Sept. 17, 1929. W. EPPENBACH 1,728,178

MILL FOR HOMOGENIZING, EMULSIFYING, AND KINDRED OPERATIONS

Filed Dec. 24, 1927 2 Sheets-Sheet 1

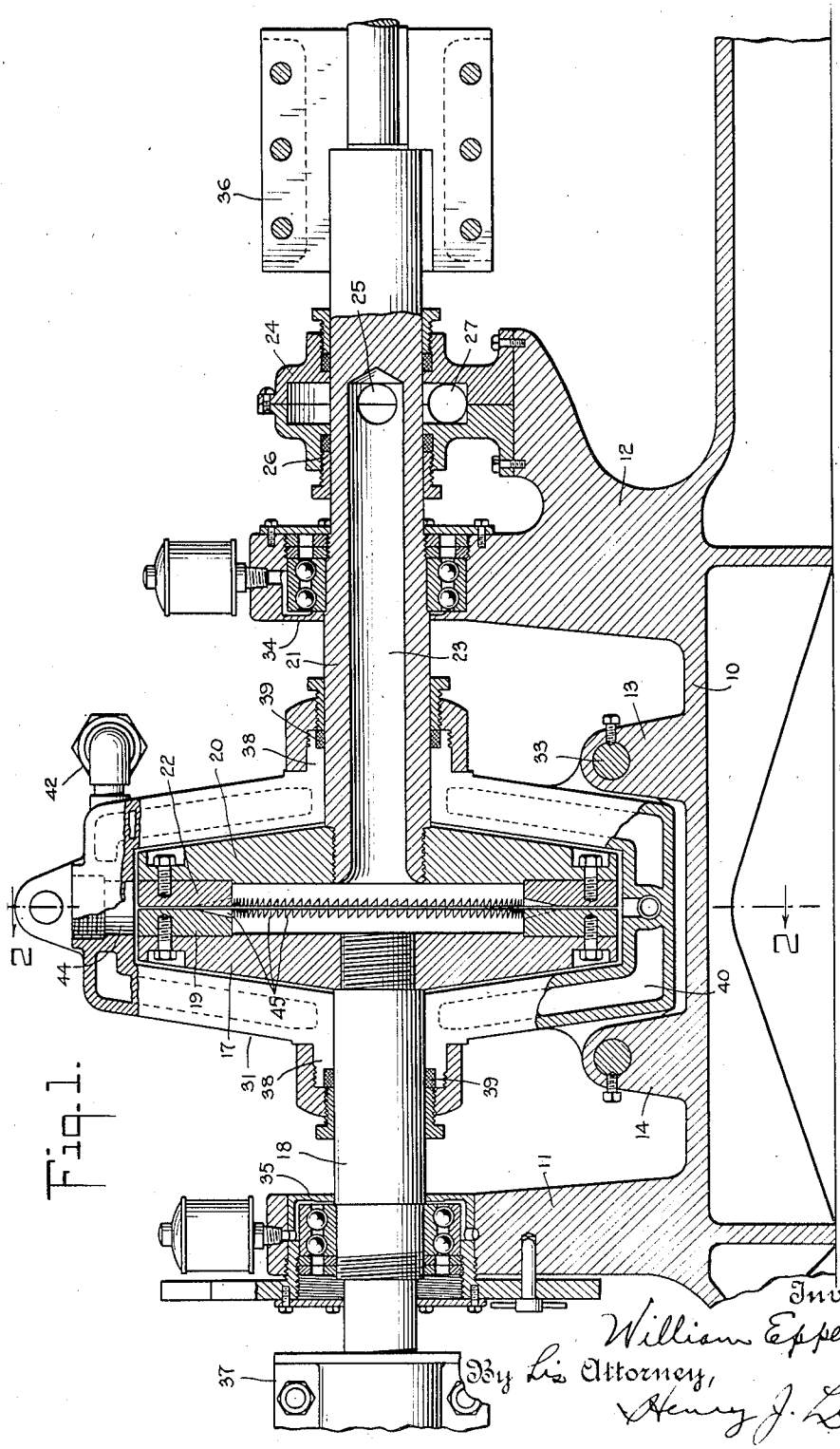


Fig. 1.

