

July 26, 1960

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2,946,440

GYRATORY SIFTING MACHINE

Filed Dec. 17, 1956

4 Sheets-Sheet 1

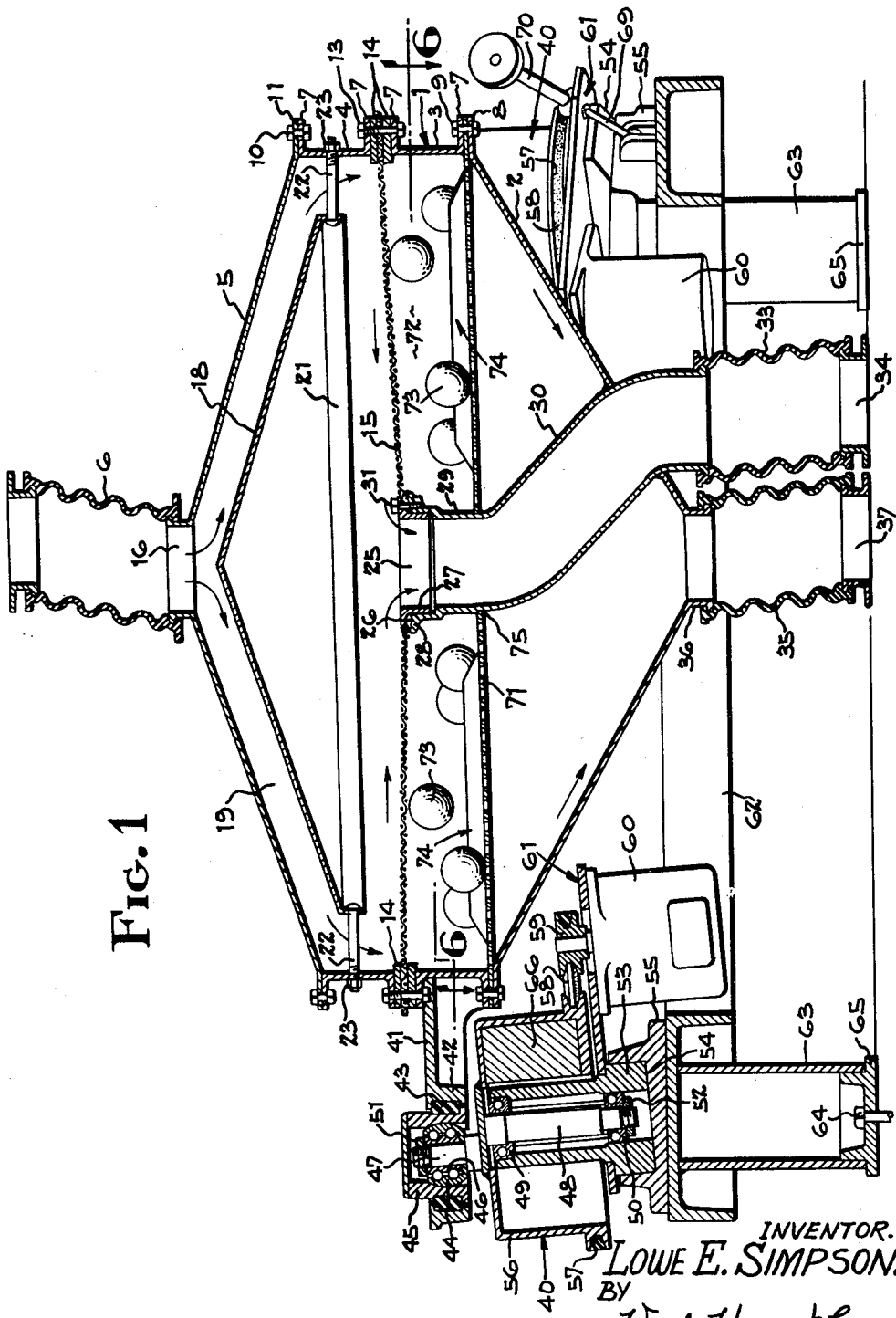


FIG. 1

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4 Sheets-Sheet 2

