Jan. 27, 1959 W. G. J. HECKMANN 2,870,913

CENTRIFUGAL DEVICE FOR DEHYDRATING A FINE-GRANULAR MATERIAL

Filed Oct. 27, 1954

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Fig.1

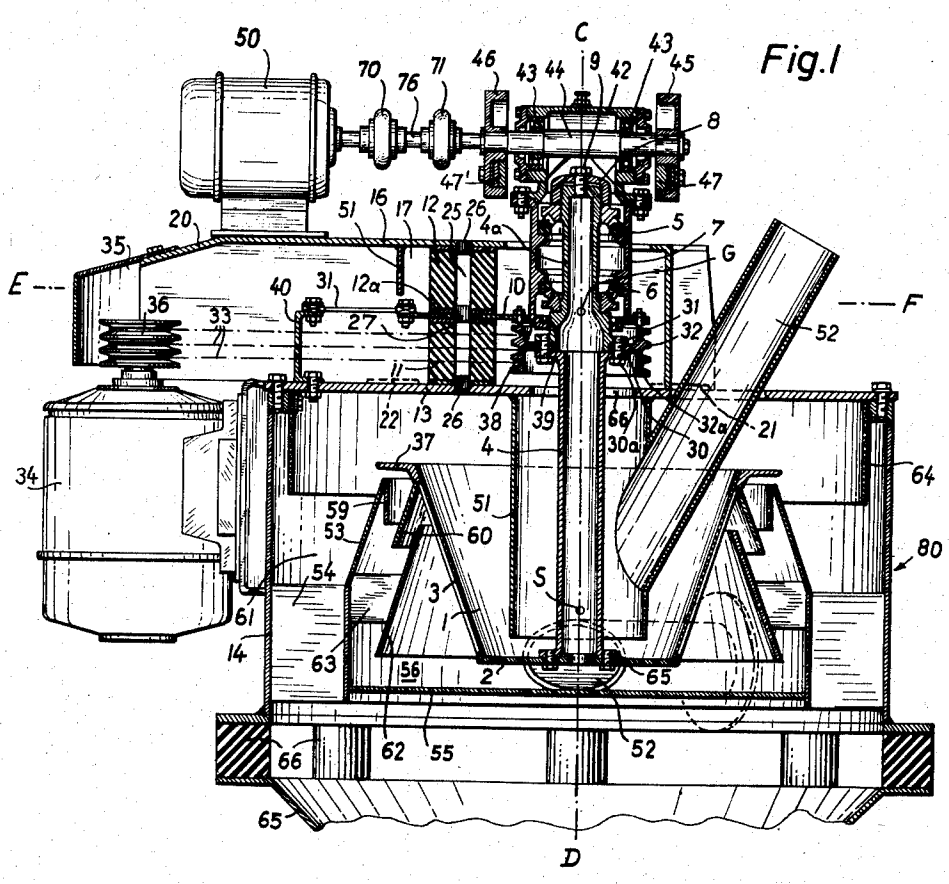
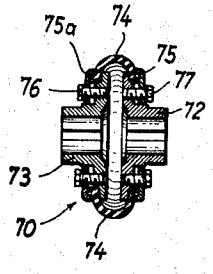


