Nov. 18, 1924. 1,515,798

J. W. SPENSLEY

GRINDING OR DISINTEGRATING AND MIXING MACHINE

Filed July 6, 1922 3 Sheets-Sheet 1

Fig.1.

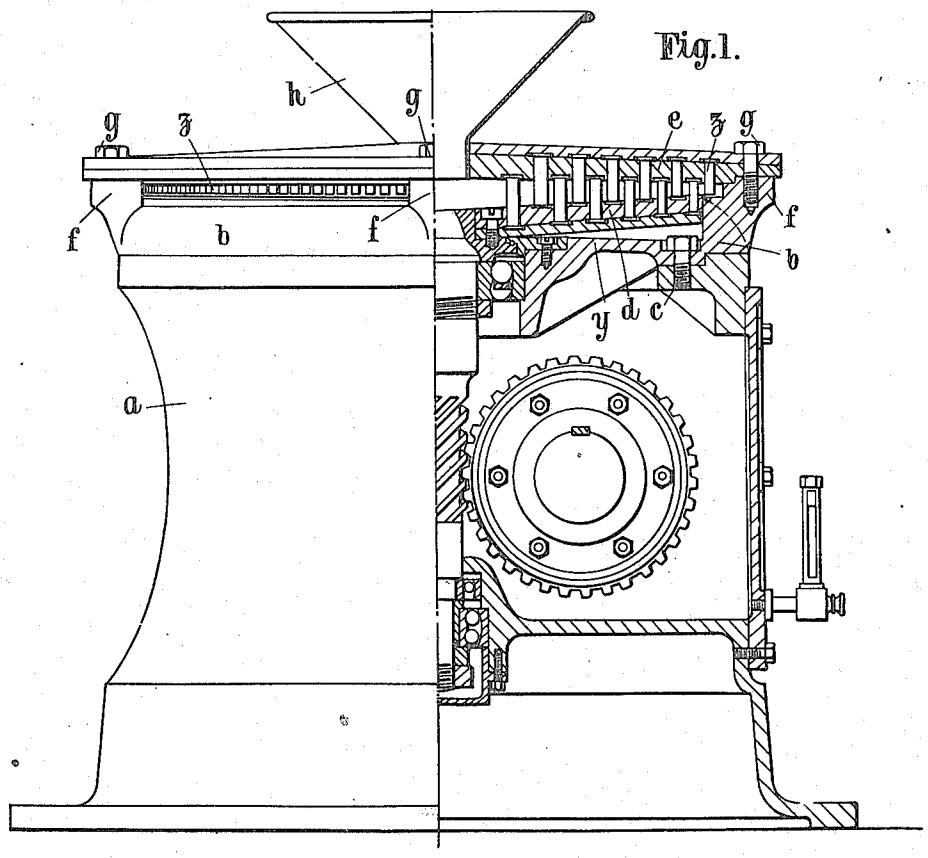

Fig.2.

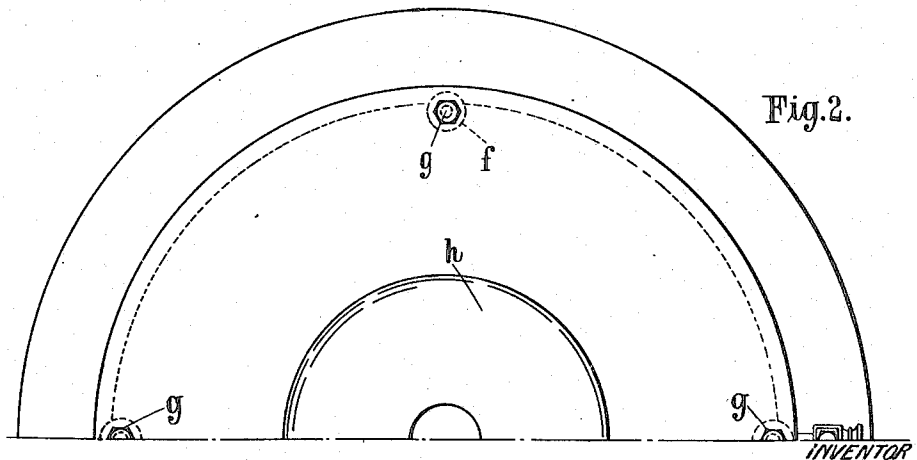

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Fig. 3.