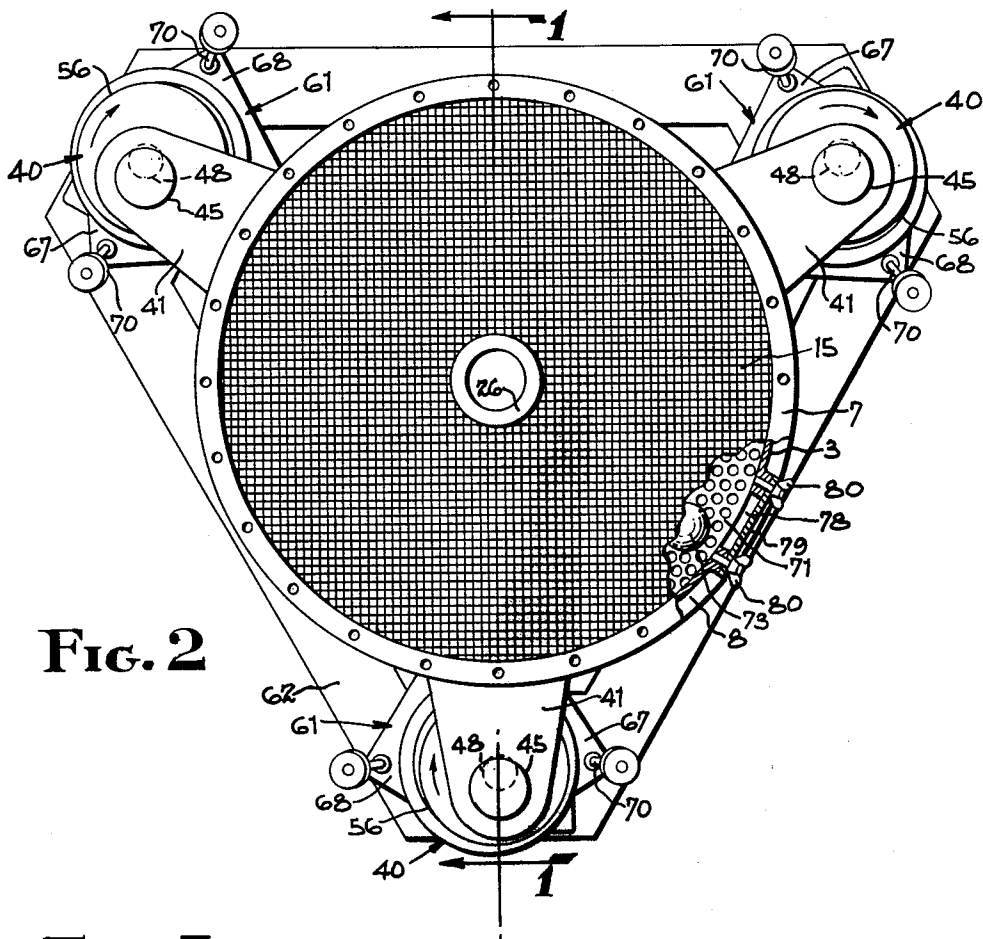
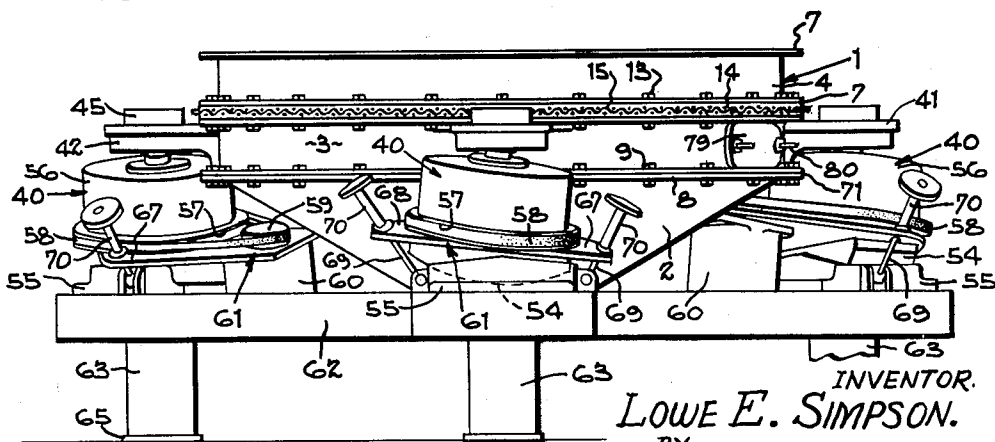


FIG. 2

FIG. 3



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FIG. 4

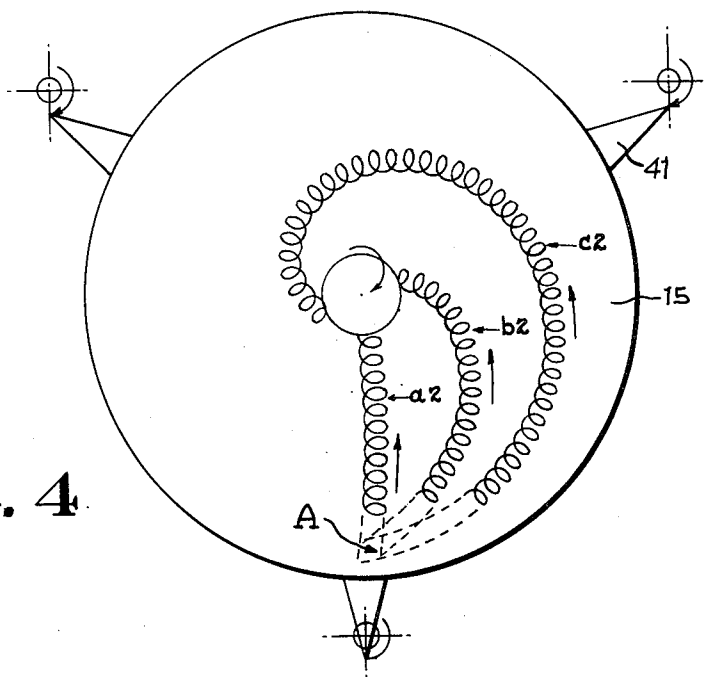
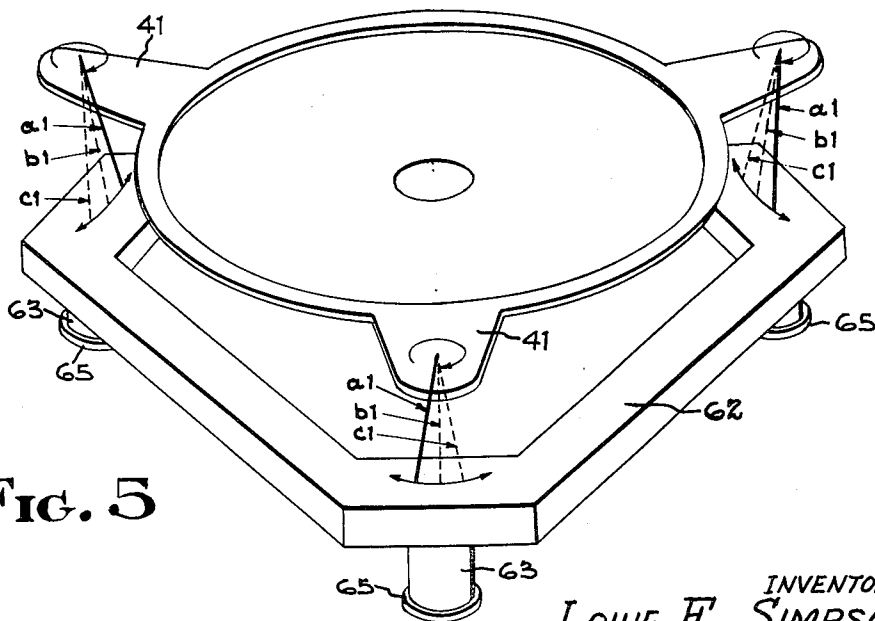