Inventor,
William Eppenbach,
By his Attorney,
Henry J. Lucas.

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Fig. 2.

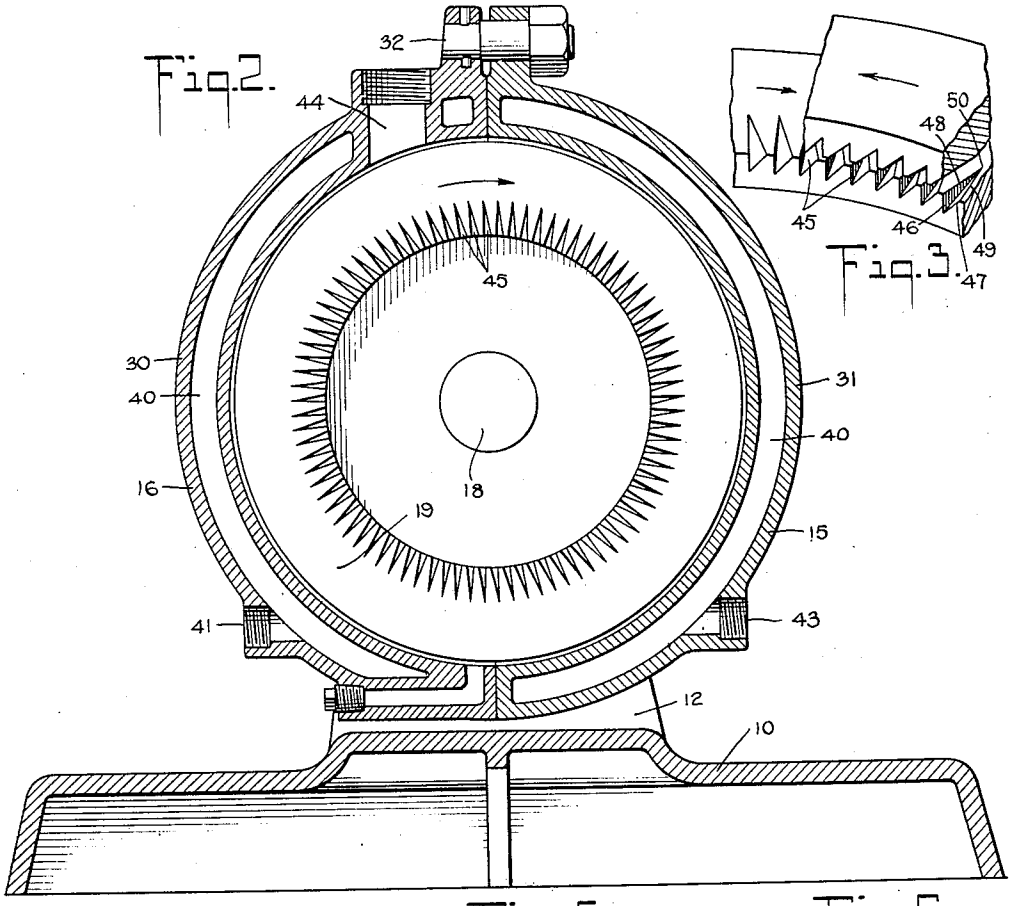


Fig. 3.

Fig. 4.

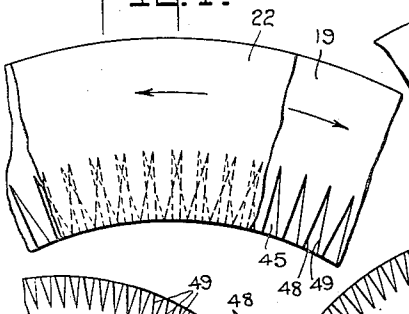


Fig. 5.

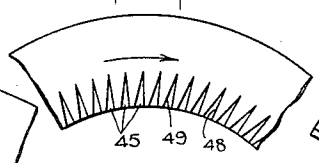


Fig. 6.

