Feb. 6, 1968 A. MOTOSI 3,367,499

SHAKING-FUNNEL DEVICE FOR THE GRAVITY CONCENTRATION OF SOLID PARTICLES

Filed Jan. 12, 1965 2 Sheets-Sheet 1

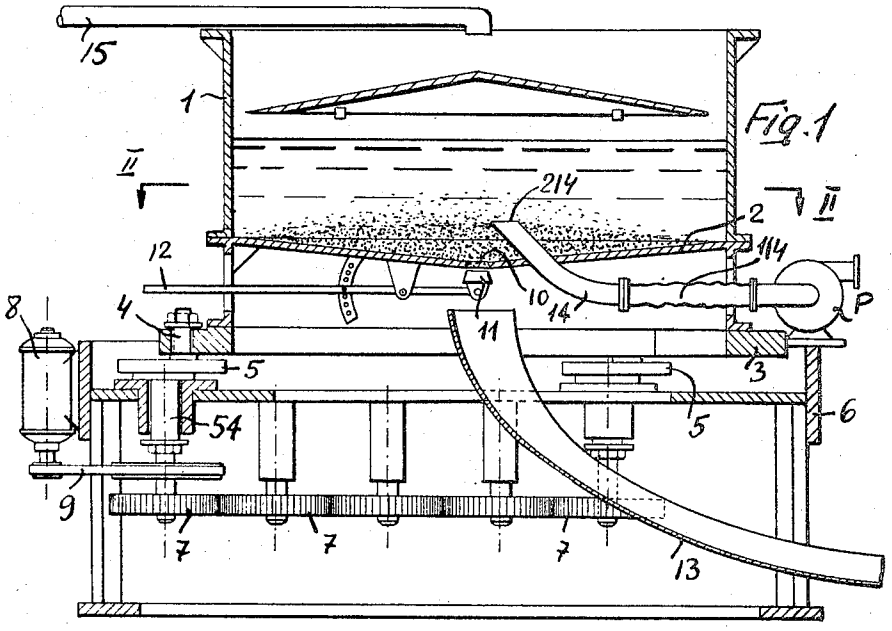


Fig. 1

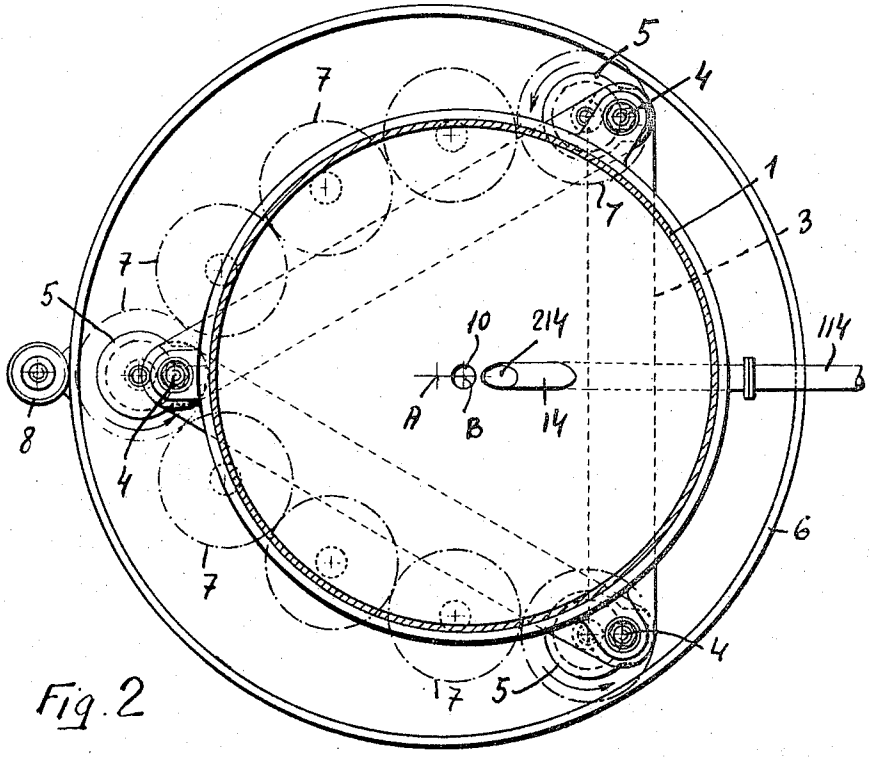


Fig. 2

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SHAKING-FUNNEL DEVICE FOR THE GRAVITY CONCENTRATION OF SOLID PARTICLES