FIG. 5



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4 Sheets-Sheet 4

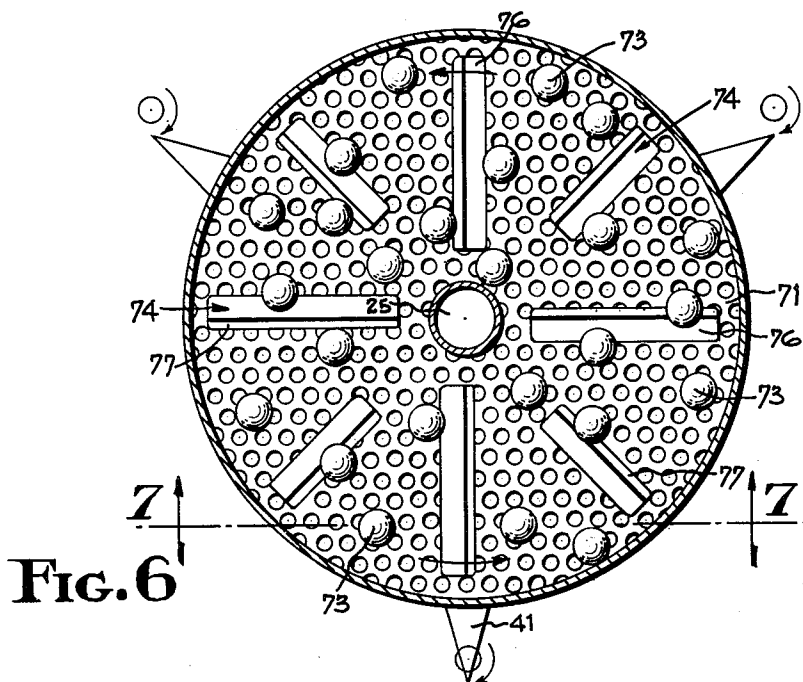


FIG. 6

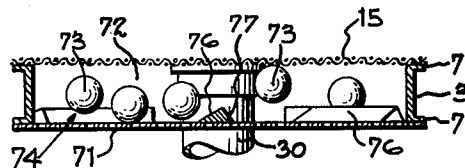


FIG. 7

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2,946,440

GYRATORY SIFTING MACHINE

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Filed Dec. 17, 1956, Ser. No. 628,726

5 Claims. (Cl. 209—326)

This invention relates to improvements in the construction of sifting or deliquifying machines of the type in which a shaking motion is imparted to substantially level screening or separating surfaces for making continuous mechanical separations of granular or fibrous material according to particle size, or for separating granular or fibrous material held in suspension in liquid from the liquid in which it is suspended.

A principal objective of this invention has been to provide a sifting machine wherein the feed material to be sifted may be caused to travel in generally predetermined paths over the screen surface from feed areas adjacent the perimeter or circumference thereof toward a central area such that particles smaller than the openings of the sifting screen may pass through it while particles larger than the openings in the sifting screen will be retained thereby for discharge through an opening at the central portion of the screen. In this manner the invention provides an improvement through which wear of the screen member is minimized and through which rapid and efficient sifting action is obtained. More specifically, the object of my invention is to provide means for enabling the operator to readily make adjustments in adapting the machine to the requirements of each specific screening task, and to otherwise accomplish convenience and economy of operation.

Machines of the present invention are adapted to be used for sifting or deliquifying a variety of comminuted materials such as food products, abrasives, face and dental powders, pigments, pharmaceuticals, fillers, spirit distiller's mash, clays and clay slips, spices, starch, sugar and many other types of materials. Some of such materials, for instance those of mineral nature, sift readily; others such as flour tend to cling to the screen or clog it rather than to fall through freely. In the past various so-called "screen cleaners" have been used comprising brushes, for wiping over the screen or balls which are caused to bounce against the screen and thereby knock loose adherent particles. Ball cleaners are generally more efficient than brush cleaners, but the balls wear during use and from time to time must be removed and replaced. In past constructions this replacement has required dismantling of a substantial portion of the machine including the screen itself, at considerable down-time and expense. An objective of the present invention has been to provide a sifting machine having a cage beneath the screen containing balls which are caused to bounce against or strike the lower surface of the screen during operation of the machine, but having deflectors which are effective not only to cause the balls to impinge against the screen but also effective to cause the balls to advance progressively and repeatedly around the central discharge spout for oversize material past a normally closed opening into the case. Removal or replacement of the balls may be accomplished readily by merely removing the closure of the opening into the cage and retracting balls

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through the opening in their otherwise normal course of movement past it.

Another objective of this invention has also been to provide a "floor-type" sifting machine, as distinguished from the suspended type, having a generally circular frame or housing carrying a sifting screen in a generally horizontal plane with means arranged above the housing for feeding material onto circumferential portions of the screen, a discharge conduit communicating with a central portion of the screen for receiving oversize material or tailings, and drive members spaced circumferentially about the frame for imparting to the screen a gyratory wobble motion, the extent or nature of which may be varied as desired to alter the path of infed material over the screen surface from the circumference toward the center as the material is being sifted. More specifically in this respect, the objective of the invention has been to provide apparatus for gyrating the screen in such manner that material being sifted may be caused to flow in paths generally radial with respect to the screen or in paths of a generally arcuate or spiral nature, whereby the length of travel of the particles being sifted over the screen surface may be varied in accordance with the nature of the material being sifted in order to provide optimum results.

