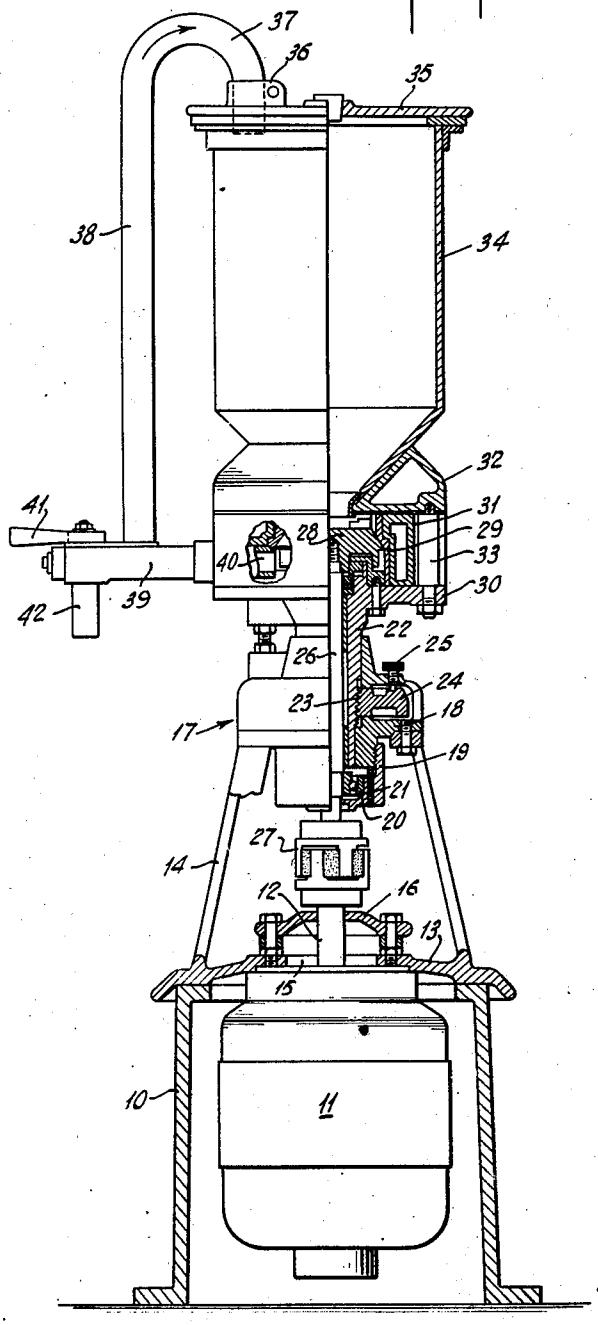
Oct. 7, 1947. E. G. EPPENBACH ET AL 2,428,415

ADJUSTABLE COLLOID MILL

Original Filed April 7, 1942 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

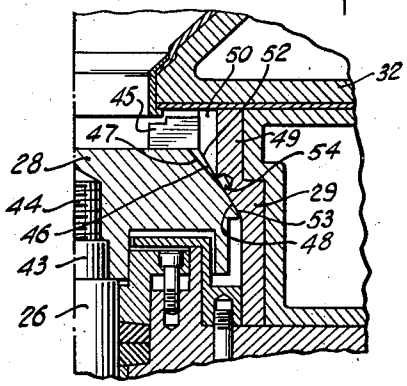


Fig. 3.

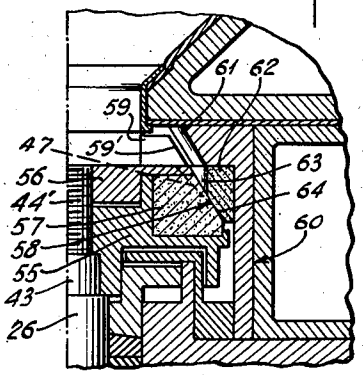


Fig. 4.

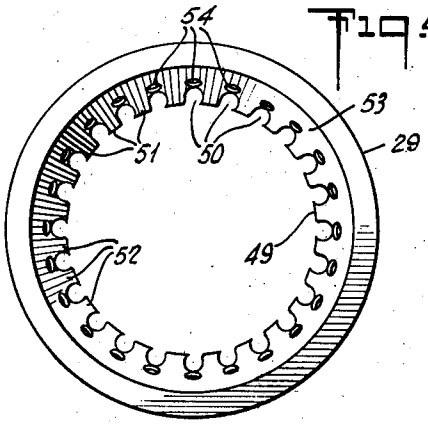


Fig. 5.