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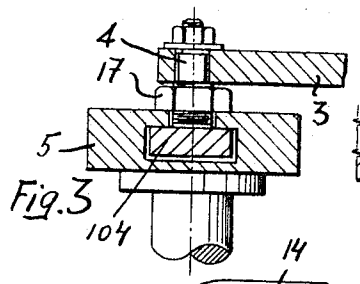


Fig. 3

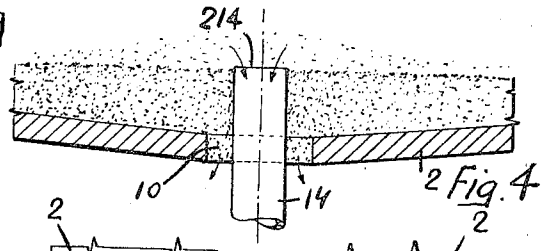


Fig. 4

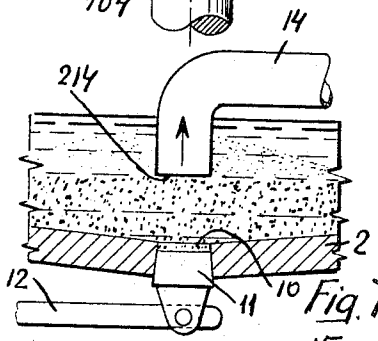


Fig. 7

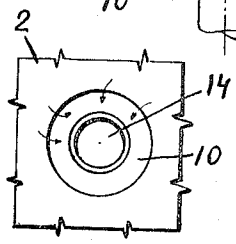


Fig. 5

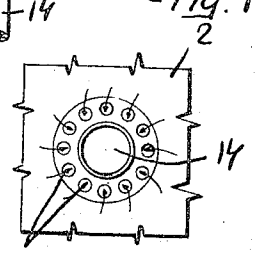


Fig. 6

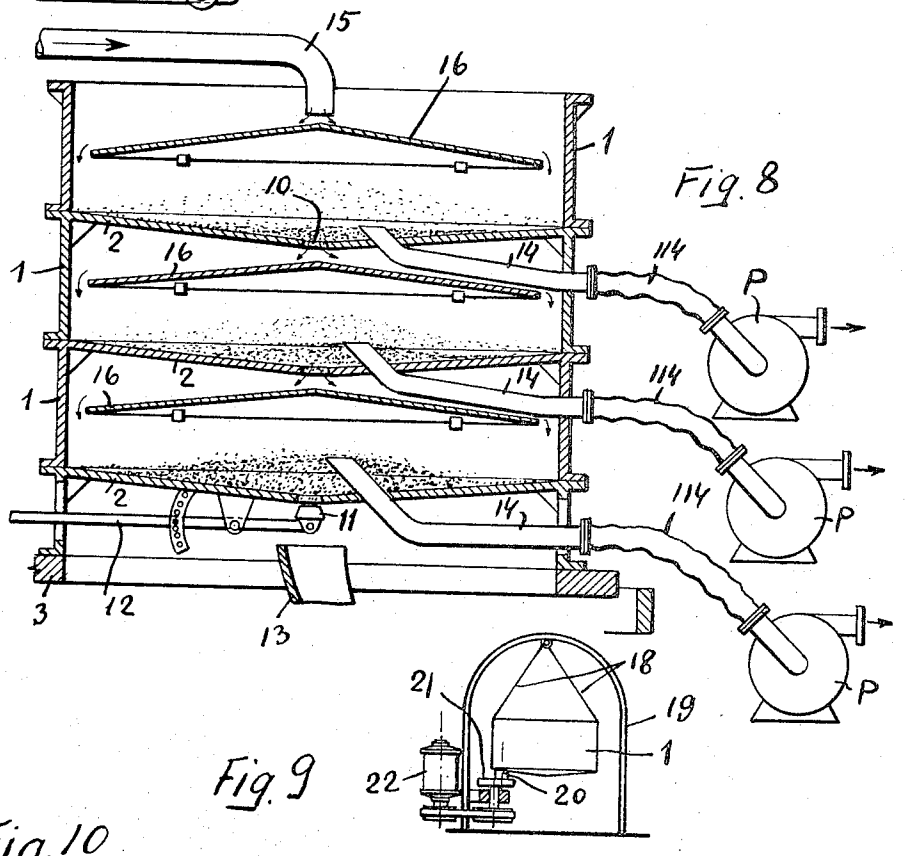
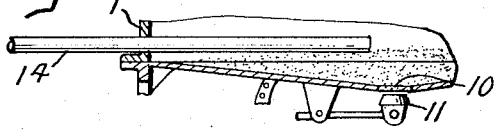