Briefly, in accordance with this invention, a sifting machine is provided which comprises a frame or housing having a pan or hopper at its lower portion communicating with an outlet conduit and adapted to receive sifted particles, a screen of cloth or metal or other suitable material extending across the housing above the pan or hopper and having a central opening communicating with a second conduit to receive oversize material or tailings, and means above the screen for distributing material to be sifted to the circumferential peripheral portion of the screen. The feed means in the preferred construction comprises an inlet conduit arranged centrally over the screen but served by a distributing cone which causes the material to be sifted to be deposited onto the outer portions of the screen as the material moves downwardly over the cone, but those skilled in the art readily will understand that other types of distributors may be used to accomplish a similar result, such as moving spouts or the like.

In the preferred construction, the hopper, screen, feed cone, and upper housing portion are movable as a unit and they are supported in assembly from the exterior of the housing upon drive members which may be mounted on a stationary base or mounting but which are arranged in spaced relationship to one another around the housing and each drive member comprises a rotatable shaft having an eccentric in connection with the housing, but the axes of the shafts are angulated with respect to the plane of the screen such that rotation of each drive shaft causes the eccentric thereof to rotate in a plane angulated with respect to the screen plane. By this means all points on the screen are gyrated through orbital paths corresponding to the diameters of the circles of revolution of the eccentrics, but the screen is also subjected to motion transverse to the screen by reason of the angular relationship of the axis of rotation of the eccentrics with respect to the general plane of the screen or the plane passing through its rim. In other words, points on the screen surface are caused to follow orbital paths in planes that are slightly out of parallel with the plane of the screen surface. The axes of the respective drive shafts are tilted not only with respect to the screen plane but also in relation to one another to cause the screen to wobble as it gyrates. Thus, one eccentric reaches the high point in its plane of revolution at a different moment than other eccentrics respectively reach their high points while all points on the surface travel in orbits lying in

various planes and have circular motion. Through this motion, material deposited upon the screen is caused to advance or progress over its surface. The invention, however, contemplates means for adjusting the extent of wobble, i.e., the extent of vertical movement in the compound motion, by varying the angle of eccentric tilt of the axes with respect to the plane of the screen. This adjustment may be made while the machine is running, thereby permitting the operator to readily observe the effect of adjustment as he goes.

Since the eccentrics are interconnected with the frame, they are respectively interconnected with one another, and therefore, they operate in unison even though only one is power driven. For this reason, the eccentrics may be powered independently of one another or in unison. Each eccentric preferably is equipped with a counter balance to dampen undue vibrations which might otherwise occur when the gyratory wobble motion is imparted to the apparatus at a high rate.

By virtue of the compound motion of gyration and wobble of the screen, material deposited upon the screen is caused to move in a generally inward direction toward the center of the screen and particles which are small enough to pass through the screen openings do so as they move progressively across it. Materials which are slow to sift because they are of a somewhat sticky nature may be caused, by adjustment, to proceed toward the center along a curved, arcuate, or spiral path and thereby be subjected to a more extensive sifting action than is needed when the feed sifts freely. This action, moreover, permits stratification of the feed material as it is deposited upon the screen at the outside areas thereof, whereby larger particles or tailings subjected to agitation along with the finer particles will move toward the upper surface of the feed layer during its movement, permitting the smaller or finer particles to move downwardly and pass more readily through the screen.

In respect to cleaning of the screen membrane, balls or ball-shaped members which are preferably of a somewhat elastic nature, may be disposed within a cage beneath the screen on a foraminous support extending across the hopper underneath the screen. This support, of course, has openings large enough to permit sifted material to pass through it for collection in the lower portion of the hopper, but the support carries deflectors having surfaces angulated with respect to the screen so as to cause balls impinged upon such surfaces to be deflected upwardly toward the screen and to impinge upon it. However, in accordance with this invention, the surfaces of the deflectors are angulated differentially with respect to one another to cause the balls to be deflected at a lesser angle (with respect to the screen) when striking the deflectors from one direction than when striking the deflectors from a relatively opposite direction, and the deflectors are so positioned that their lesser angulated surfaces face generally in the same direction circumferentially of the screen and vice versa. Therefore, although the balls will always bounce or be thrust toward the screen when hitting either face of any deflector, they will be deflected to different degrees when hitting upon the deflector surfaces facing in one direction than when hitting upon the deflector surfaces of different angulation facing in the opposite direction. In this manner, the ball, upon operation of the machine, are caused not only to bounce up and down to effect cleaning of the screen but also to progress generally around the inside of the cage. During operation some of the balls hitting deflector surfaces of steep angle will, of course, momentarily move thereafter in a direction counter to the general trend of movement, but the trend direction nevertheless is established statistically by the difference in angulation. A "flow" of bouncing balls around the inside of the cage is thus obtained. The flow may be diverted through the access opening, or the balls

may be retracted from the cage as they move past it when the balls are to be removed.

From the foregoing discussion of the principles upon which this invention is predicated and the following detailed description of the drawings in which a preferred embodiment of the present invention is illustrated, those skilled in the art will understand the variations of structure to which the invention is susceptible.

In the drawings:

Figure 1 is a sectional view taken vertically through the machine to show the operative relationship of the parts as taken on the line 1—1 of Figure 2;

Figure 2 is a plan view of the machine shown in Figure 1 with the top cover and feed distributing cone removed and with part of the screen cloth cut away to show the mesh cleaner ball compartment therebeneath and the covered opening giving access to the ball compartment;

Figure 3 is a side view of the machine as it is shown in Figure 2;

Figure 4 is a diagrammatic plan view showing various paths the particles of material being sifted may be caused to flow over the screen cloth under different adjustments of the means used for controlling the flow path of the feed material;

Figure 5 is a diagrammatic view in perspective illustrating various inclinations to which the drive shafts may be adjusted to vary the flow path;

Figure 6 is a plan view taken on the line 6—6 of Figure 1 showing construction of the mesh cleaner ball compartment; and

Figure 7 is a sectional elevation taken on the line 7—7 of Figure 6.

