

Aug. 29, 1944.

W. H. MECHLIN

2,356,775

SEPARATOR

Filed April 11, 1941

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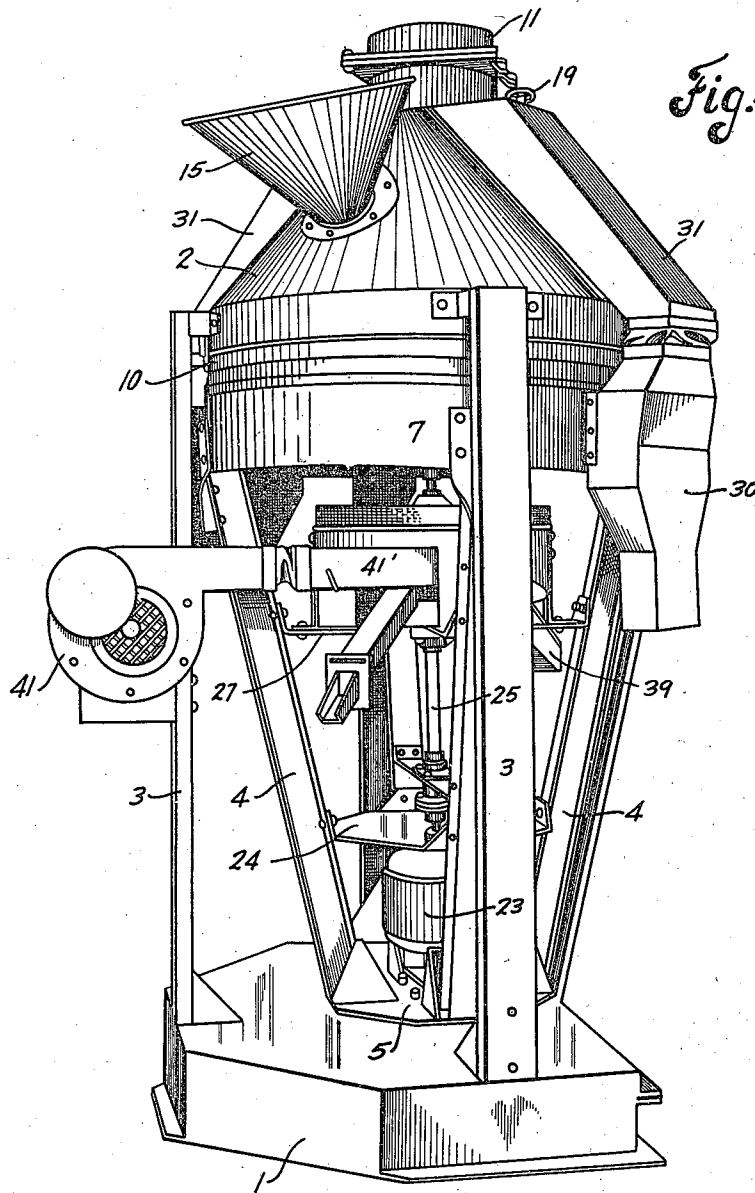