Fig. 8

Fig. 9

Fig. 10



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SHAKING-FUNNEL DEVICE FOR THE GRAVITY CONCENTRATION OF SOLID PARTICLES

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Filed Jan. 12, 1965, Ser. No. 424,976
Claims priority, application Italy, Jan. 21, 1964, 1,554/64
2 Claims. (Cl. 209—445)

ABSTRACT OF THE DISCLOSURE

Mechanical shaking apparatus for the separation by gravity of particles having different densities comprising a container and drive means to impart thereto a compound, nonuniform circular and vibratory motion, and including a plurality of idler gears.

This invention relates to a mechanical shaking apparatus for separating a mixture of solid particles having practically the same size but a considerable difference in density or specific weight and applies particularly to the dressing of ores or to the concentration of the valuable components of a powdery or granulated mixture, either dry or in slurry form.

According to the invention, the improved shaking apparatus for the concentration by gravity of powdered ores or the like comprises an open-top container or vat having at least a preferably wide-angled funnel-shaped bottom or diaphragm or "funnel" provided with an outlet port at its lower reduced central part and a distributing baffle cone arranged above said or above each of said funnels and adapted to distribute the feed at the periphery of each container, above each funnel, means being provided for imparting to said containers and funnel a gyratory or planetary shaking movement, due mainly to vibrations imparted to the moving parts due to the drive arrangement of the construction, whereby the feed, which is preferably in a wet or slurry form, but which in some cases may be also dry, due to the slope of the funnels towards the centre thereof, and to the vibration of the container, moves in the direction of the gyratory motion towards the centre of the funnel where the heavy material collects in form of a lower layer in proximity of the funnel, and tends to flow towards the outlet port thereof from which it may be readily discharged, while the light fraction of the material comes to float above the said lower layer and forms an upper layer which may be removed by means of a discharge duct whose inlet mouth lies a certain distance above the said outlet port and the boundary surface between the said upper and lower layer of material.

It is apparent that by suitably regulating the feed as well as by regulating the diameter of the eccentrical path along which the funnel is revolved as well as its velocity and the shaking or vibration inherent or combined with said gyratory movement, a continuous operation of the separating device may be obtained by feeding and discharging continuously the two materials to be separated.