The sifting machine shown in the drawings comprises a sheet metal housing indicated generally at 1 which is made up of a pan or hopper 2, a screen box comprising lower and upper circumferential or girth members 3 and 4 respectively, and a top cover 5 to which, in one mode of construction, a flexible sleeve or spout 6 is connected. The cover or pan may be provided with one or more inspection windows (not shown) as desired.

Each of the circumferential members 3 and 4 is flanged outwardly at its upper and lower edges as at 7. The hopper 2, terminating in a marginal flange 8 at its upper end, is connected to the lower flange of the lower circumferential housing member 3 as by spaced bolts 9, and the upper flange of the upper circumferential housing member 4 is connected by spaced bolts 10 to the marginal flange 11 of the cover 5. The upper flange of the lower member 3 and the lower flange of the upper member 4 are interconnected to one another by spaced bolts 13, but inbetween these flanges gasket members 14, 14 are installed at the opposite faces of a screen member 15, which extends across the interior of the housing over the pan 2. Sifting membrane 15 may be made of bolting cloth, wire mesh, or other suitable material having openings conforming to the largest particle size intended in the finished product.

Feed sleeve 6 may be fastened to the opening 16 at the top part of the cover 5 in any suitable manner, and the bolted flanging structure between the upper and lower half members 3 and 4 permits the cover 5 to be demounted conveniently whenever the screen member 15 is to be replaced either when worn out or whenever a screen having openings of different size is to be installed as may be necessary when the machine is to be converted for service on a different type of material.

A distributor cone 18 is located beneath the cover 5 in spaced relation thereto so as to provide feed passage-way 19. The apex of the cone 18 is located approximately centrally beneath the outlet of the feed spout 6, and the outer circumference of the distributor cone is spaced inwardly from the periphery of screen 15 whereby feed material falling through the inlet 16 passes downwardly and outwardly over the distributor cone 18 onto

the screen member 15 at the marginal areas adjacent its periphery. To mount the feed cone 18, its lower edge may be provided with a vertical circumferential flange 21 from which spokes 22 extend rigidly in outward direction through bores in the upper housing member 4 beyond which they carry fastening nuts 23. By this arrangement, the distributor cone is mounted for movement in unison with the screen.

In the preferred construction, the housing is round in plan. This arrangement permits all portions of the screen to be functionally active and eliminates dead spots such as might occur at the corners of an apparatus of square or rectangular outline. However, it will be understood that the principles of the present invention may be incorporated in apparatus which is polygonal or of other than round or circular plan contour if desired.

The central portion of the sifting screen 13 is provided with an opening 25. At the margin of this opening the screen material is caught between flange 26 of an inner ring 27 and flange 28 of an outer sleeve 29, the latter being formed at the upper portion of a discharge spout 30 for conducting oversize particles or tailings from the machine. Bolts 31 pass through one of the flanges into threaded engagement with the other to clamp the screen cloth thereto and the flanges are preferably angulated downwardly to the mouth of the opening as is shown in Figure 1 to avoid a "hump" or ridge which might otherwise obstruct the movement of particles into the opening 25.

Conduit 30 extends downwardly beneath the central screen opening 25 a short distance and then is angled laterally to pass through the wall of pan 2 in offset relation to the opening 25. At the outside of the housing, conduit 30 communicates with a flexible sleeve 33 which is connected to an outlet pipe 34. The oversize particles or tailings pass through this conduit.

A flexible sleeve 35, suitably connected to a collar 36 around an opening at the bottom of the pan, leads to a pipe 37 which receives the finished, sifted product. It will be understood that details as to which the finished product and tailings are conducted from the apparatus may be varied to suit given conditions, but it will also be noted that the arrangement disclosed permits flow of materials to and through the apparatus in a substantially vertical line. Thus, where a product is to be subjected to successive siftings, the machines of the present invention conveniently may be installed one directly above another on suitable supports.

The housing is movably supported at equally spaced points about its periphery, e.g., three in number, upon motion control and support members, indicated generally at 40, which respectively engage arms 41 extending outwardly from circumferential housing member 3. Units 40 individually may be of the type shown in Simpson, United States Patent No. 2,149,368. However, in accordance with the present invention, such units are arranged cooperatively to impart a gyratory wobbling motion to the screen and it is appropriate therefore to describe their construction in order that the manner in which they cooperate may readily be understood.

Each arm 41 carries a downwardly projecting annulus 42 at its outer extremity within which a shouldered rubber bushing 43 is journaled for absorbing differences between center distances of one annulus 42 and another and one eccentric bearing 44, and another due to temperature expansion and contraction of metals and, also, for absorbing the slight differences in center to center distances that occur from making angular drive shaft adjustments. The sleeve 45 carrying the rubber sleeve on its outer diameter has a spherical internal bore in which is seated the anti-friction eccentric bearing 44, having an outer spherical race of complementary configuration at least at its upper portion so as to permit the axis of the

bearing member 44 to be angulated with respect to the axis through journal block 43.

The inner races 46 of the anti-friction bearings of the respective assemblies are engaged by stub shafts 47 which are eccentrically disposed at equal radii with respect to main shafts 48 which are rotatably mounted in upper and lower anti-friction bearings 49 and 50 respectively. Eccentric 47 projects through the anti-friction bearing 44 to carry a nut 51 and shaft 48 extends below anti-friction bearing 50 to carry a nut 52.

Bearings 49 and 50 are mounted in a sleeve 53 which has a convex lower end 54 adjustably seated in a pedestal 55. A hollow flywheel 56 connected to the main shaft 48 of each assembly surrounds sleeve 53 and is welded to shaft 48 for rotation therewith, upon the support provided by the upper bearing 49. The lower portion of the flywheel 56 carries a V-groove 57 through which the flywheel is driven by a belt 58 which engages the drive pulley 59 of a motor 60. The motor is mounted on a bracket plate 61 which projects rigidly in lateral direction from sleeve 53.