Fig. 1

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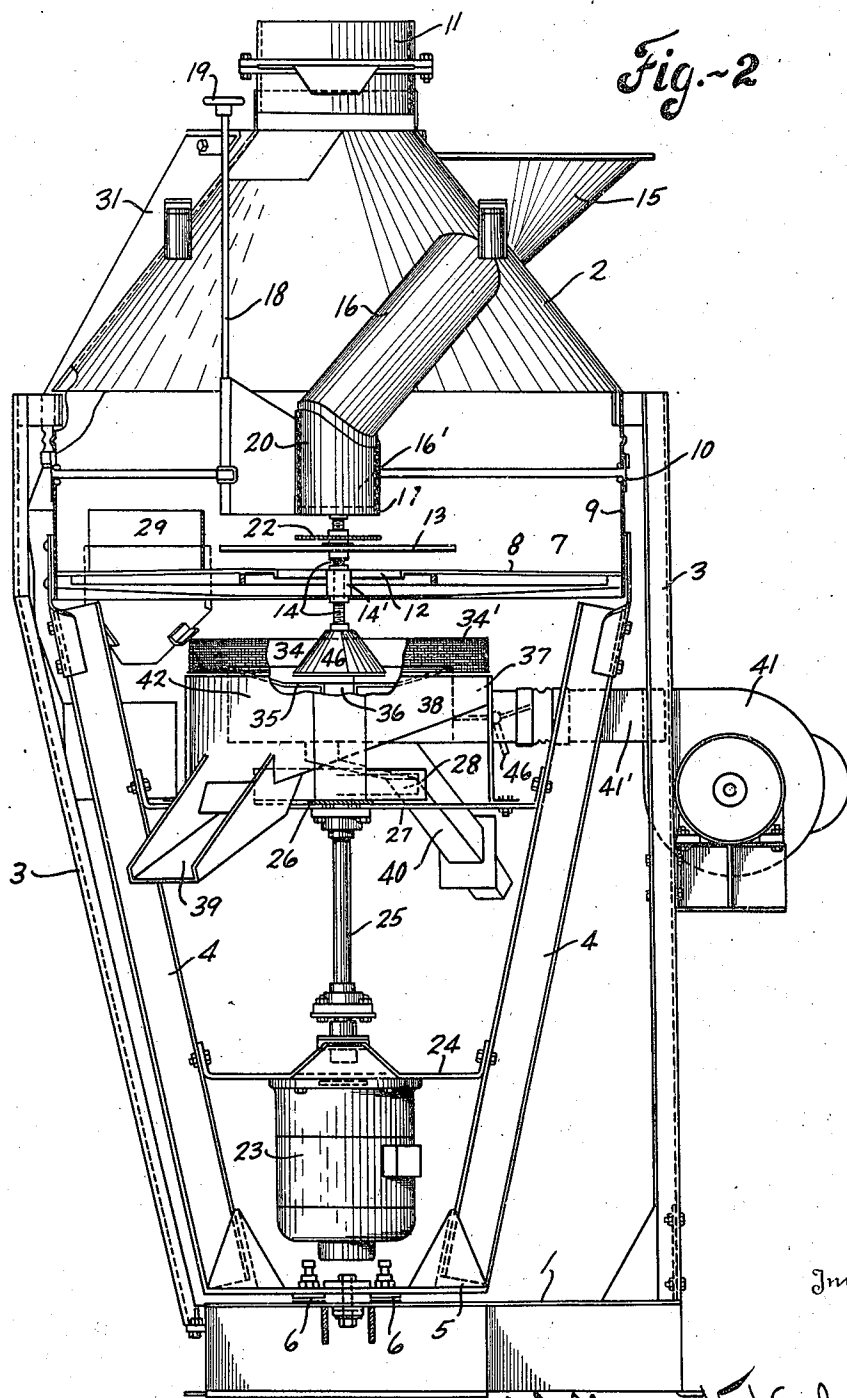
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4 Sheets-Sheet 2



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*Fig.-3*

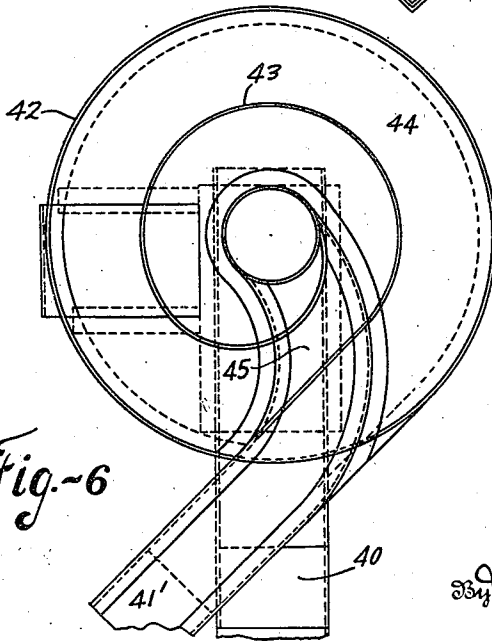
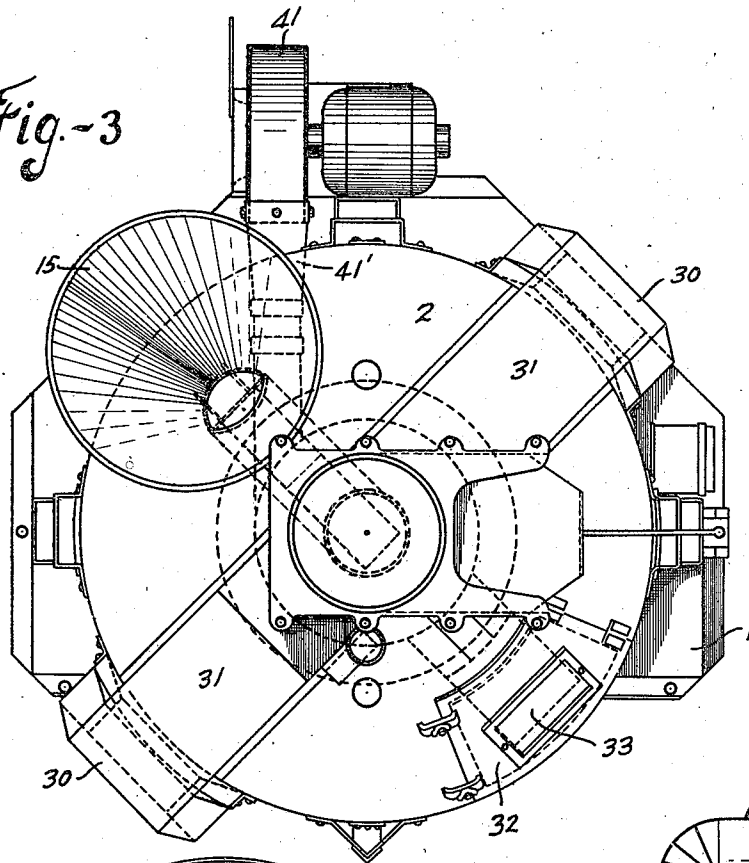