Fig.4



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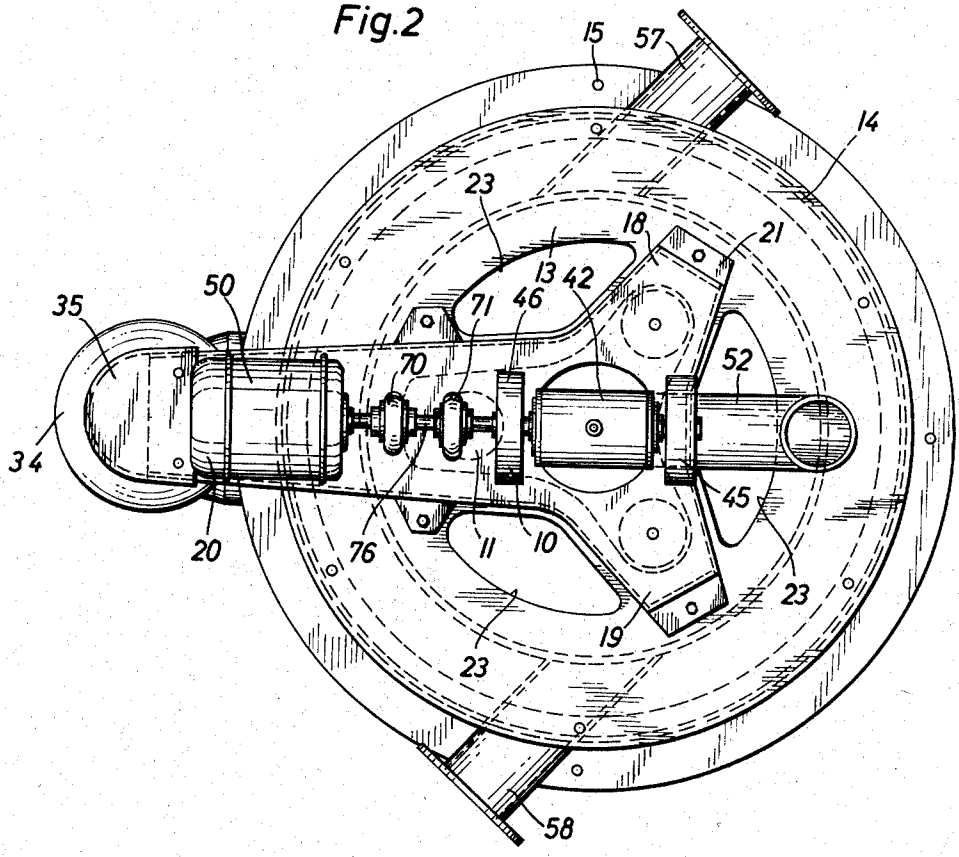
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CENTRIFUGAL DEVICE FOR DEHYDRATING A FINE-GRANULAR MATERIAL

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Fig.2



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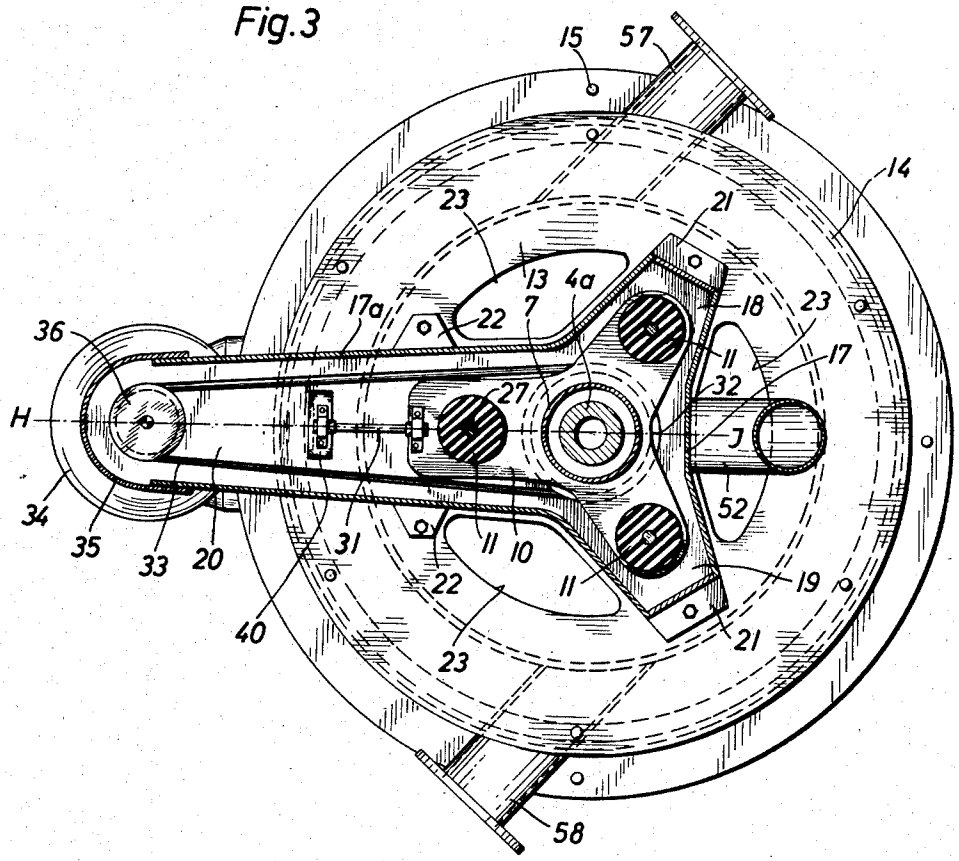
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CENTRIFUGAL DEVICE FOR DEHYDRATING A FINE-GRANULAR MATERIAL

