to the interior of the top to be drawn into the upper end of said air conduit by said suction fan, said suction fan having an exhaust exterior of said casing.

2. A device as set forth in claim 1 wherein said table is formed with a diametrically extending pocketed particle discharge opening into which the pocketed particles are pushed by said rotary collector, and a receiver under said discharge opening.

3. A device in accordance with claim 1 wherein the space between the top of said table and the walls of said dome-shaped top constitutes a controlled air chamber in which the natural outward air currents produced by rotation of said centrifugal cup and the travel of the particles therefrom and the incoming of the particles are counterbalanced by air indrawn by said suction fan into the open upper end of said air conduit from said air inlets, thereby permitting free fall of the centrifugally projected particles.

4. A device in accordance with claim 1 wherein a second dome-shaped top is supported by said casing below said suction fan, said second top being traversed by said shaft, a second stationary table supported in said casing below said second top, a second rotary collector fixed to said shaft immediately above said second table, a second centrifugal cup on said shaft between said second top and said second collector, means for feeding particles to the first and second centrifugal cups, second rotating means for rotating said second collector independently of said shaft.

5. A device in accordance with claim 1 wherein a second dome-shaped top is supported by said casing below said suction fan, said second top being traversed by said shaft, a second stationary table supported in said casing below said second top, a second rotary collector fixed to said shaft immediately above said second table, a second centrifugal cup on said shaft between said second top and the said second collector, means for feeding particles to the first and second centrifugal cups, second rotating means for rotating said second collector independently of said shaft and common drive means operatively connected to the first and said second rotating means for simultaneously operating said shaft and said first and second collectors.

6. A device according to claim 1 wherein said fan comprises a bladed rotor fixed on said shaft for rotation thereby.

7. A device according to claim 1 wherein said cup comprises an inverted hollow cone.

8. A device for segregating particles of different weights from an incoming aggregate of such particles and collecting together the particles of different weights so segregated, said device comprising a substantially closed chamber, a rotary cup for receiving the incoming aggregate and centrifugally projecting the particles over the edge of the cup as the cup rotates so that the particles travel in trajectories comensurate with their weight so that the terminals of the trajectories are radially spaced at different distances from the cup, means for turning said cup, a stationary table surrounding said cup, a rotary collector on said table comprising circumferen-

tially and radially arranged pockets bottomed by said table to receive the corresponding particles expelled from the cup at the terminals of their respective trajectories, said table being formed with a radial opening through which the collected particles fall from the pockets as the pockets come into registry with said radial opening.

9. In a centrifugal particle separator, said separator comprising a rotor for centrifugally projecting the particles, a collector surrounding said rotor, said collector comprising a stationary table formed with a radially extending particle discharge opening, a rotary grate supported upon said table, said grate comprising concentrically spaced dividers dividing the same into different radially spaced compartments bottomed by said table to receive particles having a trajectory to fall therein, said grate further comprising radial dividers extending across said compartments for pushing the particles collected in said compartments to said discharge opening, and operating means for rotating said grate.

10. In a centrifugal particle separator, said separator comprising a rotor for centrifugally projecting the particles, a collector surrounding said rotor, said collector comprising a stationary table formed with a radially extending particle discharge opening, a rotary grate supported upon said table, said grate comprising concentrically spaced dividers dividing the same into different radially spaced compartments bottomed by said table to receive particles having a trajectory to fall therein, said grate further comprising radial dividers extending across said compartments for pushing the particles collected in said compartments to said discharge opening, and operating means for rotating said grate, said operating means comprising means for simultaneously rotating said rotor.

11. In a centrifugal particle separator, said separator comprising a rotor for centrifugally projecting the particles, a collector surrounding said rotor, said collector comprising a stationary table formed with a radially extending particle discharge opening, a rotary grate supported upon said table, said grate comprising concentrically spaced dividers dividing the same into different radially spaced compartments bottomed by said table to receive particles having a trajectory to fall therein, said grate further comprising radial dividers extending across said compartments for pushing the particles collected in said compartments to said discharge opening, and operating means for rotating said grate, radially spaced separators positioned below said radial opening in the table, a receiver in which said separators are mounted, means to adjust adjacent ones of said separators to accept only the particles falling through said discharge opening from the grate compartments lying between the adjacent separators, and operating means for selectively positioning said separators.

12. A device of the character described, said device comprising a closed vertical casing, a vertical rotary shaft supported in said casing, means for rotating said shaft, a substantially inverted conical centrifugal cup secured axially on said shaft, a stationary table supported across said casing below the upper end of said cup, said table being formed with a discharge opening, a rotary collector supported immediately above said table for collecting the particles thrown off by said cup, rotating means for rotating said collector, said collector comprising radially and circumfer-

entially spaced particle receiving pockets bottomed by the upper surface of said table, said pockets being arranged to discharge their contents through said discharge opening as the pockets come into registry with said discharge opening.