*Fig.-6*

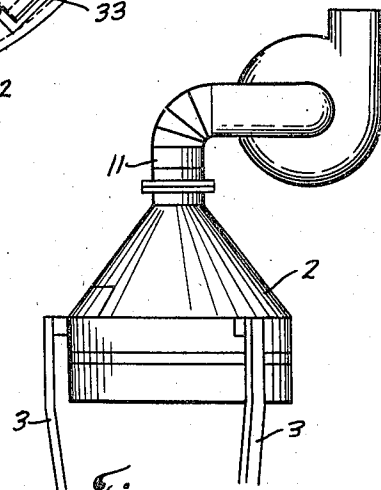


*Fig.-8*

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4 Sheets-Sheet 4

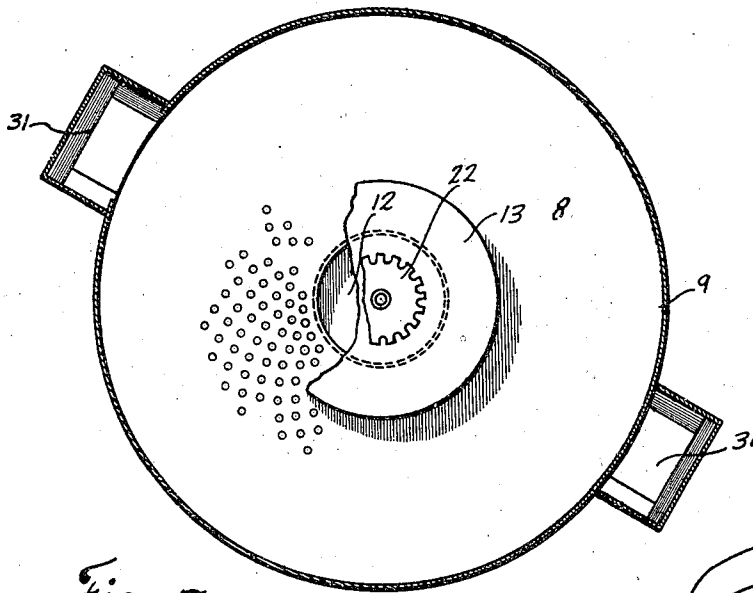


Fig.-7

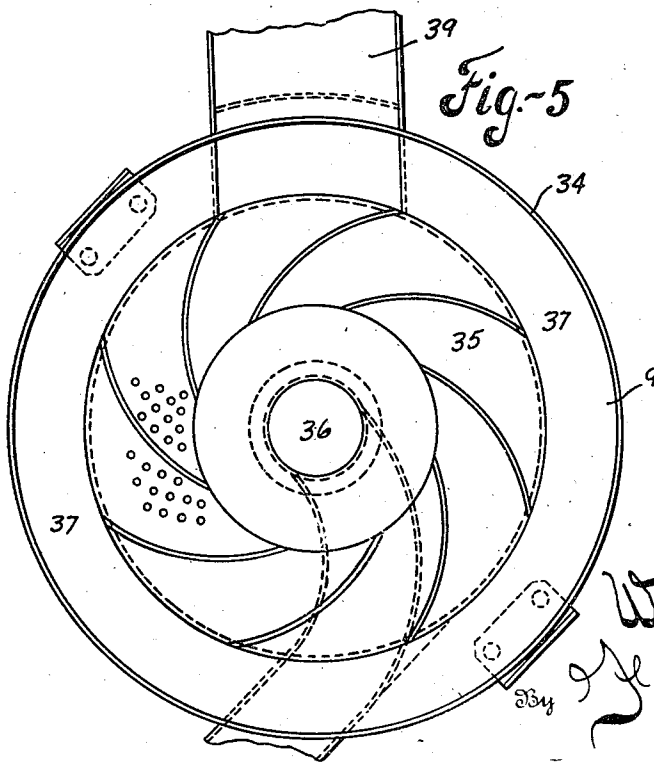


Fig.-5

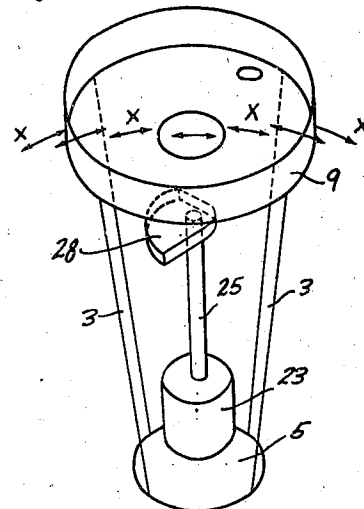


Fig.-4

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## UNITED STATES PATENT OFFICE

2,356,775

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Application April 11, 1941, Serial No. 388,136

20 Claims. (Cl. 209—467)

This invention pertains to an apparatus and method of grading and sorting intermixed bodies in accordance with their specific gravity, and more particularly to a vibratory apparatus for subjecting materials of different character to automatic separation.

While the present apparatus is herein illustrated and described in its application to separation of commercial peanuts from pops, nubs and trash, to wit, leaves, vines, stems, roots and stones, it is to be understood that such disclosure is for illustrative purpose and with no intent to unduly limit the scope or application of the invention, which is capable of a wide range of other uses, as for example, cleaning peas and beans, separating grain from chaff and refuse, classifying coarse and fine ore particles, and other comminuted and pulverized materials, and for sorting small manufactured parts and analogous purposes.

The object of the invention is to simplify the construction, as well as the means and mode of operation of grading and sorting apparatus, whereby it may not only be economically constructed and operated, but will be more efficient in use, automatic in operation, uniform in action, having relatively few operating parts, and unlikely to get out of repair.

A further and important object of the invention is to provide a compact structure having minimum power requirement, and which may be operated without the necessity of skilled operators or constant attention.

A further object of the invention is to provide a grading and separating apparatus of large capacity capable of continuous operation upon a constant flow of material and affording continuing discharge of the separated portions of the mass.

A further object of the invention is to provide a vibratory separating apparatus, wherein the material operated upon will be accurately and rapidly sorted and classified according to the weight or specific gravity of individual bodies of the intermixed materials.

A further object of the invention is to provide a method of inducing progressive travel motion along separate paths and independent discharge of separated portions of an intermixed mass of material.

A further object of the invention is to provide a grading and sorting apparatus embodying the advantageous structural features and possessing the inherent meritorious characteristics and the mode of operation herein mentioned.