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Fig.3



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CENTRIFUGAL DEVICE FOR DEHYDRATING A FINE-GRANULAR MATERIAL

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Claims priority, application Germany October 30, 1953

14 Claims. (Cl. 210—370)

The present invention relates to a centrifugal device for dehydrating a material, and more particularly to a centrifuge for dehydrating a sludge or slurry, such as a slurry consisting of coal particles.

It is an object of the present invention to render simple the construction of a centrifugal device of the kind described.

It is another object of the present invention to provide a centrifugal device having driving members which are easily accessible.

Other objects and advantages of the present invention will become apparent from the following detailed description thereof when read in connection with the accompanying drawings showing, by way of example, an embodiment of the present invention. In the drawings

Fig. 1 is an elevation, partly in section, of a first embodiment of the present invention,

Fig. 2 s a plan view of the device shown in Fig. 1,

Fig. 3 is a cross-section taken along the line E—F of Fig. 1,

Fig. 4 shows a detail of Fig. 1 on an enlarged scale.

Referring now to the drawings, the centrifugal device is provided with a sieve drum **1** open at the upper end thereof and having a bottom plate **2**. The sieve drum **1** includes a conical sieve portion **3** provided with perforations having a diameter of approximately 0.15 mm. The conical sieve portion **3** is inclined relative to the axis C—D of the drum by an angle of 10 to 15°. Preferably the sieve drum **1** is provided at the upper rim thereof with a flange **37** projecting towards the outside. The mean diameter of the sieve drum **1**, i. e. the diameter at half the height thereof amounts, for example, to 400 mm. To the bottom plate **2** is attached by means of a flange **65** a central shaft projecting upwards beyond the sieve drum **1** and comprising the two preferably hollow shaft portions **4** and **4***a* screwed to one another by means of flanges **30** and **30***b* between which an inner projection **32***a* of a pulley **32** is arranged. The parts **30**, **31** and **32** are connected by screws **30***a*. The upper shaft portion **4***a* is supported rotatably about the axis thereof by roller bearings **5** and **6** which abut against a casing or housing **7** so that the shaft portion **4***a* cannot move axially with respect to the casing or housing **7**. The bearings **5** and **6** are adjustable by means of a lock nut **8** arranged on the upper end of the shaft **4***a* and fastened by means of a screw **9**. The housing or casing **7** is provided at the lower edge thereof with a flange **10** (Fig. 3) preferably having three arms and is secured against the penetration of dirt and moisture by means of a disc **38** carrying a packing **39**. The flange **10** is clamped at three points uniformly spaced about said shaft between rubber springs **11** and **12**. The rubber springs **11** abut with the lower face thereof against a plate **13** secured by means of screws **15** to the cylindrical outer wall **14** of the frame of the centrifuge generally denoted by **80**. The plate **13** is provided with an aperture **66** through which the shaft **4** may be introduced from above. The upper end faces of