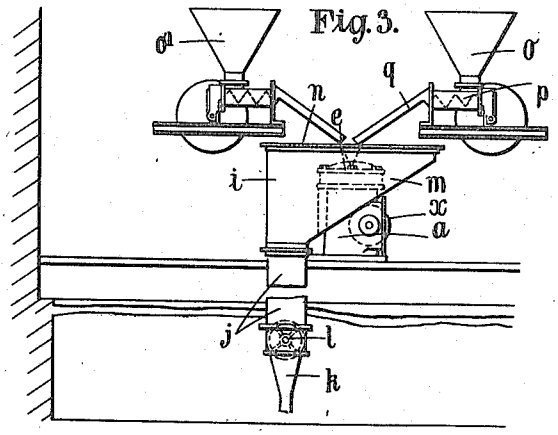

Fig. 4.

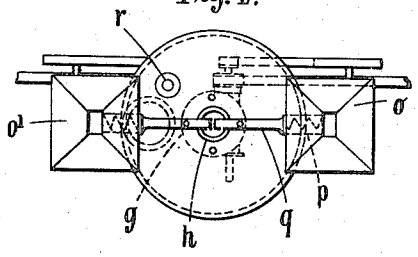

Fig. 5.

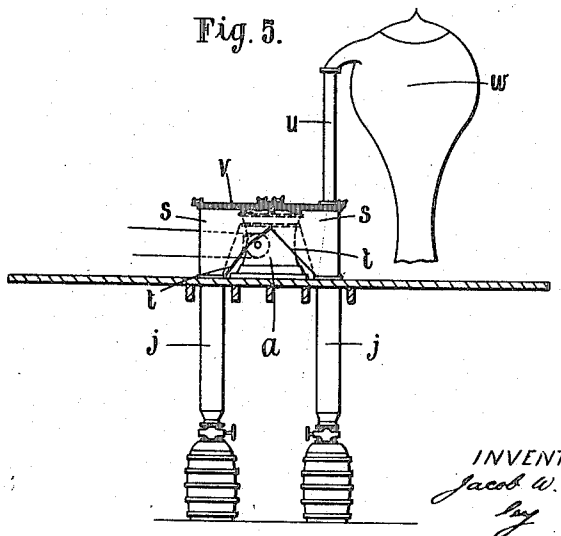

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Fig. 6.

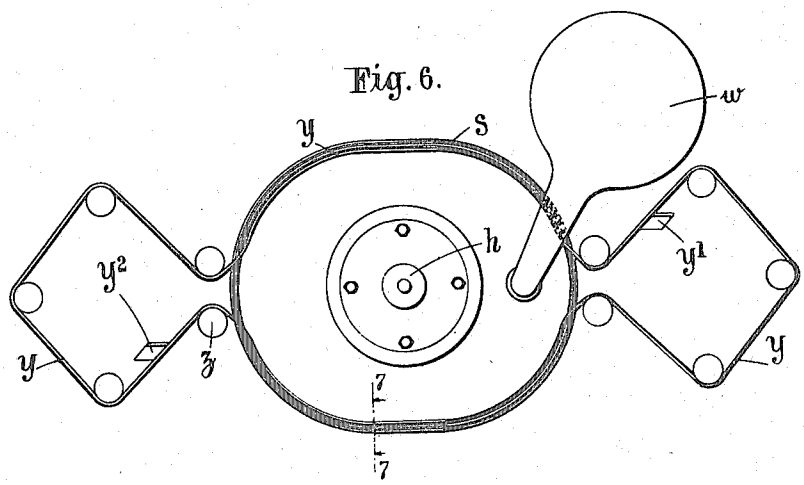
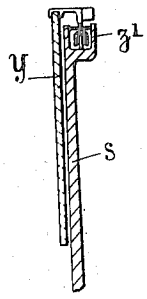


Fig. 7.