With the above primary and other incidental ob-

jects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation, or their equivalents, as hereinafter described or illustrated in the accompanying drawings.

In the accompanying drawings, wherein is illustrated the preferred, but obviously not necessarily the only form of embodiment of the invention,

Fig. 1 is a perspective view of an assembled vibratory separating and sorting apparatus embodying the present invention.

Fig. 2 is a side elevation partly in section of the assembled apparatus, viewed from the side opposite that shown in Fig. 1.

Fig. 3 is a top plan view.

Fig. 4 is a diagrammatic view illustrating the vibratory movement of the separator.

Figs. 5 and 6 are detail plan and sectional views of the secondary sorting unit.

Fig. 7 is a top plan view of the primary sorting table.

Fig. 8 is a detail view illustrating the application of air suction to the hood or dome of the apparatus.

Like parts are indicated by similar characters of reference throughout the several views.

Briefly described, the apparatus includes a sorting table or riddle on which the material is received, and which is mounted for a progressive circular wobble or rocking motion about a distant point, wherein the vertical axis of the table or carrier describes a somewhat conical figure and the margins of the gyratory carrier or table receive upward angular tossing motion. The vibratory motion is of greater range and angularity to the plane of the table near the margins thereof, and both the range and angularity of the vibratory motion decrease toward the center of the table, where a substantially horizontal movement is assumed.

The rocking or tilting motion imparts to the heavier particles of material resting thereon successive tossing impulses or bouncing action, the trajectory of which becomes lower as the particles or bodies move inwardly. Thus, the material adjacent to the periphery of the table is subjected to more violent agitation which progressively decreases toward the center of the table. The tossing or bouncing motion transmitted to the material in converging direction causes the heavier material to move inwardly where it escapes through a central outlet. The material upon the table is simultaneously sub-

jected to an air current of sufficient intensity to partially support the lighter material and litter and thus minimize the effect of the rapidly tilting table or riddle thereon, while having but little or no effect upon the heavier material. Consequently, repetitious impacts are imparted to the heavier material, causing it to move inwardly and escape through the central outlet while the lighter material shifts outwardly and is discharged from the rim of the vibratory table. The vibratory motion is transmitted by an unbalanced motor driven rotary weight connected with the table or riddle support.