Pedestals 55 of the assemblies 40 may be mounted directly upon the upper surface of an annular flanged mounting ring 62 which rests upon posts 63 which are, in turn, adapted to be located upon and fastened to the floor by means of bolts 64 extending through post feet 65.

Counter-weights 66 respectively, installed within the flywheels 56 of the assemblies 40, provided counterbalancing for the entire machine.

As is shown best in Figure 3, each bracket plate 61 has arms 67 and 68 which project in a direction circumferential with respect to the housing. These arms, at their outer extremities, are respectively traversed by hold down bolts 69, 69 having their lower ends pivoted, and clamped by the hand wheel nuts 70 to the pedestal 55 at opposite sides of the axes of rotation of shafts 48. The portions of the bolts projecting above the brackets carry knobbed adjusting nuts 70 respectively.

To facilitate adjustment of angularity of the drive shafts 48, the lower portions of sleeves 53 are arcuate, and the pedestals 55 are of complementary configuration, as is shown in elevation at the right-hand side of Figure 1 and in cross section at the left-hand side of Figure 1. The arcuate portion is generated about a center point conforming to the center of the orbit of the eccentric, as is shown in Figure 3, and the seat in the pedestal is also angulated radially as shown. By this construction, the tilt of the axis of shaft 48 may be varied in the plane of the slot of the pedestal so as to provide adjustability in the tilt of the axis of the shaft in circumferential direction. However, if desired, a spherically convex seat construction may be utilized which will accommodate adjustments in both radial and circumferential direction; the former type of construction is illustrated because the latter is needlessly expensive for most machines, including those adapted for universal service. Therefore, it will be seen that the axes of shafts 48 and the axes of rotation of eccentrics 47 which are parallel therewith, may be angulated with respect to the plane of the screen member 15 simply by loosening one nut 70 of each assembly 40, rotating the other in a downward direction until the desired change in angulation is effected, then tightening both nuts to lock the assembly in that position of adjustment.

Where the material is of a granular or free-flowing nature, it may pass through the sifting screen 15 freely without clogging the same. However, if the material is of "sticky" nature, such as flour, various other types of foods, or the like, or, otherwise tends to adhere to the screen, provisions may be necessary to clean the screen. Where machines constructed in accordance with this invention are intended for sifting a wide variety of particles, a screen cleaning apparatus is employed which includes a perforated retainer plate 71 arranged beneath

screen member 15 in spaced relation therewith to form a cage, indicated generally at 72, containing a plurality of balls or bouncing members 73. Deflectors 74 are mounted in the cage to activate the balls, i.e., to cause them to bounce against the screen. In the construction shown, retainer plate 71 has openings which are substantially larger than the openings in the screen cloth and it may be held in place across the top of the pan 2 by disposition between flange 8 of the pan and the lower flange 7 of the lower circumferential housing member 3, and the vertical portion of the tailing spout 30 passes centrally through this plate as at 75.

Deflectors 74 are mounted on the upper surface of the retainer plate by suitable bolts or tack welding or similarly formed deflecting surfaces may be stamped or formed in the perforated plate to be integral with it. Each deflector is of an elongated nature but with the deflectors preferably arranged in radial directions with respect to the vertical axis of the screen, as is shown in Figure 6. The deflectors, in cross section, are of triangular shape, but the opposite faces 76 and 77 of the deflectors (Figure 7) are disposed at different angles with respect to the plane of the retainer plate and the slopes of lesser angulation, e.g., 76, all face in one direction, e.g., clockwise, while the opposite faces, 77, face uniformly in opposite direction, e.g., counter clockwise.

The deflectors cause the balls, 73, which may be of rubber or may be in the form of wound springs, to bounce in the cleaner cage against the lower surface of the screen 15, as will be understood by those skilled in this art. However, through the novel difference in angulation of the deflector faces, the extent to which the balls are deflected laterally when striking the deflectors from one direction will be different from the extent to which the balls will be deflected laterally when striking the deflectors from the opposite direction, with the result that each ball will not merely bounce up and down in the cage over a given area of the screen, but the balls will move circumferentially around the screen in a flow of movement either generally clockwise or counter clockwise as shown, depending on which way the deflectors are placed. Where no deflectors used in the ball cage, the balls would still travel around the cage because of the gyration thereof, but in the construction shown the deflectors serve the double purpose of tossing the balls upwardly and speeding their travel around the central outlet.

The lower circumferential housing member 3 is equipped with one or more access openings indicated generally at 78 (Figure 2). Each hand-hole opening is closed by a plate 79 which is held in place by thumb nuts 80, 80. Thus, when the machine is in operation and the hand-hole cover 79 is removed, the balls will move up and down in the cage but also progress past the hand-hole opening, and therefore, while the machine is in operation, the balls readily may be removed simply by retraction through the hand-hole opening, as distinguished from the necessity of dismantling the entire machine cover to obtain access to balls which are held in compartmented cages of the type heretofore known.

Operation of the machine

In assembly the eccentrics 47 of the respective drive members reside at corresponding points in their circles of rotation with respect to the housing as seen in Figure 2. If only one of the eccentrics is power driven, the other two will follow rotationally because of the interlinkage which is provided by the rigid housing member 3 to which the eccentrics are connected through arms 41. On the other hand, if each eccentric is powered individually by its own motor 60, no special requirement is necessary for synchronizing the motors since any motor which is out of phase with respect to the others at the start of its operation will fall in step with the others momentarily thereafter by reason of the slip permitted through magnetic coupling of the motor field and armature. Thus,

the invention contemplates means for driving the screen from one, two, or each of the eccentrics by which the apparatus is supported.