the rubber springs **12** abut against a cover **16** of a box-shaped member **17** open at the lower side thereof and enclosing the springs **11**, **12**. The box **17** is, as shown in Fig. 3, preferably formed with three arms **18**, **19** and **20** providing ample space for receiving the rubber springs **11**, **12** and the flange **10**. Whereas the arms **18** and **19** are relatively short, the arm **20**, reinforced by a transversal rib **51**, is lengthened toward the outside so as to extend beyond the outer wall **14** of the frame **80**. The enclosing wall **17***a* of the box **17** is provided at the lower edge thereof with lugs **21** and **22** directed to the outside and forming members connecting the box **17** with the plate **13**. The height of the enclosing wall **17***a* is chosen so that the rubber springs **11**, **12** are slightly compressed when the box **17** is screwed to the plate **13** so as to prestress the rubber springs **11**, **12**. The prestressing may be increased or regulated by inserting plates, such as **12***a*, for instance, between the flange **10** and the springs **11**, **12**. Preferably the springs **11**, **12** are provided with an axial boring **25**, the cover **16**, the flange **10**, and the plate **13** being provided with plugs **26** and **27** protruding somewhat into the bore **25**. By this arrangement it is achieved that the springs **11**, **12** retain the correct positions thereof during the assembling of the device. Furthermore, as will be seen from Figs. 2 and 3, the plate **13** is provided inside the gaps separating the arms **18**, **19** and **20** with sector-shaped recesses **23** so that the sieve drum **1** is accessible through the same and may be easily watched in operation.

The pulley **32** is connected by means of three V-belts **33** with a motor **34** attached to the wall **14**. The V-belts **33** are arranged within the arm **20** of the box **17**, the arm **20** having a width sufficient for accommodating the V-belts **33**. Preferably, the outer end of the arm **20** is provided with a cap **35** embracing the drive pulley **36** connected to the motor **34**. The cap **35** forms the closure member of the arm **20** toward the outside so that the V-belt drive **36**, **33**, **32** is protected against dust and dirt. Within the arm **20**, and more particularly in the middle between the straight portions of the V-belts **33**, a U-shaped member **40**, made of steel or the like, is attached to the plate **13**. One end of a resilient rod or bar **31** having a circular cross-section and acting as a torsion spring is attached to the upper arm of the U-shaped member **40**, said torsion spring **31** extending in a substantially horizontal direction parallel to the plane of symmetry H—J of the drive including the V-belts **33**, the other end of the torsion spring **31** being connected with the flange **10**. The torsion spring **31** has a diameter sufficient to take up the belt pull of the drive **36**, **33**, **32**. In this manner, the shaft **4**, **4***a* cannot be displaced toward the left under the action of the pull of the V-belts.

The casing **7** is rigidly connected to a frame **42** which forms the upper cover of the casing **7** so that the inner part of the same is protected also against the penetration of dirt and moisture from above. A shaft **44** arranged in parallel to the plane of symmetry H—J is arranged for rotation in the frame **42** by means of roller bearings **43**. The shaft **44** projects at both ends beyond the frame **42** and carries two discs **45**, **46** being provided, respectively with eccentrically arranged weights **47**, **47'**. The shaft **44** is connected with a second motor **50** arranged on and above the arm **20** by means of two resilient coupling members **70**, **71** shown on an enlarged scale in Fig. 4, and an intermediate shaft **76**. The coupling members **70**, **71** each include a resilient member or rim **74** being arc-shaped in cross-section and consisting, for instance, of rubber, the rim **74** by means of rings **75**, **75***a* and screw bolts **76**, **77** connecting the clutch halves **72** and **73** arranged at a distance from each other. Thus the coupling members **70**, **71** are resilient in the

axial direction thereof owing to the resilient rim **74**, and are movable transversely in all directions in the manner of a universal joint.