Referring to the drawings, the apparatus includes a base 1 upon which a conical hood 2 is supported in elevated fixed relation with the base 1 by struts 3. Flexibly supported upon the base 1 beneath the hood 2 is a vibratory frame comprising spaced upwardly divergent legs 4—4 connected at their lower converging ends to a foot plate 5, which is yieldingly supported in spaced relation above the frame base 1 on resilient step blocks 6. The steps 6 may be of rubber or may be springs which will permit a limited range of rocking motion to the foot plate 5 and vibratory frame 4. Supported by the upper ends of the divergent legs or frame member 4 and immediately beneath the dome or hood 2 is a circular riddle 7 having a perforate bottom 8 and upstanding side walls 9. The latter are flexibly connected with the periphery of the hood or dome by an intermediate overlapping strip 10 of canvas, rubber or other yielding material. While the bottom of the vibratory table or riddle 7 is perforate, it is not for the purpose of sieving the material thereon, but for the upward passage of a current of air induced by suction applied to the neck 11 at the apex of the dome or hood. At its center the table or riddle 7 is provided with a concentric outlet opening 12 over which is disposed in slightly elevated position an imperforate disc 13. The disc 13 is mounted on the riddle or table 7 for unison movement therewith, and is axially adjustable relative thereto upon a screw stem 14 mounted in a bar 14', which intersects the discharge outlet 12 of the table or riddle 7. The disc 13 is preferably, although not necessarily, of non-metallic treated composition or fiber board.

Extending through the wall of the dome or hood 2 from a hopper 15 or other exterior source of supply, is a supply conduit 16 for the intermixture of material to be separated. The outlet 16' of this conduit is disposed concentrically with the dome or hood and with the table or riddle 7 when the latter is at rest. The relation is such that the material discharged from the supply conduit 16 falls directly upon the disc 13, which moving in unison with the table or riddle 7, describes a gyratory motion relative to the discharge conduit, which serves to distribute the material. To enable regulation of the material supply, the extremity of the discharge conduit is provided with a telescopic sleeve 17 which is axially adjustable toward and from the disc 13 by means of a rod 18 extending through the top of the hood 2 where it is provided with a hand knob 19, and which at its lower end is connected with the adjustable sleeve 17 by a wing 20. To further control the inflow of material and effect its distribution, a supplemental marginally notched disc 22 of smaller diameter is preferably supported in spaced relation above the main disc 13. The marginal serrations of the disc 22 facilitate the dislodgment of sticks and stems which

might otherwise become entangled and block the supply conduit outlet. The material discharged from the supply conduit 16 onto the discs 13 and 22 forms a wide spreading conical pile overlying the discs and spreading onto the perforate bottom of the table or riddle 7. Incoming material is thus caused to flow toward the outer marginal area of the table and away from the outlet beneath the disc 13. This distribution of material may be accelerated by substituting a conical diaphragm for the flat disc 13. To impart vibratory motion to the table or riddle and its supporting frame 4—5, there is mounted within the frame an electric motor 23. The motor is preferably suspended upon cross arms 24 which interconnect the divergent frame legs 4. The shaft 25 of the motor 23 is extended upwardly and is provided with a suitable bearing 26 upon other cross arms 27. At its upper end, the motor shaft 25 carries an eccentric weight 28 by which the motor shaft is unbalanced, and as the shaft rotates it transmits a vibratory motion to the table or riddle and its supporting structure 4—5.

The vibratory action of the movable portion of the structure is diagrammatically illustrated in Fig. 4. Due to the unbalanced condition of the motor, the table 7 is caused to assume inclined relation to the horizontal in progressively different radial planes. The table or riddle describes a circular path of travel about a vertical axis, wherein the axis of the table is inclined to the perpendicular.

As viewed in any one radial plane of movement, the table or riddle 7 appears to have a sidewise tilting motion as indicated by the arrows  $x-x$  in Fig. 4. However, this plane of oscillation progressively changes. In this to and fro tilting motion the outer edge of the table receives an impulse in an upwardly and inwardly direction, which tends to lift the material and toss it toward the center of the table.

The heavier material which rests on the perforate bottom of the riddle or table 7 receives very definite impulses while the lighter material does not receive as great impact, and hence does not respond to such movement. This differential is increased by applying sufficient suction to the neck of the hood or dome 2 to ease the pressure of the litter and trash upon the riddle or table, while the heavier particles will remain in contact with the table and receive the effect of the repetitious tossing impulses. Such impulses being inwardly directed, the heavy material is caused to travel toward the center of the table or riddle 7 where it finally passes beneath the rim of the disc 13 and escapes through the outlet 12.