13. A device of the character described, said device comprising a closed vertical casing formed in its upper part with restricted air inlet means, a vertical rotary shaft supported in said casing, means for rotating said shaft, an inverted conical cup fixed axially secured on said shaft, a stationary table supported in said casing below the upper edge of said cup, said table being formed with a discharge opening, collector means on said table for collecting particles thrown centrifugally from said cup as said cup is rotated, an air sleeve spacedly surrounding and depending below said cup and said shaft and traversing said table and said collector, and suction means in communication with the lower end of said air sleeve whereby air is drawn down said air sleeve from said air inlet means across the space between the wall of the casing and the region of said cup in a movement counter-current to the centrifugal movement of the particles from said cup.

14. A device of the character described, said device comprising a closed vertical casing formed in its upper part with restricted air inlet means, a vertical rotary shaft supported in said casing, means for rotating said shaft, an inverted conical cup fixed axially secured on said shaft, a stationary table supported in said casing below the upper edge of said cup, said table being formed with a discharge opening, collector means on said table for collecting particles thrown centrifugally from said cup as said cup is rotated, an air sleeve spacedly surrounding and depending below said cup and said shaft and traversing said table and said collector, and suction means in communication with the lower end of said air sleeve whereby air is drawn down said air sleeve from said air inlet means across the space between the wall of the casing and the region of said cup in a movement counter-current to the centrifugal movement of the particles from said cup, said air sleeve comprising an upper section, said upper section having a flaring upper end immediately surrounding and concentrically spaced from the walls of said inverted conical cup, and means for vertically adjusting said upper section to different elevations below the upper edge of said cup.

15. A device of the character described, said device comprising a closed vertical casing formed in its upper part with restricted air inlet means, a vertical rotary shaft supported in said casing, means for rotating said shaft, an inverted conical cup fixed axially secured on said shaft, a stationary table supported in said casing below the upper edge of said cup, said table being formed with a discharge opening, collector means on said table for collecting particles thrown centrifugally from said cup as said cup is rotated, an air sleeve spacedly surrounding and depending below said cup and said shaft and traversing said table and said collector, and suction means in communication with the lower end of said air sleeve whereby air is drawn down said air sleeve from said air inlet means across the space between the wall of the casing and the region of said cup in a movement counter-current to the centrifugal movement of the particles from said cup, said vertical shaft depending to a point below said

table and said suction means comprising a suction housing below said table and into which said shaft depends, and a fan fixed on said shaft within said housing, said housing having its intake connected to the lower end of said air sleeve and its discharge opening through the side of said casing.

16. A device of the character described, said device comprising a closed vertical casing, a vertical rotary shaft supported in said casing, means for rotating said shaft, a substantially inverted conical centrifugal cup secured axially on said shaft, a stationary table supported across said casing below the upper end of said cup, said table being formed with a discharge opening, a rotary collector supported immediately above said table for collecting the particles thrown off by said cup, rotating means for rotating said collector, said collector comprising radially and circumferentially spaced particle receiving pockets bottomed by the upper surface of said table, said pockets being arranged to discharge their contents through said discharge opening, said collector having depending circumferentially ribs on its under side running in accommodating grooves formed in the top of said table.

17. A device of the character described, said device comprising a closed vertical casing having a hollow hemi-spherical chamber, a stationary table supported to extend substantially entirely across said casing to close off the lower end of said chamber, restricted air inlet means in the curved walls and top of said chamber, a vertical rotary shaft mounted axially in said chamber, a rotary pocket equipped collector surrounding said shaft and positioned immediately above said table, a vertical air sleeve surrounding said shaft, said air sleeve traversing said table and said collector, a suction means below said table and connected to the lower end of said air sleeve, said air sleeve rising to a substantial height above said table and having a flaring upper part, and an inverted conical centrifugal cup secured axially to said shaft so as to turn within and in concentrically spaced relation to said flaring upper part of the air sleeve, said cup having its upper edge positioned at an elevation slightly above the upper edge of said flaring upper part of the air sleeve, said suction means being arranged to draw air down between the cup and the flaring upper part of the air sleeve from said air inlet means in a movement across the space between the wall of said chamber and said cup counter-current to the centrifugal movement of particles and entrained air from said cup whereby the centrifugally projected particles follow their normal trajectories without substantial deviation.