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UNITED STATES PATENT OFFICE.

JACOB WILLIAM SPENSLEY, OF MANCHESTER, ENGLAND.

GRINDING OR DISINTEGRATING AND MIXING MACHINE.

Application filed July 6, 1922. Serial No. 573,142.

To all whom it may concern:

Be it known that I, JACOB WILLIAM SPENSLEY, a subject of the King of Great Britain, and resident of 49 Deansgate, Manchester, in the county of Lancaster, England, have invented certain new and useful Improvements in Grinding or Distintegrating and Mixing Machines (for which I have filed applications in England dated, respectively, July 18th, 1921, February 23rd, 1922, and April 13th, 1922), of which the following is a specification.

This invention relates to grinding or disintegrating and mixing mills or machines of the type wherein one disc with pins in annular rows thereon, rotates relatively to another disc provided with intercalating annular rows of pins. These mills have been provided with tangentially arranged discharge outlets hitherto, the materials to be ground or disintegrated being fed in through a hopper at the centre of the top disc of the mill, which is stationary, and being thrown outwards by centrifugal action through the rows of pins. The mill also induces a strong current of air which assists in carrying the disintegrated products out through the tangential discharge. This form of discharge has worked satisfactorily with dry pulverulent or finely disintegrated granular products, but when the mill is called upon to disintegrate wet, sticky or oily materials it is found that these soon choke up the mill, and the discharge is quite unsatisfactory.

According to the present invention, such mills are made with a circumferential discharge outlet leading into a suitable surrounding receptacle, channel or chute, the circumferential discharge outlet from the mill being as open as possible, although it may have bosses or lugs at intervals for the attachment and support of the top plate or disc. It is then found that moist, oily or sticky materials are effectively discharged into the receiving channel, and do not tend to choke up the mill. In fact, it is found that the open discharge is better for practically all classes of materials, and I therefore prefer it for mills intended for all purposes, including dry grinding, wet grinding, and so forth.

A further feature of the invention is as follows: I have discovered that when the mill is made with an open discharge practically around the whole of its circumference, it is advantageous to add a further row of stationary pins to the fixed upper disc, the stationary pins constituting a final or outermost row. As the discharge is open around the circumference there is no risk that this outermost row of stationary pins will block the discharge, but I find that the material is ground in one passage through the machine to a greater degree of fineness without the consumption of any appreciable increase of power. The current of air which the rotation of the lower disc induces through the mill is quite sufficient to insure that the material is blown cleanly through the additional outermost row of stationary pins no matter what class of material is being treated in the mill.

The invention is illustrated in the accompanying drawings, in which:—

Figure 1 is a half elevation and half section of a mill with the open discharge ring according to the invention;

Figure 2 is a partial plan view of Figure 1;

Figure 3 is an elevation; and

Figure 4 is a plan view showing the complete mill with means for feeding the material to its hopper and means for discharging the treated product;

Figure 5 is a similar view to Figure 3, showing a modified arrangement;

Figure 6 is a plan of an embodiment similar to that shown in Figure 5, but with a conveying device for removing the treated product; and

Figure 7 is a detailed section on the line VII—VII of Figure 6.

Referring first to Figure 1 *a* represents the shell or standard of the mill in which the driving gearing is contained, at the top of this shell being a plate *y* secured by screws *c* and whose circumference constitutes the delivery ring *b*. The rotating disc *d* of the mill is secured to the driven vertical shaft which is carried in ball bearings in a suitable manner in the plate *y*, as indicated by way of example. The stationary top disc *e* is supported by a number of lugs *f*, four in the example shown, on the delivery ring *b*, and is secured by screws *g* engaging in these lugs. The bottom disc *b* which rotates has concentric rows of upwardly projecting pins upon it, while the top disc *e* which is stationary has similar concentric rows of pins intercalating with those on the disc *d*. Hitherto, in pinned disc mills, the lower disc

