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APPARATUS FOR PRODUCING SUSPENSIONS

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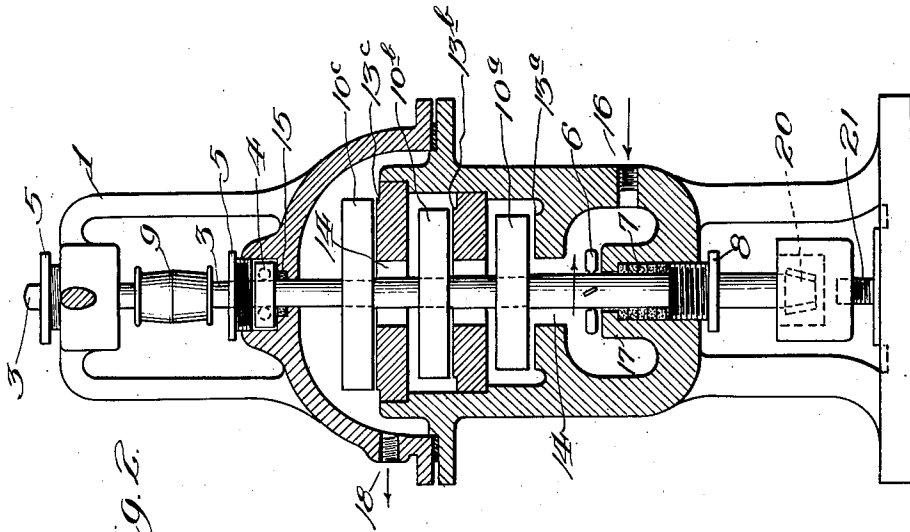


Fig. 2.

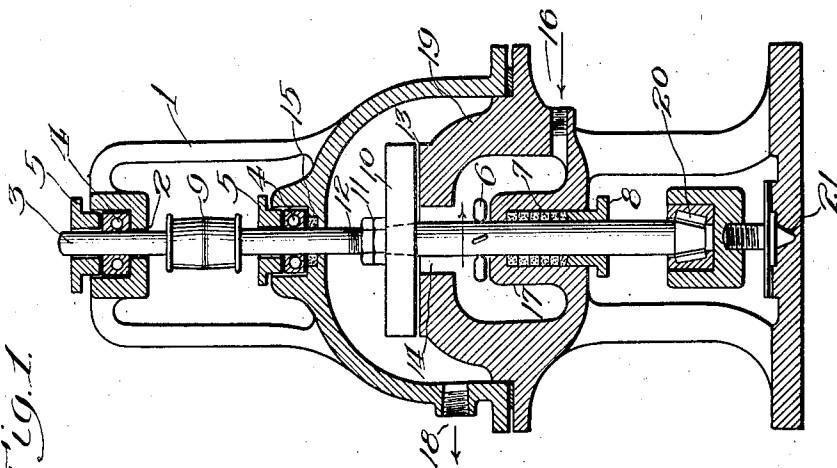


Fig. 1.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR PRODUCING SUSPENSIONS

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This invention relates to improvements in apparatus for producing suspensions, and refers more particularly to apparatus for the disintegrating or dispersing of various materials, for the homogenization of liquids, semi-solids or solids in a liquid medium in which these suspended liquids are partially or wholly insoluble.

The dispersions of liquids in a liquid medium under these circumstances are referred to as emulsions, while those of solids in liquids are known as suspensions. The dispersion may be carried to such an extent that the particles are barely visible in a high powered microscope and in some cases dispersed so finely as to pass through ordinary filter paper.

In the drawings:

Fig. 1 is a side elevational view in vertical section of one form of mill.

Fig. 2 is a side elevational view, partly diagrammatic and partly in vertical section, of another form of mill.