Each eccentric rotating about an axis which is angulated in respect to the general plane of the screen defines a circle of revolution which is in a plane residing at an acute angle to the plane of the screen. Therefore, as each eccentric approaches the high point of its circle of revolution the portion of the screen adjacent that eccentric is lifted; as the eccentric continues its rotation toward the low point in its circle of revolution, the adjacent portion of the screen falls. Hence, the screen adjacent each eccentric is subjected to up and down motion as well as to an orbital or gyratory motion conforming to movement of the eccentrics about their circles of revolution. As will be noted best in Figure 2, the axes about which the eccentrics rotate are angled differentially with respect to one another such that the eccentrics successively reach their high and low points of movement laterally with respect to the screen. In other words, as one point on the screen is at its zenith other points spaced radially therefrom are, at the given moment, moving downwardly or have reached their low limit of travel. Therefore, timewise, the high point of the screen (and, of course, the low point and intermediate points) progress circularly about the screen axis. If the vertical component of the motion were to be considered only by itself, the motion aptly could be described as a wobbling motion. However, this wobbling motion proceeds in conjunction with the gyratory movement of the screen corresponding to the orbital movements of the eccentrics in unison. Hence, the compound motion has lateral and vertical components and therefore is described as a gyratory wobbling motion. The horizontal component is of equal magnitude over all areas of the screen but the vertical component diminishes progressively from screen periphery where it is greatest toward the center where it is least.

Material fed into the machine through the inlet sleeve 6 progresses downwardly over the distributing cone 18 from which it falls onto the screen 15 adjacent the periphery thereof. Some of the material being finer than the mesh openings immediately falls through the screen past the ball retaining plate 71 into the hopper 2 and through outlet sleeve 35 and finished product delivery pipe 37. Other material, at the upper portion of the feed layer on the screen, not yet having reached the screen, begins to stratify under the influence of the motion, the finer particles proceeding downwardly toward the screen while the larger particles proceed upwardly because of their lesser apparent density. This stratification of feed material under the influence of the motion accelerates the sifting process. However, in addition to the stratification, the feed material under the influence of the gyratory wobbling motion proceeds to travel in a generally inward direction, straight toward the center on a radial path, or on a looping path extending spirally or convolutely toward the center. During this movement the finer particles which reach the screen pass through its openings while the particles too large to pass through the screen openings continue their advancement toward the center where eventually they reach the center opening and fall through conduit 30 and the tailings outlet 33.

The nature or direction of the paths which the particles are caused to follow over the screen surface is governed by the nature and the degree of angulation of the axes about which the eccentrics rotate with respect to the plane of the screen. The adjustment provided by manipulation of the hold-down nuts 69 permits the angulation to be varied while the machine is in motion whereby the operator, adjusting the position of each assembly 40 as he moves around the machine, readily may observe the effect of the adjustment and thereby set the apparatus to produce optimum sifting action on the feed material.

In the preferred construction, and for sifting a wide variety of materials, the axes of the drive shafts 40 are

set each at a compound angle relative to an axis passing perpendicularly through the screen, that is, each eccentric defines a plane of revolution which is at a small acute angle with respect to the screen but which is also at an angle with respect to the planes defined by the circles of revolution of the other eccentrics. Thus, in a typical setting the axes about which the eccentrics rotate are tilted from the vertical respectively to extend radially outwardly and in circumferential direction relative to the screen, although for some purposes it may be found that either component of tilt may be very small or not necessary at all. The tilt in either or both directions need not be very great; for example up to about 7°. An angle of approximately 4° to the vertical, for example, may be suitable for an average material. The more the tilt, the greater will be the vertical component or the greater the wobble.

Figures 4 and 5 illustrate diagrammatically the manner in which adjustment of the degree of angulation causes variation in the path of travel which the feed material will assume. With the axes of the eccentrics brought to the central point of adjustment, as represented by the dotted axis lines *b-1* on Figure 5, the material deposited on the screen at area A therefore will travel in an approximation of the path shown as *b-2* on Figure 4, spirally inwardly in counter-clockwise direction on the screen surface, assuming that the crank motion is clockwise, and material deposited on the circumferential areas will assume similar paths toward the center. If adjustment is continued so that the eccentric axes conform to the dotted lines *c-1* on Figure 5, the material will move inwardly on a longer spiral path, shown as *c-2* on Figure 4. With all eccentrics having their axes of rotation inclined to the left, as shown by the solid lines *a-1*, the material will travel over the screen in a direction fairly straight or radially toward the center opening. Although, for simplicity in the description of this invention, the adjustment knobs 70 are shown as individually adjustable members which the operator manipulates progressively as he moves around the machine, various chain or gear type mechanical devices may be readily employed to effect the adjustment of all nuts in unison from a single point if desired.

It will be understood that differing materials will leave the screen rim at differing angles or following differing paths toward the center for a given circumferential setting of crankshaft tilt. This is accounted for by the differences in frictional resistance between the materials in the screen surface. Some materials will receive their greatest forward or circumferential thrust tangentially from the orbital screen motion at a point earlier or later in the cycle of motion than will others. Factors also determining the flow path may include the granular shape of the particles of material, their moisture content and specific gravity, the percentage of "fines" in the total feed, the rate of feed, the depth of material that provides most satisfactory screening, as well as the presence of a static charge such as might cause adherence to silkscreens or the like.

The rate at which the screen is gyrated, and the extent of wobble or vertical reciprocation may be varied to suit individual requirements. By way of example, but not by way of limitation, the gyrating motion may have an amplitude of 2" to 4", a speed of between 325 to 190 strokes per minute depending on the amplitude of stroke, and an amplitude of vertical motion of 1/8" to 1/2" depending on the stroke and nature of the material sifted.

In machines equipped with the mesh cleaning ball retainer structure which has been described, motion imparted to the housing 1 causes motion to be imparted to the caged balls whence they bounce against the under surface of the screen in consequence of their impact against the deflectors. This action shakes loose from the screen particles which have not passed through freely or which tend to cling or obstruct the screen openings. This

action therefore maintains the screen in an open condition as is well understood by those skilled in the art. However, as previously described, the difference in angulation of the faces of the deflectors causes the balls, as they move up and down, to move around the cage in a circuitous but generally circular trend of flow whereby the balls move past the outlet 78 through which they may be removed whenever desired.