which rotates, has always carried the outermost row of pins, this being essential in the case of mills with a tangential discharge, in order to insure the throwing out of the ground materials through such discharge. A feature of this invention is that it enables me to apply an additional annular row of pins *z* to the upper fixed disc *e*, outside the last row of pins on the lower disc *d*, and so to improve the efficiency of the mill. I find that with the addition of this row of pins *z*, the material is ground to a greater degree of fineness in one passage through the mill, without the consumption of appreciably more power, and without any risk of choking the mill owing to the open circumferential discharge. The current of air which the rotation of the lower disc induces through the mill is quite sufficient to insure that the material is blown cleanly through the additional outermost row of stationary pins no matter what class of material is being treated in the mill. *h* is a feed hopper at the centre of the top disc for delivering the materials to be treated on to the surface of the rotating disc *d*.

It will be realized that with this construction practically the whole circumference of the annular gap between the pinned discs is open, the lugs *f* being the only obstruction, and as these are of small dimensions in fact no materials can accumulate against them so as to cause any blocking of the discharge. For practical purposes therefore the whole of the discharge area is directly open so that the materials can be thrown out from the circumference of the revolving disc without collecting anywhere inside of the mill.

Referring now to Figures 3 and 4, it will be seen what constitutes a convenient arrangement for feeding materials to be treated to the mill, collecting the discharged products and delivering them where required. The mill is shown as being surrounded by a casing *i* with an inclined bottom surface at *m* leading into a discharge chute *j*. This may have any suitable discharge outlet at the bottom such as a funnel *k*, the passage of materials through which is controlled by a cut-off operated by a hand-wheel and spindle *l* for example. The casing *i* can be enclosed at the top in any convenient manner to prevent the splashing or throwing out of the treated materials. In the construction shown, a flat disc or cover plate *n* is provided into the centre of which the hopper *h* fits. For feeding moist, oily or sticky materials to the hopper *h* a worm feed may be needed in order to insure a uniform rate of feed, and this is illustrated in Figures 3 and 4. The materials are supplied in bulk to a hopper *o* which maintains the feed to a worm *p*, the materials being extruded by this worm down a chute *q* discharging into the centre of the hopper *h* of the mill itself. Any required number of such worm feeds may be provided for delivering a plurality of materials simultaneously to the hopper *h* of the mill. In Figure 3, two such feeds are shown, the second hopper being indicated by *o'*. The circle at *r* in Figure 4 represents a flanged outlet in the cover *n* which may be connected to a dust-balloon or otherwise for collecting dust particles while allowing of the escape of air induced by the mill.

The mill shown in Figure 5 has a casing *s* with doubly inclined bottoms *t* leading to two delivery chutes *j*. For the rest, the construction resembles that of Figures 3 and 4. A connexion *u* is shown in this case extending from the cover *v* to the casing *s* and leading to a dust-collecting balloon *w* of a known type. The mill is driven through pulleys *x* on a transverse shaft from which the drive is transmitted to the rotating lower disc through helical gears in the known manner. Either form of the casing as shown in Figures 3 and 4, or in Figure 5, admits of the disposal of the drive so as not to interfere with the inclined bottoms of the collecting casings.

It will be seen that in each construction the collecting casing provides a clear space around the circumferential discharge of the mill for receiving the discharged materials in the casing and allowing them to fall downwardly over the inclined bottoms to the chutes *j*. For any materials which tend to cling to the walls of the casings, scrapers or other means of maintaining the discharge may be provided in the casings *i* and *s*, as may be required. In Figures 6 and 7, a travelling band conveyor *y* is shown for this purpose. The band is formed of laths and is continually passed into and out of the casing *s*. It may be driven, for example, by a spur wheel *z* and may be supported on rollers *z'* running in a track along the upper edge of the casing *s*. It is clear that the treated product may be removed, for example, manually at the ends of the conveyor *y* outside the casing *s*. In some cases also the casing *i* or *s* may be jacketed in order to keep oily matter in a more fluid condition for discharge purposes.