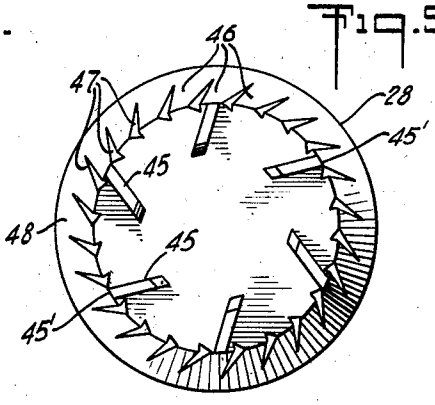
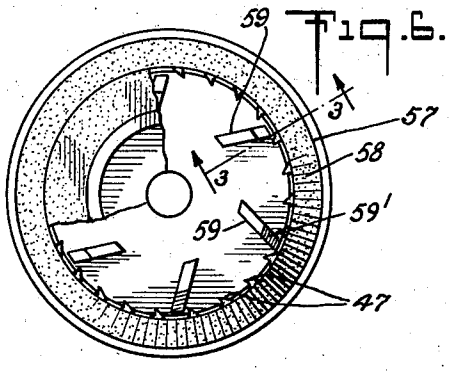


Fig. 6.



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ADJUSTABLE COLLOID MILL

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Original application April 7, 1942, Serial No. 437,979. Divided and this application March 1, 1944, Serial No. 524,824

10 Claims. (Cl. 241—259)

1

This invention relates generally to grinding, milling and homogenizing devices, particularly of the vertical type, although it may be operated horizontally or in any other desired position.

The present application is a division of our co-pending application Serial No. 437,979, filed April 7, 1942, matured into Patent No. 2,403,914, issued July 16, 1946, and has for its prime object to provide specially designed combination pre-cutting, mincing or grinding and milling elements, which are preferably adjustable relative to one another, and wherein these elements are interchangeable and are adapted to facilitate the handling of any type of material or a combination of materials to bring them to the desired fineness, uniformity, colloidal state or consistency.

Another object of the present invention is to provide in a colloidal grinding or milling device, mill units equipped with specially designed pre-cutting, cutting or mincing, and grinding means, adapted to gradually diminish the material to be treated, and which mill units are further provided with cooperating milling surfaces for producing a fine milling operation before the pre-cut, cut, minced or ground material is ultimately discharged from the units.

These and other objects and important improvements of the present invention will become more readily evident from the following description, reference being had to the accompanying drawings, wherein:

Fig. 1 illustrates an elevation of the device in its presently preferred form, shown partially in section;

Fig. 2 illustrates an enlarged partial detail view of the grinding or milling mechanism;

Fig. 3 is a similar illustration of a modified form of the grinding or milling arrangement, on a section taken on line 3—3 of Fig. 6;

Fig. 4 is a bottom view of a portion of the stator in one of its forms used with the grinder shown in Fig. 2;

Fig. 5 is a top view of a rotor such as employed in the construction shown in Fig. 2; and

Fig. 6 illustrates a top view of a rotor such as employed in the construction shown in Fig. 3.

Referring now specifically to the drawings, numeral 10 denotes the base of the device, which is preferably placed upon the floor, but which may be swung to any desired position and secured in that position by bolts or other means not shown in the drawings. Within base 10 there is suspended a motive source 11, such as an electric motor, with a vertical shaft 12 extending upwards. The motor is suspended from the enclosed bottom structure 13 of a frame 14, which latter rests upon base 10. The center of frame bottom 13 is apertured at 15, which aperture is covered by a drip guard 16. Structure 13 and drip guard 16 effectively prevent liquid or moisture from entering the base and damaging the motor.

2

Secured to and supported by frame 14 is a combination journaling and adjusting member 17, consisting of a hub structure 18, with which is associated a threaded adjustable cup 19, accommodating a shaft bearing 20. Cup 19 may be set in its adjusted position in respect to hub 18 by set screws 21. Within hub 18 is lodged and guided a sleeve 22, which is threaded externally at 23 and is engaged by an internally threaded and calibrated index ring 24, by means of which ring sleeve 22 may be adjusted in upward or downward directions. Sleeve 22 may be held in its adjusted position by means of set screw 25 engaging ring 24.

Within sleeve 22 and journaled in bearings 20 is rotor shaft 26. The latter is joined with shaft 12 of motor 11 by means of coupling 27, located within frame 14. Secured to shaft 26 is rotor 28, forming a part of the grinder or mill unit of the device. Rotor 28 is exchangeable. The stator of the mill is indicated at 29 and also comprises an exchangeable member or insert, which is supported by the broadened upper or flanged end 30 of sleeve 22, and which broadened end forms the bottom of the mill casing, which houses the grinder unit. It will be seen that the casing is provided with a water jacket 31, whereby the casing, and therefore the grinder unit, may be readily cooled or held at any desired temperature required for the matter to be treated within the device.