The above and other characteristic features of the invention and the inherent advantages will appear from the following specification of some preferred embodiments which are diagrammatically shown by way of non-limiting example in the accompanying drawings, in which:

FIGURE 1 shows in vertical section a shaking concentrating apparatus according to the invention;

FIGURE 2 is a plan view thereof, in horizontal section on line II—II of FIGURE 1;

FIGURE 3 shows in enlarged scale a vertical section of a detail of the adjustable crank mechanism for driving the apparatus shown in FIGURES 1 and 2;

FIGURES 4, 5, 6 and 7 show variations of outlet ports for the separated materials;

FIGURE 8 shows in vertical section a multiple apparatus according to the invention;

FIGURE 9 shows in elevation another embodiment of the apparatus according to the invention, and

FIGURE 10 is a fragmentary sectional view showing another modification.

With reference to FIGURES 1 and 2, the shaking apparatus according to the invention comprises a preferably cylindrical vat or container **1**, having a preferably slightly concave or funnel-shaped bottom **2**, which is preferably dismountable, and may be replaced by differently shaped funnels, to suit the apparatus to different requirements.

Vat **1** is mounted upon a supporting member **3** which may be moved along an annular path in a substantially horizontal plane. The revolution centre A of the annular path which is described by the vat **1** is eccentrical with respect to the centre B of said vat, as it appears from FIGURE 2.

In order to impart to the containers or vats **1** a gyratory shaking motion, the containers may be provided with a supporting member **3** mounted upon vertical pins **4** forming part of three cranks **5**, whose vertical shafts **54** are mounted upon a framework **6** and are preferably coupled together, for example by means of gears **7**. Said cranks **5** are driven by a motor **8** preferably through a belt drive **9**. In order to cause the vat to vibrate and shake the material, the construction of the cranks **5**, supporting framework **6** and gears **7** is very rough, as it is customary in machines for the dressing or sorting of ores.

The funnel-shaped bottom **2** of the vat **1** is preferably wide-angled, as shown, and has a central outlet port **10** the free area of which may be regulated for example by means of a adjustable conical shutter **11** carried by a lever **12** which is adjustable in different angular positions (see also FIGURE 7). The outlet **10** of the funnel **2** opens above a channel or chute **13**. At a certain height above the funnel **2**, in correspondence or in proximity of the axis of vat **1**, there opens the inlet end **214** of an outlet pipe **14** which is connected by means of a hose section **114** to a pump P which might be an air pump or a mud pump.

The mixture of the two solid materials to be separated or feed, is fed into the vat **1**, preferably together with a sufficient amount of water, by means of pipe **15**, opening towards the axis of said vat, upon a conical distributing baffle member **16** whose edges end in proximity of the cylindrical walls of vat **1**.

Thus said mixture flows down in form of rain towards the inside periphery of said vat **1** near the edges of funnel **2**, while an eccentrical gyratory movement and some shaking and vibration is imparted to said vat **1** and funnel **2**, by the said described crank transmission. As a consequence of said gyratory and shaking or vibratory movements, the solid particles of the two materials to be separated tend to flow or settle with different settling velocities along spiral segment-like paths inclined towards the central funnel outlet port **10**, but due to the difference in settling velocities, the heavy material collects itself in close contact with funnel **2**, while the light material forms a top layer which collects itself above the heavy layer. The whole is adjusted in such a manner that the boundary surface between the heavy material and the overlying light material comes to be approximately at the height of the inlet of the discharge pipe **14**, or a little below said inlet. This condition, viz, said position of the boundary surface between the light material and the underlying heavy material may be stabilized by suitably adjusting the amount of material fed, the movement (speed and/or eccentricity A–B) of the vat **1** and the free areas of the outlets **10**, **14**. In this manner a continuous feed and discharge of the heavy material may be obtained through the central port **10** and a continuous discharge of the light material

through pipe **14**. The heavy material discharged through the bottom opening **10** is let outside the apparatus through duct **13** or the like.

In the embodiment as shown in FIGURES 4 and 5, the pipe **14** for the outlet of the light material is introduced into the vat **1** from below, through a considerably wider central opening **10** through which is discharged all around the pipe **14** also the heavy material. In the embodiment according to FIGURE 6, instead, the pipe **14** passes, without leaving a gap, through the bottom **2** of vat **1** and all around thereto, in the funnel **2**, a crown of holes **110** is provided for the discharge of the heavy material. In the variation of embodiment shown in FIGURE 10, the pipe **14** for the discharge of the light material penetrates into the vat **1** through the side wall thereof and is substantially horizontal or slightly inclined downwardly towards the exterior.