A centrally arranged tube or pipe **51** is connected to the lower side of the plate **13** symmetrically to the aperture **66**, the tube or pipe **51** terminating at a small distance above the bottom plate **2** of the sieve drum **1**. An inclined tube or pipe **52** opens laterally into the tube or pipe **51**, the tube or pipe **52** being connected at its upper end with a feed pipe (not shown) for the material to be centrifuged. The sieve drum **1** is surrounded by an annular wall **53** preferably shaped in the upper part thereof as a cone. Ribs **54** secure the lower part of the annular wall **53** to the outer wall **14**. The annular wall **53** is closed at the lower end thereof by a bottom **55** so as to form a container **56** collecting the water separated from the material to be centrifuged. Immediately above the bottom **55** two pipes **57** and **58** open into the container at opposite places, the pipes **57** and **58** withdrawing the separated water from the container **56**. The wall **53** extends upwards so that its upper edge is separated from the lower side of the flange **37** so as to define a gap therebetween. Preferably the wall **53** is provided at the inner side thereof with a hollow cylindrical ring **59** directed downwards. Furthermore, it is advisable to arrange on the flange **37** a hollow conical ring **60** extending parallel to the conical part of the wall **53** and having a lower edge arranged below the ring **59**. Preferably a hollow conical ring **62** is provided within the container **56** formed by the wall **53**. The conical ring **62** is attached by means of ribs **63** to the wall **53** and extends parallel to the ring **60** so as to project with the upper edge portion thereof into the gap between the conical sieve portion **3** and the ring **60**. The lower edge of the ring **62** is arranged at a distance from and above the bottom **55**. The annular space **61** between the walls **53** and **14** opens towards the lower side thereof into a collecting bunker **65** on which the centrifuge is mounted, preferably on rubber springs **66**. Preferably a hollow cylinder **64** consisting of rubber or similar resilient material is arranged on the inside of the upper end of the wall **14** and at a distance therefrom, the cylinder **64** extending downward so far that its lower rim is arranged below the level of flange **37**.

The operation of this device is as follows:

The shaft **4**, **4***a* and the sieve drum **1** rigidly connected thereto are rotated by the motor **34** by means of the belt drive **36**, **33** and **32** at, for instance, 1400 revolutions per minute. At this speed of revolutions a centrifugal acceleration $r.\omega^2$ of approximately 400 times the acceleration of gravity prevails at half the height of the drum **1**, that is where the same has a diameter of 400 mm. At the same time, the discs **45** and **46**, with the eccentrically arranged weights **47**, **47'** are rotated by the motor **50** connected with the discs **45**, **46** by the coupling members **70**, **71** and the intermediate shaft **76**. On an average about 30 cubic meters per hour of concentrated coarse coal slurry containing about 600 grams of coal per liter, having a particle size below and including 1 mm. diameter, are supplied to the sieve drum **1** by the tubes or pipes **52** and **51**. The slurry, after its exit from the tube **51**, hits the bottom **2** of the sieve drum **1** from where it is transported by the action of the centrifugal force to the conical sieve portion **3**, a large portion of the water contained in the slurry being discharged through the openings in sieve portion **3**.

The torsion spring **31** is flexible in all directions and furthermore, permits a twisting of the casing **7** about the longitudinal axis thereof. In consequence thereof, the casing **7** may rotate within certain limits about the point G, being the intersection of the axis of the torsion spring **31**, with the axis C—D, the rotation being effected as it were in the manner of a universal joint. By this, the shaft **4**, **4***a* is enabled to carry out precession movements about the fixed point G if an unbalance is produced within the sieve drum **1**, for instance, owing to non-uniform distribution of the material.

The center of gravity S of the system suspended from the springs **11**, **12** is very low owing to the large mass of the sieve drum **1**—**3** and of the contents thereof. In consequence thereof, the shaft **4**, **4***a* which is influenced by substantially horizontal centrifugal components caused by the rotating weights **47**, carries out a pendulum movement about the point S. The casing **7** may follow these movements since the torsion spring **31** is flexible in all directions. The pendulum movement carried out by the sieve drum **1**—**3** is so small owing to the short distance of the center of gravity S from the bottom **2** of the sieve drum **1** that it is practically negligible. The vertical components of the centrifugal forces exerted by the weights **47** impart vertical vibrations having an amplitude of about 1.5 to 3 mm. to the shaft **4**, **4***a* and to the sieve drum **1**—**3** carried by the same. The drive for the vibrational movements is preferably operated at hypercritical speeds, that is far above the natural frequency of vibration, for instance, at a frequency of 50 cycles per second. Under the action of the vibrating movement, the coal travels as a layer of about 10 mm. thickness on the sieve drum **3** towards the upper rim **37** thereof, the coal being further dehydrated thereby. The dehydrated coal finally leaves the sieve drum **3** over the flange **37** from whence it is thrown against the rubber ring **64** preventing the coal from hitting the wall **14**. Thus further disintegration by a bounding effect, particularly of the coarser coal particles is prevented by the rubber wall **64**. The coal dropping from the wall **64** passes through the annular space **61** into the collecting bunker **65**. The water passing through the conical sieve portion **3** hits the conical rings **62** and **60** and is deflected by the same toward the bottom **55**. Sprayed water particles which might be deflected toward the top are caught by the cylindrical ring **59**. Thus, the rings **62**, **60** and **59** practically prevent the water from passing from the container **56** into the annular space **61**. The water collecting in the container **56** is discharged through the pipes **57** and **58**.