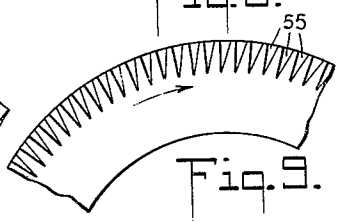
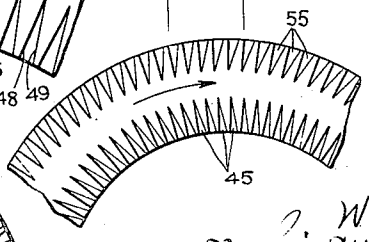
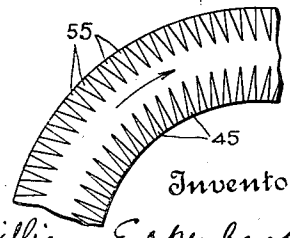


Fig. 9.

Fig. 8.





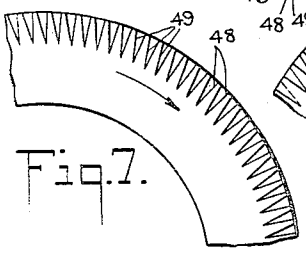


Fig. 7.

Inventor,
William Eppenbach,
By his Attorney,
Henry N. Lucke.

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UNITED STATES PATENT OFFICE

WILLIAM EPPENBACH, OF COLLEGE POINT, NEW YORK

MILL FOR HOMOGENIZING, EMULSIFYING, AND KINDRED OPERATIONS

Application filed December 24, 1927. Serial No. 242,361.

This invention relates to mills for homogenizing, emulsifying, and kindred operations.

Pursuant to my invention, the rotor means of the mill comprises a single rotor carrying a grinding ring cooperating with a fixed grinding ring, or two rotors rotating in opposite directions.

Pursuant to my invention, my mill may be operated either by feeding the mixture of materials to be treated from a region peripherally exterior of the grinding rings and discharging from a region interior of the grinding rings, or by feeding the mixture to be treated to the interior of the grinding rings and discharging the treated material from the exterior thereof.

Preferably, the grinding rings are provided with depressions of uniform or non-uniform contour and locations and disposed either at the feeding edge of the grinding ring or rings or at the discharge edge of the same, or at both the feeding edges and the discharge edges of the grinding ring or rings. Such depressions serve as shearing means which coact with the minute clearance at high speed between the grinding rings in facilitating the homogenization and emulsifying of the mixture.

A preferred form of my invention comprises what is known as a horizontal type of mill and consists generally of a casing having hollow walls for the flow of a temperature-regulating medium, bearings disposed in such casing for the single or double shafts for either one or a pair of rotors, one of said shafts being hollow to afford a passage therethrough, in coaction with a hollow chamber or other suitable passage means communicating with such hollow shaft portion for the discharge or the inflow, as the case may be, of the mixture to be treated.

Further features and objects of the invention will be more fully understood from the following detail description and the accompanying drawings, in which

Fig. 1 is a central vertical section of a two-rotor type of horizontal mill embodying my invention;

Fig. 2 is a sectional elevation on line 2—2, of Fig. 1;

Fig. 3 is a detail perspective view illustrating a form of shearing depressions on two grinding rings, which are rotated in opposite directions; this form of depression is a modification of those illustrated in Figs. 1 and 2;

Fig. 4 is a detail top plan of a further modification; and

Figs. 5, 6, 7, 8, and 9 are respectively further modifications of other forms of grinding rings and shearing depressions.

Referring to Figs. 1 and 2, the mill is preferably mounted on a unitary base 10, with which may be cast the bearing support 11 for the left hand rotor shaft, the bearing support 12 for the right hand rotor shaft and also for the hollow inflow or discharge chamber, also the supporting lugs 13, 14 for the respective halves 15, 16 of the casing.

The form of the mounting base and casing assembly are set forth and claimed in my co-pending application Serial No. 207,866, and the elements of these parts are described but generally herein.