The rate of discharge is largely determined by the relative spacing of the adjustable disc 13 above the level of the table 7. The lighter particles being practically suspended by the air current which enters through the perforate table 7 beneath the mass of material, will not have such strong tendency to travel toward the center of the table and are therefore separated from the heavier material and displaced and forced outwardly toward the rim of the table. Such light material is discharged through peripherally spaced outlets 29 in the side walls 9 of the riddle or table, which communicate with discharge chutes 30 exteriorly of the vibratory table but attached thereto. These discharge chutes for light material are connected by conduits 31 with the top of the hood 2, whereby they too are subjected to the suction influence induced within the

hood. In order that the progress of separation may be observed and that access may be had to the separating or sorting table, a door 32, having therein a glass panel 33, is provided in the dome or hood 2.

In the event that the apparatus is employed for cleaning shelled peanuts, and for separation of stones and other heavy foreign bodies therefrom, or for making a second separation of the initially isolated heavier material, a second riddle or sorting unit 34 of smaller size is mounted in the same vibratory frame 4—5 immediately below the primary sorting table 7. The second riddle or unit 34 is positioned to receive directly therein the material discharged through the central outlet 12 of the initial table 7.

The secondary separator comprises a circular wall or shell 34 carried on the transverse arms 27, which connect the divergent vibrator arms 4. Supported in concentric spaced relation within the upstanding circular shell 34 is a slightly concave perforate sorting table 35, having therein a central opening 36 for escape of the heavier material, in this instance stones. Surrounding the concave sorting table is an annular space 37 intermediate the margin of the table and the circular wall 34, through which the lighter material is discharged. Beneath this annular outlet space is an inclined chute 38 which leads to a discharge spout 39. The bottom of the discharge chute 38 is disposed in an inclined plane within the shell 34, having its high side opposite the discharge spout 39 and directing to the spout the material which falls over the peripheral margin of the sorting table 35. The heavy material which escapes through the central opening 36 of the table falls into a chute 40, through which it is discharged from the apparatus.

Instead of supplying suction from above to the secondary sorting unit as in the primary construction, an air current is supplied thereto by a blower 41 by which the air is directed into an air chamber or chest 42 immediately beneath the perforate concave sorting table 35, and which defines the inner wall of the inclined chute 38 leading to the spout 39. The interior of the air chamber or chest is divided by a spiral wall 43 into a winding air channel or passage 44, the top of which comprises the perforate concave sorting table 35 through which the air current escapes upwardly. There is also in the air chamber 42 a curved passage 45 which leads to and discharges upwardly through the central opening 36 of the table 35.

The blower conduit 41' has therein a damper 46, by adjustment of which the air discharge from the blower 41 may be directed in varying proportions through the respective air passages 44 and 45 for discharge upwardly through the perforations of the sorting table 35 and through the central discharge outlet 36 thereof. Immediately above the central outlet 36 is a distributing cone 46, by which material falling through the outlet 12 of the primary sorting unit 7 is diverted laterally onto the sorting table 35 of the secondary unit.

The secondary separating unit 34 being mounted on the cross arms 27 connected with the vibratory frame members 4, moves at all times in unison with the primary separating unit 7 and through a similar path of travel but of less range. The heavy material discharged through the outlet 12 of the primary separator falling into the secondary separator is reworked thereby, and the heavier portion thereof, for example, stones, are

again caused to converge toward the center and pass out through the central opening 36 and thence through the discharge chute 38 and spout 39. At the same time, the lighter material, in this instance the cleaned, shelled peanuts, is caused to move outwardly upon the second separating table 35 and discharged over the periphery thereof through the chute 38 and spout 39. To facilitate the travel of the material upon the sorting units 7 and 34, these, if desired, may be provided with evolute ribs or beads, as shown in Fig. 5, which form shallow channels through which the material is directed to the proper outlets. A suction fan or blower 47 is connected to the neck 11 of the hood 2.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement or parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise the preferred form of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. In a vibratory separating apparatus, a main frame including a base, an elevated hood and stationary supports for the hood, a gyratory frame mounted upon said base for oscillatory motion about a pivotal center at its bottom, a sorting table carried by the gyratory frame in elevated relation above the center of oscillation and beneath the hood, a discharge outlet at the center of the sorting table, an elevated cover therefor in spaced relation above the central discharge outlet affording an annular opening intermediate the periphery of the elevated cover and the margin of the discharge outlet, a second discharge outlet at the periphery of the table, a supply conduit for material to be operated upon extending within the hood into position substantially over the said elevated cover for the discharge outlet, and adjustable terminal for the supply conduit by which the space intermediate the outlet of the supply conduit and the elevated cover of the discharge outlet may be varied, an actuating motor, and an unbalanced rotary weight journaled in the gyratory frame and driven by the motor, by rotation of which the frame and sorting table are given oscillatory motion about said center of oscillation.