The improved operation of the mill with the open circumferential discharge according to this invention, as compared with the known mills having only a local tangential discharge, even as applied to the dry grinding of materials, may be explained as follows: In the mills with a tangential discharge a considerable amount of energy was wasted, and the pins in the outermost rings were needlessly worn away, by the beating about of the materials at the outer circumference of the rotating disc before they reached the position for escaping through

the tangential discharge outlet. By the use of the open type of discharge outlet centrifugal force is better utilized in driving the materials through the mill, and any risk of banking up of the ground products is eliminated. The blast of air which the revolving pinned disc induces also has more freedom to escape and to assist in carrying out the ground materials at the circumference.

In experiments which I have made, I have satisfied myself that there are many materials which could not be caused to pass efficiently through the older types of pinned disc mills, but which can now be ground very efficiently in the mill with the "open" type of discharge. Various food products such as chocolate for example, which are somewhat moist, oily or gummy, and were therefore liable to choke up the machine with a tangential discharge, can be ground with ease upon the machine with an "open" discharge. Moreover, the increased freedom with which centrifugal force acts on the materials due to the absence of circumferential obstruction to movement, causes the impact blows to which the material is subjected to be harder, and the fineness of grinding of the products is substantially increased.

Among the materials which can be ground or disintegrated in the mill with an open discharge are oil-bearing seeds, pods and so forth, pigments whether dry or mixed with liquid, solid or semi-solid fatty matter and the like. The mill is also very useful for mixing substances of widely differing characters. For example an oleaginous material can be disintegrated and mixed with a relatively dry or powdery material, so that the powdery material absorbs or becomes coated with the oleaginous substance giving a substantially homogeneous product. The mill will also break up oleaginous substances, bituminous substances and the like, so finely as to bring them into a state of intimate mixture with water or other liquids, to form stable emulsions.

Another use of mills of the type forming the subject of this invention is to remove the husk from grain, seeds, pips, berries and other natural products and to render the husk easy to separate from the body of such products by winnowing, sieving and other like operations.

In the making of intimate mixtures of dry or partly moist substances, and also in wet grinding, the fact that centrifugal force is always acting to drive the materials through the mill between the relatively moving pins is of very great practical importance, as it enables such materials to be forced through under pressure conditions which are not attainable in other types of grinding and mixing machines. Relatively thick and viscous substances or mixtures are forced through the mill in this way, and in wet grinding much higher concentrations of solid or semi-solid matter can be treated than it is possible to treat in other high-speed but non-centrifugal mills. The mills according to this invention can be run up to speeds of about 20,000 feet per minute at the circumference of the pinned disc, and at such speeds of relative movement between the fixed and moving pins, the centrifugal action and the grinding action are so intense that physical effects are produced which have never been produced in any other known type of mill. In fact, chemical reactions can be made to occur practically instantaneously which have hitherto involved prolonged treatment with the use of heat, agitation and so forth.

It will be realized that the invention is not confined to the use of any particular form of receiving casing around the mill proper, and the two types shown in Figures 3 to 5 are intended to serve by way of example only. All that is essential is that the discharge outlet of the mill proper shall be open for the majority of the space surrounding the discs so that the treated materials may be discharged freely in all directions. any suitable receiving casing being provided to surround the mill at the discharge level, and to conduct away the received products. Similarly, any convenient means may be provided for feeding the materials to be treated into the inlet hopper or aperture of the mill, and for proportioning the rate of feed of solid, viscous, or liquid materials when two or more ingredients are required to be fed into the mill at substantially constant rates.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

1. A high speed centrifugal pinned disc mill comprising a fixed casing shaped with supporting parts spaced around its periphery, a disc journalled to rotate in said casing, concentric rows of pins projecting from one surface of said disc, a stationary disc concentric with said rotating disc, having one surface facing the operative surface of said rotating disc and secured to said spaced parts of said casing and concentric rows of pins projecting from the last mentioned surface of said stationary disc and intercalating with said first-mentioned concentric rows of pins the spaces between said supporting parts of said casing being of sufficient width and circumferential length as to allow of free delivery around the peripheral portion of said disc.