In Figs. 1 and 2 I have illustrated a pair of rotors with suitable means for rotating the rotor shaft in opposite directions. One rotor 17, appearing at the left in Fig. 1, is mounted centrally on its shaft 18 and carries a grinding disk 19, illustrated as annular in form. The other rotor 20 is mounted centrally on its rotor shaft 21 and carries the grinding disk 22. In this instance, the rotor shaft 21 is illustrated as hollow to provide for the passage 23 which extends from the end of the shaft 21 leading to a region interior of the grinding rings 19, 22 to the hollow casing 24, through discharge openings communicating therewith, for the discharge or inflow of the mixture to be treated. The casing may be made in symmetrical halves, bolted together as shown, and is provided at each end with a suitable stuffing box 26. A suitable connection as at 27 provides for conducting the liquid or other material to or from the casing.

The rotors and grinding disks are enclosed in a housing consisting of the two sections 30 and 31, fitting together in the vertical, axial plane of the machine and secured together by an upper bolt 32, Fig. 2, and lower bolts

33, Fig. 1; these bolts also serve to support the housing and relieve the shafts entirely or largely of its weight. The shafts are supported in bearings 34 and 35 of which bearing 35 is adjustable to admit relative axial adjustment of the rotors, and couplings 36 and 37 to provide for connection of the shafts to suitable driving means. The casing sections have hub portions 38 which provide bearing fits on the respective shafts and stuffing boxes 39, to prevent leakage of the mixture. The housing sections are provided with chambers 40 for the circulation of the temperature regulating medium such as city water for cooling purposes, which enter at 41, Fig. 2, then passes from one of the housing sections to the other by means of a suitable exteriorly extending inter-connecting pipe connection 42, Fig. 1, and discharged from the other housing section 31 at 43. The liquid to be treated may enter or be discharged from the housing through a passage 44 in housing section 30. All of the construction features mentioned are more fully described in the above identified application.

While grinding disks with plain or smooth, flat faces, as disclosed in my above mentioned application, are satisfactory for many purposes, it has been discovered that for other purposes and particularly for the more effective homogenizing and emulsifying, including grinding and the like of certain materials it is preferable to provide the active faces of the disks with supplemental shearing means arranged to more effectively act upon the material and reduce it to the desired fineness or consistency at reduced consumption of energy in the drive of the mill and substantially wholly without any chattering of the mill parts.

Such shearing means are here illustrated in several different forms and arrangements. In Figs. 1 to 4, assuming now that the liquid is supplied through the hollow shaft 21 and is discharged through the passage 44, the confronting faces of the disks 19 and 22 at or adjacent their inner peripheries or entering edges, are provided with generally tapering depressions 45, these shearing depressions 45 are in opposite relative arrangement on the respective disks. The depressions are each defined by two surfaces 46 and 47, of which the surfaces 46 in this particular example lie substantially on the axial planes of the respective shafts, and surfaces 47 which are in angular relation thereto. The surface 46 thus terminates at its intersection with the face of the disk in an edge 48 which is substantially radial, and the surface 47 terminates in an edge 49 which, as it proceeds inwardly from the apex 50 of the depression, is inclined forwardly with relation to the radius, and is inclined forwardly also with relation to the direction of rotation of the particular disk, indicated by arrows in Figs. 3 and 4. Thus the large inward ends of the depressions afford opportunity for the ready inflow of the liquid and entry thereof between the active faces of the disks, while the radial edges of the equally spaced depressions of the disks in the rapid rotation thereof engage the relatively solid or viscous portions of the liquid in such manner as to most effectively shear the particles or the film of the material to be treated in coaction with the high speed and narrow clearance of the grinding disks. Thereafter the liquid passing between the outward plane faces of the disks is further treated in substantially the same manner as in the above mentioned application; and the treated liquid is then discharged through the passage 44.

Fig. 5 shows substantially a reversal of the edge arrangement of Fig. 4, that is, the radial edges 48 are in the lead with reference to the direction of rotation, as indicated by the arrow, and the diagonal edges are therefore the effective edges for producing the improved shearing effect upon the material.

Fig. 6 illustrates a variation in which depressions 55 are provided on the disk faces adjacent the outward peripheries thereof, these depressions being substantially similar to the previous example except that their apices are directed inward and their larger portions are located at the outer periphery of the disk. The edge arrangement is similar or equivalent to Figs. 1 to 4, and provides an improved action upon the material when the flow direction is inward at the disk periphery.