Above jacket 31 is a jacketed top member 32, held together with flange 30 of sleeve 22 by means of spacer bolts 33. Supported by upper jacket structure 32 is a hopper 34, provided with a cover 35, which may be completely closed if so desired. By means of the jacket in member 32 the contents of the hopper may be kept at any desired temperature. The top of the hopper is provided with an inlet 36 into which is removably placed the end of the goose neck 37 forming the upper portion of conduit 38, joined at its lower end with outlet pipe 39. The latter is connected at 40 with the grinder unit, and its discharge is controlled by valve 41. This valve may be so placed that it either provides a direct discharge from the grinder unit through its hollow structure 42, or that it closes outlet pipe 39 to provide circulation of the matter being milled through pipe

38 to the top of hopper 34 and back into the grinder.

Referring now to Figs. 2 to 6, inclusive, and especially to Figs. 2, 4 and 5, vertical rotor shaft 26 is provided with an off-set 43, against which rests rotor 28, which latter is secured to shaft 26 by means of threaded shaft extension 44.

The rotor, as shown in plan view in Fig. 5, is provided with turbine blades or vanes 45, which serve for drawing in the material to be handled and to catapult it against stator 29 and into the spaces between stator and rotor. These turbine vanes extend upwards from the horizontal top portion of the rotor and are positioned at a tangent in respect to a theoretical inner circle. The outer edges 45' of the turbine vanes are also disposed in a circle, which however is larger in diameter, and form cutters which cooperate with corresponding instrumentalities of the stator 29, as will be presently evident.

In addition to the cutting edges of the turbine blades, the work face of the rotor is provided with two other distinct work portions, that is, an upper conical portion, which comprises cutting or mincing fields 46, interposed between substantially V-shaped or wedge-shaped recesses 47, and a lower conical portion, which constitutes an unbroken, tapered milling surface 48.

The stator 29 is also composed of several distinct work portions which may be clearly observed in the bottom view shown in Fig. 4. The upper portion 49 is substantially cylindrical in shape and is provided with a plurality of internal flutes or recesses 50, equipped with cutting edges 51, which latter cooperate with cutting edges 45' of turbine blades 45 of the rotor. It will be observed that the number of flutes 50 far exceeds the number of vanes 45. Recesses 50 are vertical and are substantially cylindrical in shape, although portions of their cylindrical shapes are cut off to provide the aforesaid cutting edges 51. The bottom edges of recesses 50 and the surfaces between them are cone-shaped. These conical portions disposed between each two recesses are indicated at 52 and constitute cutting or mincing areas, which cooperate with the mincing fields 46 of the rotor. The lower conical portion 53 of the stator, commencing at the lower ends of recesses 50 and continuing downwards in parallel relation to milling surface 48 of the rotor, represents the stator milling surface, which cooperates with milling surface 48 of the rotor.

Just below the lower termini of recesses 50 there are provided, within conical milling surface 53, retaining cups or smaller recesses 54, which cooperate with the lower tips of wedge-shaped recesses 47 of the rotor. Between these two instrumentalities the material is temporarily retained until it is finely ground or minced before being passed on between the unbroken milling surfaces 48 and 53.

From the foregoing detail description of the work surface arrangement of the rotor and of the stator, it becomes clearly evident that any material drawn in by the turbine blades 45 is first precut between edges 45' of the turbine blades and the cutting edges 51 of recesses 50, whereupon a secondary or re-cutting step of the material to a finer state takes place between the lower ends of recesses 50 and the upper ends of V-shaped recesses 47 of the rotor. This operation is followed by a grinding or mincing operation between cups 54 and the lower ends of recesses 47, whereupon the minced material is subjected to a milling operation between surfaces 48 and 53. Thus material or a mixture of materials progressing from the top of the mill unit to the bottom thereof becomes gradually diminished in size. Due to the successive steps of diminishing the size of material by pre-cutting, recutting, mincing or grinding and milling, each of the progressive operations require but a minimum of power and as a result the overall power expenditure necessary for successfully operating the device will be found appreciably less, as compared with the power required in other devices of a similar nature. Furthermore, in consequence of the positive actions taking place at each stage of operation of the working unit, the uniformity of the resulting product issuing from between the two milling surfaces may be always depended on throughout extended working periods of the device.