Since the conduit 30 may be fastened relatively rigidly to the pan 2, the central portion of the screen 15 fastened to the conduit 30 may derive support therefrom to prevent undue sagging of the screen if the diameter is quite large or if the material being screened is very heavy. It will also be understood that the central portion of the screen may reside slightly below the level of the screen perimeter to accelerate the flow of material nearing the center of the screen where there is less rise and fall than at the perimeter, but it will also be understood that the screen surface may be completely flat and taut such as may be desired when solids held in liquid suspension are to be dewatered.

An important advantage obtained by the feed of material to the outer periphery of the screen plus flow over the screen toward its center resides in the fact that the screen is not subjected to excessive wear at any local areas and screen life is therefore increased. In multi-stacked installations, or where the finest cloth which requires the most frequent replacement is used, the single screen cloth is readily accessible upon unclamping and lifting of the top cover 5 and associated upper housing member 4. Any suitable screen tensioning will be employed, but it will also be noted that the circular design facilitates equalization of screen tension in all directions.

Having described my invention, I claim:

1. A sifting machine comprising, a circumferential housing member disposed in a generally horizontal plane, a screen extending across the said member and having a tailings opening at substantially its center portion, means for delivering material which is to be sifted to upper surface areas of said screen adjacent the circumference thereof, a conduit communicating with the central opening of the screen and extending therebeneath, drive members in spaced circumferential relationship to one another interconnected with said housing member, said drive members comprising eccentrics rotatable about axes which are tilted from vertical direction for imparting a gyratory wobbling motion to said screen whereby material to be sifted is caused to move over the surface of the screen in paths of travel extending from the circumferential areas to which the material initially was delivered generally toward the central area such that particles smaller than the openings of said screen member pass through it during their courses of travel and particles larger than said openings move over the screen surface and escape through the central opening and conduit connected thereto, and means for absorbing differences in the center spacing of said eccentrics.

2. A sifting machine comprising, a housing, a screen member residing in a substantially horizontal plane disposed across said housing, a distributing cone substantially centrally surmounting said screen member, the periphery of said cone terminating inwardly above the screen periphery, means for delivering material which is to be sifted to the apex portion of said cone whereby the material falls downwardly over the cone and is deposited upon outer portions of said screen, said screen having a tailings opening at substantially its central portion, a tailings outlet conduit residing beneath said screen communicating with said opening, means for imparting a gyratory wobbling motion to said housing, said means comprising rotatable eccentric members interconnected with said housing at spaced circumferential points thereon, the said eccentric members having axes of rotation tilted outwardly with respect to the plane of said screen, means for absorbing differences in the center spacing of said eccentrics,

and power means for driving at least one of said eccentric members whereby all rotate in unison.

3. A sifting machine comprising, a circular housing, a screen member residing in a substantially horizontal plane disposed across said housing, a distributing cone substantially centrally surmounting said screen member, the periphery of said cone terminating annularly inwardly above the screen circumference, means for delivering material which is to be sifted to the apex portion of said cone whereby the material falls downwardly over the cone and is deposited upon outer annular portions of said screen, said screen having a tailings opening at substantially its central portion, a tailings outlet conduit residing beneath said screen communicating with said opening, means for imparting a gyratory wobbling motion to said housing, said means comprising rotatable eccentric members interconnected with said housing at equally spaced circumferential points thereon, the said eccentric members having axes of rotation tilted outwardly and circumferentially with respect to the plane of said screen, means for absorbing differences in the center spacing of said eccentrics, and power means for driving at least one of said eccentric members whereby all rotate in unison.

4. In a sifting machine having a substantially horizontally disposed shifting screen and having a central tailings opening in said screen, means for imparting a gyratory wobbling motion to said screen for causing particles to move over its surface in paths extending generally from the periphery thereof toward said central opening, said means comprising drive units spaced around said screen, each drive unit having a rotatable shaft, power means for rotating the shaft, an eccentric driven by the shaft, means interconnecting the eccentric respectively with said screen, the said shafts being positioned with respect to the screen such that the circle of revolution of each eccentric defines a plane which is at an acute angle with respect to the plane of the screen and which is not parallel to the planes passing through the circles of revolution defined by the other eccentric members, and means for absorbing differences in the center spacing of said eccentrics.

5. In a sifting machine having a housing containing a substantially horizontally disposed mesh sifting screen, a screen mesh cleaner comprising a retainer plate disposed in said housing beneath said screen, said plate having openings larger than the openings in said screen and forming a cage with said screen, a plurality of ball-like elastic members disposed in said cage, and a plurality of deflectors mounted on said retainer plate, the said deflectors being disposed in generally radial relation to an axis passing transversely through substantially the center of said screen, the deflectors respectively having oppositely downwardly sloping upper surfaces, the surfaces of the deflectors which face in one direction of rotation with respect to said axis being disposed at steeper angles with respect to said screen plane than those surfaces of the deflectors which face in the opposite direction, and means imparting a translating motion to said screen such that the elastic members impinging on said angulated deflector faces are caused to bounce up and down and against the lower surface of said screen and to advance in a generally circular path around said axis because of the difference of angulation of said deflector surfaces.

References Cited in the file of this patent

UNITED STATES PATENTS

589,929	Bunge	Sept. 14, 1897
1,980,490	Lide	Nov. 13, 1934
2,149,368	Simpson	Mar. 7, 1939
2,226,416	Simpson et al.	Dec. 24, 1940
2,284,671	Meinzer	June 2, 1942
2,540,517	Glasco	Feb. 6, 1951
2,676,706	Temple	Apr. 29, 1954

FOREIGN PATENTS

4,338	Great Britain	Mar. 1, 1894
18,223	Great Britain	Aug. 24, 1898
23,671	Great Britain	Nov. 10, 1898
480,003	Great Britain	Feb. 15, 1938
550,661	Great Britain	Jan. 19, 1943