I have described a preferred embodiment of my invention, but it should be understood that this disclosure is only for the purpose of illustration and that various omissions or changes in shape, proportion and arrangement of parts, as well as the substitution of equivalent elements for those herein shown and described, may be made without departing from the spirit and scope of the invention set forth in the appended claims.

I claim:

1. A centrifugal device for dehydrating a fine-granular material comprising, in combination: a frame, a casing resiliently mounted on said frame for performance of vibrating movements substantially in the direction of its longitudinal axis, a first shaft, a first portion of said shaft being rotatably and axially immovably arranged in said casing, a second portion of said shaft projecting from said casing, a sieve drum surrounding at least a part of said second portion of said shaft and being rigidly connected therewith, driving means for rotating said shaft, and vibrating means for imparting vibrations to said casing whereby said sieve drum is subjected to vibrating movements in addition to its rotating movements.

2. In a centrifugal device as claimed in claim 1, said sieve drum having an open end, and one end of said shaft extending beyond said open end of said sieve drum.

3. In a centrifugal device as claimed in claim 1, said driving means including a motor and means operatively connecting same with said shaft, said motor being mounted on said frame.

4. A centrifugal device as claimed in claim 1, said casing and said first shaft being coaxial with one another.

5. A centrifugal device as claimed in claim 4, including a flange fixedly attached to said casing, and resilient means for clamping said flange to said frame.

6. A centrifugal device as claimed in claim 5, said resilient means including rubber springs.

7. A centrifugal device as claimed in claim 6, said rubber springs being arranged in pairs, said flange being clamped between said pairs of springs.

8. A centrifugal device as claimed in claim 7, said rubber springs being arranged in a plurality of positions uniformly spaced on said flange about said first shaft.

9. A centrifugal device as claimed in claim 8, including a second shaft rotatably arranged on said casing at an angle to said first shaft, drive means for rotating said second shaft, and vibrating means responsive to rotation of said second shaft to impart axial vibrations to said casing.

10. A centrifugal device as claimed in claim 9, including at least one weight arranged eccentrically on said second shaft for imparting to the same vibrations in the transversal direction thereof, and means for transmitting said axial vibrations to said casing.

11. A centrifugal device as claimed in claim 9, including a belt drive for rotating said shaft about the axis thereof, said belt drive having a plane of symmetry, and said axis being arranged in said plane of symmetry of said belt drive.

12. A centrifugal device as claimed in claim 11, including a resilient member connecting said casing with said frame, said resilient member being arranged in said line of symmetry of said belt drive.

13. A centrifugal device as claimed in claim 12, said resilient member being a resilient bar the respective ends thereof being fastened to said flange and to said frame.

14. A centrifugal device for dehydrating a fine-granular material comprising, in combination: a frame, a casing resiliently mounted on said frame for performance of vibrating movements substantially in the direction of its longitudinal axis, a shaft, a first portion of said shaft being rotatably and axially immovably arranged in said casing, a second portion of said shaft projecting from said casing, a sieve drum surrounding at least a part of said second portion of said shaft and being rigidly connected therewith, means for rotating said shaft, a second shaft arranged on said casing at an angle to said shaft, means for rotating said second shaft, coupling means including resilient parts for coupling said second shaft with said means for rotating the same, and at least one weight arranged eccentrically on said second shaft and imparting to the same vibrations in the transversal direction thereof, said transversal vibrations imparting axial vibrations to said casing whereby said sieve drum is subjected to vibrating movements in addition to its rotating movements.

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