When it is desired to subject the material to be treated to a more rapid or more extensive grinding operation, a modified rotor construction may be employed, such as illustrated in Figs. 3 and 6. In Fig. 3 there is illustrated a detail view showing vertical rotor shaft 26, off-set at 43, but provided with a somewhat longer threaded extension 44', serving for attaching such modified rotor. The rotor in this case is composed of a bottom or supporting member 55 and a top or locking member 56, between which two members is inserted an abrasive element 57. This element, while shown with a smooth, conical, outer surface 58, may also be provided with recesses such as shown at 47 in Fig. 5. Top member 56 of the rotor is equipped with turbine blades 59, similar to blades 45 of Fig. 2, terminating in a tangential cutting edge 59'.

The stator in this modified form is indicated at 60. It comprises an inverted dish-formed casing, provided at its dished end with inclined flutes or recesses 61. Below the fluted end the casing accommodates an abrasive insert 62 provided with vertical flutes, retaining cups or smaller recesses 63, which form continuations of inclined flutes 61 of the upper stator portion. The lower surface 64 of abrasive element 62, below flute 63, is relatively smooth and cooperates with the lower smooth portion of conical surface 58 of the rotor.

The modified form shown in Figs. 3 and 6 operates on the same principle of successively diminishing the material to be treated. It thus provides for what is termed as pre-cutting of the material, and also employs the steps of re-cutting or mincing of the material prior to the milling operation performed by the relatively smooth surfaces 58 and 64 of the rotor and stator.

The employment of abrasive elements in both these instrumentalities is particularly advantageous for the reason that the grade, coarseness or fineness of the abrasive material may be chosen for specific requirements to produce different grades of the finished product. The exchangeability of these abrasive inserts also facilitates their ready replacement, and otherwise provides numerous advantages over mill elements made of one piece of material.

While only two specific forms of our mill units are illustrated, it is obvious that changes, modifications and improvements may be made therein, and we therefore reserve for ourselves the right to alter and improve our mill structure, without departing from the broad scope of our invention, as expressed in the annexed claims.

We claim:

1. In a colloidal mill device, a grinding or mill unit comprising a rotor and an adjustable stator,

both having continuous work surfaces composed of pre-cutting, mincing and milling areas, the pre-cutting area of the stator being provided with spaced recesses or flutes arranged adjacent to and extending beyond its milling area, the pre-cutting area of the rotor also extending beyond its milling area and including a plurality of vanes projecting from the top of the rotor body and being tangentially disposed in respect to a theoretical inner circle, said vanes being adapted to cooperate with said flutes of the stator.

2. In a colloidal mill device, a grinding or mill unit comprising rotor and stator having cooperating work surfaces composed of pre-cutting, mincing or grinding, and milling portions forming immediately adjacent continuations of one another, the pre-cutting portion of the stator including a plurality of flutes, the pre-cutting portion of the rotor comprising a plurality of vanes, said flutes and vanes having cooperating cutting edges; said mincing portion comprising relatively small recesses in the rotor and material-retaining recesses in stator; said milling portion comprising relatively smooth, continuous cooperating faces of both the rotor and stator.

3. In a colloidal mill device, a grinding or mill unit comprising rotor and stator having cooperating work surfaces composed of pre-cutting, mincing or grinding, and milling portions forming immediately adjacent continuations of one another, the pre-cutting portion of the stator including a plurality of flutes, the pre-cutting portion of the rotor comprising a plurality of vanes, said flutes and vanes having cooperating cutting edges; said mincing portion comprising relatively small recesses in the rotor and material-retaining recesses in stator; said milling portion comprising relatively smooth, continuous cooperating faces of both the rotor and stator, the mincing and milling portions being provided in removable or exchangeable inlays made of abrasive material.

4. In a colloidal mill device, a grinding or mill unit comprising rotor and adjustable stator members, both having cooperating work surfaces composed of pre-cutting, mincing and milling portions forming immediately adjacent continuations of one another, the pre-cutting portion of the stator member being provided with a plurality of spaced recesses or flutes, the pre-cutting portion of the rotor member including a plurality of vertical vanes extending from the rotor member and arranged tangentially to a theoretical inner circle, said flutes and said vanes having sharp exterior cutting edges adapted to coact with one another for cutting matter before it reaches the milling portion of the two members, the milling portion of both members comprising exchangeable abrasive elements.