2. In a vibratory separating apparatus, a perforate sorting table, a vibratory frame upon which the table is mounted for to and fro motion about a center of oscillation remotely offset beneath the plane of the sorting table and perpendicular to the plane thereof, a hood positioned over the sorting table, a flexible peripheral wall connecting the sorting table with the hood, a central discharge outlet in said sorting table and a second discharge outlet at the periphery thereof, means for inducing simultaneous reverse travel motion of different portions

of the material operated upon inwardly and outwardly over the table to the central and peripheral outlets respectively, including means for transmitting to the vibratory frame and to the table carried thereby oscillatory motion relative to said offset center of oscillation and a suction outlet from the hood through which an air current is induced through the perforate sorting table.

3. In a vibratory separator, a hood subjected to air exhaustion, a perforate vibratory sorting table located beneath the hood, means for transmitting vibratory motion to the sorting table by which the material resting thereon is subjected to angular elevating impact impulses, the entrance of air through the perforate sorting table into the air exhausted hood serving to partially suspend the lighter material, whereby such material will be subject to less impact influence of the vibratory table than the heavier material, the impact impulses being delivered to the material in such direction as to induce relative travel movement of the material upon the table, and peripheral and central escape outlets for the light and heavy materials respectively.

4. In a separating apparatus, a perforate sorting table through which an upwardly directed air current is induced, and by which light material thereon will be partially suspended, means for transmitting to the sorting table a vibratory motion by which the material thereon is subjected to upward impact impulses, the impulses delivered to the lighter partially suspended material being less than those delivered to the heavier material resting thereon, said impact impulses being delivered in a direction angular to the plane of the table by which relative movement of the material is induced, and relatively spaced outlets for escape of the heavier and lighter materials from the table.

5. In a separating apparatus, a sorting table having a relatively flat surface onto which a mass of material to be separated is discharged, an oscillatory support upon which the flat sorting table is supported in elevated distantly spaced relation above a center of oscillation of the support and table, an escape outlet for one class of material at the center of the table and an escape outlet for a different class of material at the rim of the table, an air circulatory device for subjecting the materials operated upon to influence of an air current and an actuator imparting a substantially uniform progressive circular wobble motion so as to induce differential movement of different classes of material over the table by transmitting oscillating motion to the support, the construction and arrangement being such that the materials of different character will be caused to travel simultaneously in opposite directions over the table to the corresponding escape outlets.

6. A separating apparatus, a perforated sorting table onto which a mass of material to be separated is discharged, a support therefor on which the sorting table is capable of simultaneous rocking and side shifting motion, and means for inducing travel movement of material of different characteristics in different directions over said table by actuation of the table, the construction and arrangement being such that upwardly directed impact impulses are delivered to the material in converging directions, and means for simultaneously directing an air current through the table by which the impact impulses are minimized upon a portion of the ma-

terial, causing the remainder thereof to be influenced thereby to greater degree, and separate escape outlets from the table for different portions of the material to which such portions thereof are directed by the vibratory action.

7. In a vibratory separator, a flat riddle having a central discharge opening for heavier materials and a marginal discharge opening for lighter material over which different portions of intermixed materials of different characteristics are caused to travel simultaneously one portion toward the center and the other toward the margin of the table by a substantially upwardly and inwardly converging motion thereof, a support therefor on which the riddle is mounted for vibratory motion, an air circulatory device inducing an upwardly flowing air current through the riddle simultaneously with its vibratory motion and an actuator for the riddle.

8. The herein described method of separating a mass of intermixed heavy and light particles of material, including vibrating the material by a rocking motion about a center of vibration offset relative to the plane thereof, thereby inducing travel motion of the heavier particles inwardly toward the center of mass, and simultaneously subjecting the material to the influence of air pressure by which the lighter material will be partially suspended, and the inward travel influence of the vibratory action thereon minimized.

9. The herein described method of separating intermixed heavy and light particles of material by imparting to the heavier particles thereof, successions of impact impulses in upwardly and inwardly converging directions thereby inducing inwardly travel motion of the heavier particles and simultaneously partially floating the lighter material by air current of sufficient intensity to relieve the impact impulses upon the lighter material, but insufficient to materially relieve the impact impulses upon the heavier material, the operation being such that the heavier material is shifted inwardly toward a common point and the lighter material is separated outwardly therefrom.