2. A high-speed centrifugal pinned-disc mill comprising a casing having spaced lugs projecting upwardly from its upper edge, a disc journalled therein to rotate within said lugs about a vertical axis, a fixed disc secured to said lugs, and two intercalating sets of concentric rows of pins each set project-

ing from the face of one of said discs, the spaces between said lugs being such as to allow of free delivery around the peripheral portions of said discs.

3. A high speed centrifugal pinned disc mill comprising a fixed casing having spaced lugs projecting upwardly from its upper edge, a disc journalled therein to rotate within said lugs about a vertical axis, a fixed disc secured to said lugs, two intercalating sets of concentric rows of pins, the sets projecting relatively from the adjacent faces of said two discs, the spaces between said lugs being such as to allow of free delivery around the peripheral portions of said discs and a casing surrounding the periphery of said discs to receive the ground material but spaced from the periphery of said discs so as not to obstruct the free delivery.

4. A high speed centrifugal pinned disc mill, comprising a fixed casing shaped with supporting parts spaced around its periphery, a disc journalled therein to rotate within said casing, a stationary disc secured to said spaced parts of said casing, two intercalating sets of concentric rows of pins, the sets projecting relatively from the adjacent faces of said two discs, the spaces between said supporting parts of said casing being of sufficient width and circumferential length as to allow of free open delivery around the peripheral portion of said disc, and a receiving casing surrounding and enclosing said fixed casing but located at such a distance from the open discharge of the mill that the materials collecting on the wall of the receiving casing cannot build up so as to obstruct the open discharge, said receiving casing being shaped with its bottom surface inclined and being formed with a discharge chute.

5. A high speed centrifugal pinned disc mill, comprising a fixed casing shaped with supporting parts spaced around its periphery, a disc journalled therein to rotate within said casing, a stationary disc secured to said spaced parts of said casing, two intercalating sets of concentric rows of pins, the sets projecting relatively from the adjacent faces of said two discs, the spaces between said supporting parts of said casing being of sufficient width and circumferential length as to allow of free delivery around the peripheral portion of said disc, and a receiving casing surrounding and enclosing said fixed casing but located at such a distance from the open discharge of the mill that the materials collecting on the wall of the receiving casing cannot build up so as to obstruct the open discharge, said receiving casing having its bottom surface shaped to form two oppositely inclined portions and also formed with two discharge chutes.

6. A high speed centrifugal pinned disc mill, comprising a fixed casing shaped with supporting parts spaced around its periphery, a disc journalled therein to rotate within said casing, a stationary disc secured to said spaced parts of said casing, two intercalating sets of concentric rows of pins, the sets projecting relatively from the adjacent faces of said two discs, the spaces between said supporting parts of said casing being of sufficient width and circumferential length as to allow of free open delivery around the peripheral portion of said disc, a receiving casing surrounding and enclosing said fixed casing but located at such a distance from the open discharge of the mill that the materials collecting on the wall of the receiving casing cannot build up so as to obstruct the open discharge, and a travelling band conveyor moving in contact with the inner wall of said receiving casing.

7. A high speed centrifugal pinned disc mill, comprising a fixed casing shaped with supporting parts spaced around its periphery, a disc journalled therein to rotate within said casing, a stationary disc secured to said spaced parts of said casing, two intercalating sets of concentric rows of pins, the sets projecting relatively from the adjacent faces of said two discs, the spaces between said supporting parts of said casing being of sufficient width and circumferential length as to allow free delivery around the peripheral portion of said disc, a receiving casing surrounding and enclosing said fixed casing but located at such a distance from the open discharge of the mill that the materials collecting on the wall of the receiving casing cannot build up so as to obstruct the open discharge, a travelling band conveyor moving in contact with the inner wall of said receiving casing, and stationary scrapers located to remove material received upon said travelling band conveyor.

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