5. In a colloidal mill device, a grinding or mill unit comprising rotor and adjustable stator members, both having cooperating work surfaces composed of pre-cutting, mincing and milling portions forming immediately adjacent continuations of one another, the pre-cutting portion of the stator member being provided with a plurality of spaced recesses or flutes, the pre-cutting portion of the rotor member including a plurality of vertical vanes extending from the rotor member and arranged tangentially to a theoretical inner circle, said flutes and said vanes having sharp exterior cutting edges adapted to coact with one another for cutting matter before it reaches the milling portion of the two members, the milling portion of both members comprising

exchangeable abrasive elements, the number of the recesses or flutes of the stator member far exceeding the number of vanes of the rotor member.

6. In a colloidal mill device, a grinding or mill unit comprising rotor and adjustable stator members, both having cooperating work surfaces composed of pre-cutting, mincing and milling portions forming immediately adjacent continuations of one another, the pre-cutting portion of the stator member being provided with a plurality of spaced recesses or flutes, the pre-cutting portion of the rotor member including a plurality of vertical vanes extending from the rotor member and arranged tangentially to a theoretical inner circle, said flutes and said vanes having sharp exterior cutting edges adapted to coact with one another for cutting matter before it reaches the milling portion of the two members, the milling portion of both members comprising exchangeable abrasive elements, the number of the recesses or flutes of the stator member far exceeding the number of vanes of the rotor member, said flutes being substantially cylindrical in cross section.

7. In a colloidal mill device, a grinding or mill unit comprising rotor and adjustable stator members, both having continuous work surfaces composed of pre-cutting, mincing and milling portions, the pre-cutting portions of both members being provided with cooperative pre-cutting means, including depressions in the stator and vanes extending from the rotor, adapted to pre-cut matter and facilitate its feeding towards the mincing portions of the members, a mincing stage provided with both members and comprising diminutive material cutting means, the pre-cutting and diminutive cutting means of both members being immediately adjacent to each other and forming a direct continuation of their respective milling surfaces, said mincing portion of the members comprising substantially cup-shaped recesses in the stator and substantially wedge-shaped recesses in the rotor, the area of the rotor below said recesses forming a continuation of the milling stage of the rotor member.

8. In a colloidal mill device, a grinding or mill unit comprising rotor and adjustable stator members, both having continuous work surfaces composed of pre-cutting, mincing and milling portions, the pre-cutting portions of both members being provided with cooperative pre-cutting means, including depressions in the stator and vanes extending from the rotor, adapted to pre-cut matter and facilitate its feeding towards the mincing portions of the members, a mincing stage provided with both members and comprising diminutive material cutting means, the pre-cutting and diminutive cutting means of both members being immediately adjacent to each other and forming a direct continuation of their respective milling surfaces, the pre-cutting portion of the work surface of the stator member being provided with recesses or flutes, the mincing portion of the stator member comprising retaining cups or recesses, adjacent to these flutes, the latter having sharp cutting edges.

9. In a colloidal mill device, a grinding or mill unit comprising rotor and adjustable stator members, both having continuous work surfaces composed of pre-cutting, mincing and milling portions, the pre-cutting portions of both members being provided with cooperative pre-cutting means, including depressions in the stator and vanes extending from the rotor, adapted to pre-

cut matter and facilitate its feeding towards the mincing portions of the members, a mincing stage provided with both members and comprising diminutive material cutting means, the pre-cutting and diminutive cutting means of both members being immediately adjacent to each other and forming a direct continuation of their respective milling surfaces, the pre-cutting portion of the work surface of the rotor member including a plurality of spaced, vertical vanes extending beyond the solid body of that member, the pre-cutting portion of the work surface of the stator member being provided with a plurality of flutes, said rotor vanes and said stator flutes having cooperating sharp cutting edges.

10. In a colloidal mill device, a grinding or mill unit comprising rotor and adjustable stator members, both having continuous work surfaces composed of pre-cutting, mincing and milling portions, the pre-cutting portions of both members being provided with cooperative pre-cutting means, including depressions in the stator and vanes extending from the rotor, adapted to pre-cut matter and facilitate its feeding towards the mincing portions of the members, a mincing stage provided with both members and comprising diminutive material cutting means, the pre-cutting and diminutive cutting means of both members being immediately adjacent to each other

and forming a direct continuation of their respective milling surfaces, the pre-cutting portion of the work surface of the rotor member including a plurality of spaced, vertical vanes extending beyond the solid body of that member, the pre-cutting portion of the work surface of the stator member being provided with a plurality of flutes, said rotor vanes and said stator flutes having cooperating sharp cutting edges, the number of flutes in the stator member being considerably in excess of the number of vanes extending from the rotor member, said vanes being positioned tangentially to a theoretical inner circle.

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