18. In a centrifugal separator for solid particles of varying mass, a table, a substantially closed casing rising around and forming a substantially closed semi-spherical dome-shaped space above said table, an inverted conical centrifugal cup characterized by relatively steep sides, means rotatably mounting said cup substantially at the vertical center of said space and above said table, means for rotating the cup, said cup having relatively steep sides to cause particles therein to spiral upwardly along the sides of the cup and be centrifugally projected over the upper edge of the cup in an umbrella-like shower the outside of which substantially conforms to the shape of the dome-shaped casing, and collector means on said table for separately collecting the projected particles which fall at differ-

ent radial distances from the cup according to their mass, the construction and arrangement being such that the outer portion of the shower is closely adjacent the inner surface of the dome-shaped casing.

19. A separator in accordance with claim 18 wherein the dome-shaped casing formed with restricted air inlet means and wherein the lower part of said cup is surrounded by the upper part of an air sleeve traversing said table and having suction means in communication with its lower end, said suction means operating to draw air across the casing from said air inlet means into the upper end of said air sleeve counter-current to the travel of the particles from the cup and the air entrained therein so as to permit free fall of the particles onto said table, the upper part of said air sleeve being relatively closely spaced from the sides of said cup and having a diameter not substantially greater than that of said cup.

20. A device for segregating particles of different weight, from an incoming aggregate of such particles, and collecting the particles of a different weight so segregated, said device involving an approximately semi-spherical dome, means for producing within said dome a spherical or umbrella-like shower of said material, the axis of which shower is substantially coincident with the axis of said dome, and means spanning the lower portion of the dome and arranged to intercept the precipitated materials according to the radial projection of the materials from the axis of the dome and to maintain the separation thus initiated, said device being so constructed and arranged that the outer portion of shower is closely adjacent the inner surface of the semi-spherical dome.

21. The structure defined in claim 20 in which the means for producing the shower is a rotary power-driven cup with its open end upward near the top of said dome and arranged to rotate approximately on the vertical axis of the dome.

22. A device for segregating particles of different weight, from an incoming aggregate of such particles, and collecting the particles of a different weight so segregated, said device involving an approximately semi-spherical dome, means for producing within said dome a spherical or umbrella-like shower of said material, the axis of which shower is substantially coincident with the axis of said dome, and means at the base of said dome for collecting the precipitated stock in accordance with the trajectory on which it is projected from the axis of the dome, said device being so constructed and arranged that the outer portion of shower is closely adjacent the inner surface of the semi-spherical dome.

23. The structure defined in claim 20 in which the means for producing the spherical shower of material is a rotary centrifugal projector, and in further combination with means for rotating said projector at variable speeds.

24. The structure defined in claim 20 in which the means for producing the shower is a rotary power-driven cup set with its open end upward near the top of said dome and arranged to rotate on the vertical axis of the dome, and in further combination with means for rotating said cup at variable speeds.

25. In a machine for separating particles of different weight from an incoming aggregate of such particles, means for outwardly projecting an umbrella-like shower of material, a casing

enclosing said shower-producing means, the construction and arrangement being such that the outer portion of the shower is closely adjacent the inner surface of the casing, and means at the base of said casing for collecting the precipitated stock in accordance with the trajectory on which it is projected from the axis of the dome.

26. In a machine for separating particles of different weight from an incoming aggregate of such particles, means for outwardly projecting an umbrella-like shower of material about a vertical axis, a casing enclosing said shower-producing means the construction and arrangement being such that the outer portion of the shower is closely adjacent the inner surface of the casing, and means at the base of said casing for collecting the precipitated stock in accordance with the trajectory on which it is projected from the axis of the dome.

27. The structure defined in claim 25 in further combination with means for maintaining a movement of air inwardly through the shower of material, toward the axis thereof.

28. The structure defined in claim 25 in which the shower-enclosing casing is provided with a series of circumferentially spaced perforations, and in further combination with means for maintaining a flow of air into the casing through said perforations and through said shower of material toward the axis thereof.

29. The structure defined in claim 25 in which the shower-producing means is in the nature of a rotary power-driven cup with its open end located near the top axial portion of the casing.

30. In a machine for separating particles of different weight from an incoming aggregate of such particles, means for outwardly projecting an annular umbrella-like shower of material about a vertical axis, a casing enclosing said shower-producing means and shaped to closely follow the outer portion of the projected shower of material in close outwardly spaced relation thereto, and means at the base of said casing for collecting the precipitated stock in accordance with the trajectory on which it is projected from the axis of the dome, the construction and arrangement being such that the outer portion of the shower is closely adjacent the inner surface of the casing.

31. In a machine for separating particles of different weight from an incoming aggregate of such particles, a vertically disposed cross-sectionally cylindrical casing, means located near the upper axial portion of the casing for receiving an aggregate of material and projecting the same outwardly therefrom in an annular shower, the outer portion of which annular shower is inwardly spaced from the casing and is shaped to approximately correspond to the contour of the interior of said casing, and means at the base of said casing for collecting the precipitated stock in accordance with the trajectory on which it is projected from the axis of the dome the construction and arrangement being such that the outer portion of the shower is closely adjacent the inner surface of the casing.