10. The herein described method of separating intermixed heavy and light particles of material, including inducing inwardly travel motion of the heavier particles toward the center of mass by transmitting thereto a succession of upwardly and inwardly converging percussion impulses about a remote axially offset center and simultaneously subjecting the material to an upward air current by which the lighter material is partially supported by which the influence of the percussion impulses thereon are minimized while percussion impulses are delivered to the heavier particles thereof.

11. A vibratory separating apparatus, including a riddle, a support therefor upon which the riddle is mounted for alternating tipping action to and fro past level position, means for actuating the riddle to impart to the contents thereof successions of impact impulses in upwardly converging directions, the intensity and angularity of which decrease toward the center of the riddle, and means for inducing an upward air current through the riddle by which the lighter portions of the material are partially supported while the heavier particles thereof are subjected to impact impulses, the riddle having a central discharge opening for discharge of heavy particles of material and an outwardly spaced dis-

charge opening for discharge of lighter particles of material.

12. The herein described method of separating materials of different specific gravity, including the steps of partially suspending the lighter material by air pressure and simultaneously subjecting the heavier material to inward travel influence relative to the partially suspended lighter material by repetitious impact impulses in upwardly converging relation, by which the heavier material is caused to move toward a common central point.

13. The herein described method of separating the materials of different specific gravity, including the steps of partially suspending the lighter material by air influence, inducing inwardly traveling influence upon the heavier portions of the material by subjecting the heavier material to repetitious upwardly converging impulses, the angularity of which decreases with corresponding decrease of trajectory as the heavier material approaches a common central point, and effecting outwardly displacement of the lighter material by concentration of the heavier material adjacent such common point.

14. In a separating apparatus of the character described, a perforate sorting table mounted for progressive tilting movement in changing radial planes, means for producing an upward current of air therethrough a centrally disposed outlet in said table for heavier material and a peripheral outlet for lighter material, and means for actuating the table to transmit upwardly converging impact impulses to material on said table, the construction and arrangement being such that the heavier material is impelled inwardly toward and through the central outlet and the lighter material in a partially suspended state is displaced outwardly toward and through the peripheral outlet.

15. In a separating apparatus, a sorting table mounted for tilting movement in progressively changing radial directions, a centrally disposed outlet in said table for a portion of the material, a cover for the outlet in elevated relation above the table and providing a passage intermediate the plane of the table and the cover for escape of material to said outlet, a supply conveyor for material discharging onto said outlet cover portion from which the material flows onto the table and means for imparting tilting motion to the table by which upwardly and inwardly directed impact impulses are delivered to the material thereon, the construction and arrangement being such that heavier material is shifted inwardly and beneath the elevated outlet cover to said outlet and lighter material is displaced outwardly to the margin of the table.

16. In a separating apparatus, a perforate vibratory sorting table mounted for progressive tilting motion symmetrically relative to distant center of movement, wherein vertical motion is transmitted to the margins of the table while

the medial portion thereof receives shifting motion in an approximately horizontal plane, relatively spaced discharge outlets, one at the approximate center of the table and another contiguous to the outer margin thereof, means for transmitting to the table a progressive tilting motion in different radial planes and means for inducing a flow of air through said perforate sorting table.

17. In a separating machine a vibratory sorting table having a centrally disposed outlet, a receiving platform for material to be sorted mounted in elevated position above the plane of the table for unison movement therewith and overlying the central outlet thereof affording an entrance to the outlet intermediate the receiving platform and the table, a supply conduit for material to be sorted discharging onto said platform, and means for transmitting vibratory motion to the table.

18. In a separator, a vibratory sorting table, a material receiver mounted in spaced relation above the plane of the table for unison motion therewith, a supply conduit for material discharging upon the receiver, by which the material is deflected onto the table, the outlet of the discharge conduit and the material receiver being relatively adjustable whereby the relation of the material outlet and the receiver may be varied to regulate the supply of material to the receiver, and actuating means for vibrating the table and material receiver.

19. In a separating apparatus, a vibratory sorting table, central and marginal discharge outlets therefrom for different portions of the material operated upon, a support upon which the table is mounted for tilting motion in progressively changing radial planes, a vertical rotary actuating shaft associated with said support and an unbalanced rotary weight upon the actuating shaft by which motion is transmitted to the support and table carried thereby, the construction and arrangement being such that heavier portions of the material are directed by the vibratory motion toward and through the central outlet and the lighter material is discharged from the margin of the table.

20. In a separating apparatus, a vibratory support mounted for tilting movement in progressively changing radial planes, plural sorting tables carried thereby in superposed relation, a central discharge outlet in each table through which separated portions of the material operated upon are discharged from a higher to a lower sorting table and thence from the lower table out of the apparatus, and discharge outlets from the margin of each table for other separated portions of the material, and actuating means for the vibratory support by which simultaneous tilting motion is transmitted to each of the sorting tables.

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