In the embodiment as shown in FIGURE 7, the pipe **14** for the discharge of the light material may be provided with a downwardly bent end which opens at a certain distance above the outlet port **10** of the funnel **2** from which the heavy material is discharged.

If desired, to render the gyratory movement of the funnels adjustable, the vat **1** may be driven by cranks having variable crank arms, of known construction. Thus, in the embodiment as shown in FIGURE 3, each crank pin **4** may be provided with an enlarged foot part **104** which is slidably mounted in a corresponding inverted-T-groove formed in crank arm or disk **5** and which may be locked in adjustable position by a nut **17**.

In FIGURE 8 there has been shown a shaking concentration apparatus according to the invention provided with a plurality of serially arranged distributing baffle cones **16** and funnels **2** mounted in a single vat **1** provided with a single supporting member **3** to which the gyratory and shaking and vibrating motions are imparted by known means. The feed is effected through pipe **15** and the first baffle cone **16** into the top funnel **2** through the bottom outlet port **10** of which the heaviest material is discharged upon the second cone **16**, and so on, while the lighter material of the top layer is discharged from each funnel outside of the apparatus through a corresponding pipe **14**. Thus the heavy material comes to be progressively concentrated so that from the bottom outlet **10** of the lower funnel is discharged a material which may have a very high purity degree.

In FIGURE 9 an embodiment is shown in which the vat **1** provided with one or more funnels **2** is suspended overhead and is imparted a gyratory and shaking movement by a crank device **20–21** driven by motor **22**. The shaking may be increased even by slightly inclining the driving cranks.

From the foregoing it is apparent that the invention is not limited to the embodiment as above described and shown, but which may be amply varied and modified, above all constructively, and furthermore applied to any suitable materials, without departing from the basic principle as set out above and as claimed hereinafter.

I claim:

1. Mechanical shaking apparatus for the separation by gravity of material composed of mixtures of solid particles having like size but a considerable difference in density comprising, in combination,

a container having a wide-angled, funnel-shaped, generally horizontal bottom provided with a central outlet port,

a frame for supporting said container,

means for imparting horizontal rotary motion and a superimposed horizontal vibratory shaking motion to said container whereby said bottom of the container describes a circular path whose center is offset from said outlet port,

said means comprising a first crank mounted on said frame for rotation about a vertical axis and pivotally connected to said container at a point offset from said vertical axis, a second crank mounted on said frame for rotation about a second vertical axis spaced from the first mentioned vertical axis and pivotally connected to said container at a point offset from said second vertical axis, drive means mounted on said frame and directly connected to said first crank for rotating same about said first vertical axis in substantially uniform fashion, and means connecting said drive means to said second crank for rotation about said second vertical axis and to allow substantially nonuniform rotary motion thereof,

means for distributing material to be separated peripherally of said bottom,

and means for withdrawing material from said container at a level above but adjacent to said outlet port, said means connecting said drive means to said second crank comprising a plurality of idler gears.

2. Mechanical shaking apparatus for the separation by gravity of material composed of mixtures of solid particles having like size but of considerable difference in density comprising, in combination,

a container having a wide-angled, funnel-shaped, generally horizontal bottom provided with a central outlet port,

a frame for supporting said container,

drive means on said frame and connected with said container for imparting a compound circular and vibratory motion to said container, said drive means comprising mechanism for imparting substantially uniform circular horizontal motion to one portion of said container and mechanism for imparting substantially nonuniform circular horizontal motion to a remote portion of said container,

means for distributing material to be separated peripherally to said bottom,

and means for withdrawing material from said container at a level above but adjacent to said outlet port, said mechanism for imparting nonuniform circular motion comprising a plurality of idler gears.

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