32. In a machine for separating particles of different weight, from an incoming aggregate of such particles, means for outwardly projecting an umbrella-like shower of material, and a casing enclosing said shower producing means and shaped to substantially correspond to the shape of the outer portion of the projected shower of material, said means comprising a

rotary delivery cup provided with a vertically adjustable annular rim applied at its perimeter, the interior of said vertically adjustable rim being of uniform diameter and extending parallel to the axis of the cup.

33. In a machine for separating particles of different weight, from an incoming aggregate of such particles, means in the nature of a vertical axis power driven rotary cup for projecting an annular shower of material, a casing enclosing said annular shower producing means and shaped to substantially correspond to the outer portion of the projected annular shower of material, and a rim closely embracing the perimeter of the cup and mounted thereon for vertical adjusting movements between the plane of the upper edge of the cup and a plane above the upper edge of the cup, whereby to effectively vary the vertical depth of the cup and the shape of the projected shower of material.

34. A device of the character described, said device comprising a closed vertical casing, a vertical rotary shaft supported in said casing, a stationary table across said casing below the top of the casing and traversed by said shaft, a rotary collector immediately above said table, rotating means for rotating said collector independently of said shaft, said collector comprising radially and circumferentially spaced pockets bottomed by the upper surface of said table, an air conduit spacedly surrounding said shaft and traversing said collector and said table, a suction fan having its intake connected to the lower end of said air conduit, a centrifugal material projecting cup fixed to said shaft within the open upper end of said air conduit for projecting particles deposited in said cup to differently radially spaced ones of said pockets of said collector in accordance with the specific gravity of the particles, and air inlets in said dome-shaped top admitting outside air to the interior of the top to be drawn into the upper end of said air conduit by said suction fan, said suction fan having an exhaust exterior of said casing, said table being formed with a diametrically extended pocketed particle discharge opening into which the pocketed particles are pushed by said rotary collector, a receiver under said discharge opening, and said receiver comprising a receptacle comprising a bottom formed with a plurality of outlets arranged in radially outwardly spaced manner respecting said table, individual delivery spouts connected with said outlets, and a plurality of adjustable valve means in said receiver for directing particles from one or a selected number of radially spaced pockets of said table exclusively into a selected one or ones of said outlets.

35. A device of the character described, said device comprising a closed vertical casing, a vertical rotary shaft supported in said casing, a stationary table across said casing below the top of the casing and traversed by said shaft, a rotary collector immediately above said table, rotating means for rotating said collector independently of said shaft, said collector comprising radially and circumferentially spaced pockets bottomed by the upper surface of said table, an air conduit spacedly surrounding said shaft and traversing said collector and said table, a suction fan having its intake connected to the lower end of said air conduit, a centrifugal material projecting cup fixed to said shaft within the open upper end of said air conduit for projecting particles deposited

in said cup to differently radially spaced ones of said pockets of said collector in accordance with the specific gravity of the particles, air inlets in said dome-shaped top admitting outside air to the interior of the top to be drawn into the upper end of said air conduit by said suction fan, said suction fan having an exhaust exterior of said casing, said table being formed with a diametrically extending pocketed particle discharge opening into which the pocketed particles are pushed by said rotary collector, a receiver under said discharge opening, said receiver comprising a receptacle comprising a bottom formed with a plurality of outlets arranged in radially outwardly spaced manner respecting said table, individual delivery spouts connected with said outlets, and a plurality of adjustable valve means in said receiver for directing particles from one or a selected number of radially spaced pockets of said table exclusively into a selected one or ones of said outlets, said plurality of adjustable valve means comprising a number of vertical plates hinged at their lower ends on the bottom of said receptacle, the upper ends of said plates having spring pressed followers to maintain contact with the bottom of said collector during differently angulated positions of said plates, and means for selectively adjusting the angular positions of the individual plates.

36. In a machine for separating particles of different weight, from an incoming aggregate of such particles, means in the nature of a vertical axis power-driven rotary cup for receiving an aggregate of such particles and projecting therefrom an umbrella-like annular shower of the particles, a casing enclosing said annular shower producing means and shaped to closely correspond to the outer portion of the projected annular shower of particles, the construction and arrangement being such that the outer portion of the shower is closely adjacent the inner surface of the casing and means for varying the speed of discharge of material from the rotary cup so as to vary the shape and diameter of the outside of the shower, whereby the shape of the shower may be made to more closely conform to the shape and size of the casing to compensate for variations in cup speed and different material characteristics.

37. The structure defined in claim 36 in which the last said means is in the nature of a rim closely embracing the perimeter of the cup and mounted thereon for vertical adjusting movements.

WILLIAM N. SMITH.