The same arrangement of depressions and active edges may be employed when the flow is from the inward toward the outward peripheries of the disks.

Fig. 7 shows an arrangement similar to Fig. 6 except that in this instance the arrangement of the depression edges with relation to direction of disk rotation is reversed; thus the radial edges 48 are in advance of the diagonal edges 49 and the latter are therefore the effective edges for the shearing action upon the material treated, and provide by the cooperation of the two disks a highly improved shearing action upon the more viscous or solid portions of the material.

Fig. 8 shows practically a combination of the features of Figs. 4 and 6, that is to say, the disk faces have inner and outer sets of depressions 45 and 55 respectively, the edge arrangement being otherwise the same as in Figs. 4 and 6.

Fig. 9 shows a disk which is provided with both inner and outer depressions or edges, or practically a combination of the features of Figs. 5 and 7.

An important feature of the invention, as indicated early above, is that I have dis-

covered by study and experiment that improved results are obtained in many cases when the flow of the treated liquid is generally outward; that is, when it is supplied through the casing 24 and the hollow shaft 21 to the inward peripheries of the disks and flows outwardly through the homogenizing gap, and discharged through the passage 44. By such direction of flow of the material to be treated, pressure on the material in advance of its inflow into the mill, is obviated and the stuffing boxes, pipe connections, and the shafts and bearings and disk faces are relieved to a large part of additional pressure and consequent friction, wear or tendency to leakage.

It will be observed that my preferred form of shearing means extend either from the inflow edge or the discharge edge of any grinding disk, or from both edges but a fraction of the effective distance between the inflow edge and the discharge edge of such disk, thus requiring all particles of the mixture to be forced into and through the adjusted narrow gap between the grinding faces. Further, such arrangement provides for locating the dimension of maximum depth of each shearing depression at a lateral face of the grinding disk, thus facilitating the entry or discharge, or both, as the case may be, of the material into or from the interior of each depression.

I claim:

1. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc.

2. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having a liquid passage external to the homogenizing gap, passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, certain of said edges being substantially radial.

3. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, certain of said edges being substantially radial, and others in angular relation to the radial edges.

4. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, one edge of each depression being directed substantially radially and the other diagonally thereto.

5. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, the disc also having other generally similar depressions extending inward from its other periphery.

6. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active

face of the disc, said depressions extending only part-way from said periphery toward the other periphery of the disc, thus providing a plain disc face to also operate upon the liquid.

7. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, one edge of each depression being directed substantially radially and the other diagonally thereto, said depressions extending only part way from said periphery toward the other periphery of the disc, thus providing a plain disc face to also operate upon the liquid.

8. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, the disc also having other generally similar depressions extending inward from its other periphery, said depressions extending only part way from their respective disc peripheries toward the other periphery, thus providing a smooth, flat disc face to also operate upon the liquid.

9. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, said complemental disc being provided with substantially similar depressions.

10. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, one edge of each depression being directed substantially radially and the other diagonally thereto, said complemental disc being provided with substantially similar depressions.

11. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, the disc also having other generally similar depressions extending inward from its other periphery, said complemental disc being provided with substantially similar depressions.

12. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized, one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, said depressions extending only part way from said periphery toward the other periphery of the disc, thus providing a plain disc face to also operate upon the liquid, said complemental disc being provided with substantially similar depressions.

13. A mill for purposes described comprising a rotor, an annular grinding disc thereon, a complemental grinding disc in closely spaced relation to the first one for effecting homogenization, a housing enclosing the discs and having passage means for the discharge of the homogenized material, passage means for directing the material to be homogenized,

one of the discs having on its active face spaced depressions of generally tapering form of which the larger ends constitute openings for liquid worked on and located at a periphery of the disc, the depressions having substantially sharp edges at the active face of the disc, one edge of each depression being directed substantially radially and the other diagonally thereto, said depressions extending only part way from said periphery toward the other periphery of the disc, thus providing a plain disc face to also operate upon the liquid, said complemental disc being provided with substantially similar depressions.

In testimony whereof I have signed this specification this 28th day of Nov. 1927.

WILLIAM EPPENBACH.