Referring in detail to Fig. 1 of the drawings, 1 designates the upper shell or cover, which may be solid or in the form of a skeleton supporting frame, with bearing support portion 2, in which is mounted the vertical drive shaft 3. Above the bearing portions 2 are positioned the usual ball bearings 4 held in place by the closure cap 5. Fixedly mounted on the shaft 3 and adapted to rotate therewith are the repelling vanes 6, which function as a centrifugal pump in forcing the liquid away from the packing gland 7, which it is noted is adjustable and removable, having the annular cap 8. A belt pulley 9 is mounted on the shaft 3 adapted to be used where belt drive is employed. This form of drive is merely illustrative as it may be advisable to use direct motor or steam turbine drive for high speeds.

Adjustably mounted on the shaft 3 is a rotary disk or rotor 10, vertically adjustable on said shaft through the screw threaded boss 11 registering with the screw threaded portion 12 of the shaft, 13 represents the stationary annular disk or stator, centrally apertured as shown at 14. The packing washer 15 may be provided if desirable.

It is to be noted that a feature of the invention is the use of the solid rotary disk or rotor 10 with the stationary annular disk or stator 13. The liquid and material to be suspended, may be introduced through the inlet 16 into what may be termed the supply chamber 17. The rotor 10 works in close relation with the stator 13 with clearances ranging from .002 inches upward. The material in supply chamber 17 is thrown upwardly between the rotor and stator by the action of the blades 6 and pressure maintained on the material introduced through inlet 16. The suspension may be withdrawn through the outlet 18. The suspended particles are thus subjected to a shearing action assisted by the forces created as the particles progress to the outer edge of the disks 10 and 13, owing to the varying peripheral speeds at varying distances from the center of the shaft 3. The suspended particles are thus disrupted or disintegrated and dispersed. For certain purposes, the inner surfaces of the disks may be grooved, although this is optional. Wet grinding, as a general proposition, has been found superior to dry grinding in ball or pebble mills and other type mills so that the advantages found here will be immediately apparent.

19 designates the main casting or support, constituting the supply chamber 17. It must be understood that although we have shown the stator 13 formed integral with the casting 19, nevertheless it may be a separate plate. The thrust bearing 20, ball bearing 4 and packing gland 7 tend to keep the shaft in proper alignment and prevent displacement of the rotor 10, also tending to maintain an adjusted space between the rotor 10 and stator 13 uniform during an operating period, very important features of this invention.

21 represents a micrometer adjusting screw for the purpose of adjusting the distance between the rotary and stationary elements. Port holes with cover plates may be fixedly attached to the frame 1 to make and observe adjustments of the disks. In order to keep suspended particles from fouling the packing gland 7, two devices may be utilized, namely, the vanes 6 which have a repelling

action, or a liquid seal such as a mercury seal, may be maintained at the top of the packing gland 7, thus preventing the materials undergoing treatment from entering the gland proper.

In Fig. 2, we have disclosed apparatus utilizing principles similar to those utilized in the apparatus of Fig. 1, excepting that there are a plurality of rotary plates 10a, 10b and 10c, and stationary annular surfaces 13a, 13b and 13c, so adjusted that the space between opposed surfaces decreases as the treated material progress upwards, for example, the space between the lower set of opposed surfaces may be .01 inch; the space between the middle set may be .005 inch and the space between the upper opposed surfaces may be decreased to .002 inch. This results in increasing dispersion with the upward progress of the liquid and facilitates the handling of relatively coarse suspensions, and the obtaining of a finished product having a fine degree of dispersion. Under some circumstances it may be desirable to have grooves on the surfaces of the bottom rotor and stator.

Where it is desired to disperse solids in liquids, the solid material is usually ground previous to introduction to the mill. The materials to be dispersed, whether liquid or solid, are fed in together with the liquid dispersion medium through inlet 16.

The operation of the mill may be now described. The distance between the rotary disk and the stationary annular disk may be first adjusted by means of the micrometer screw 21, making use of the port holes in the upper shell or cover. The port holes are covered by plates when operating. The plates may be held in position by wing or other nuts and bolts. The mill is then started, utilizing either direct or other driving mechanism. The material to be treated, for example, a mixture of oil and water (containing an emulsifying agent) may be fed into inlet 16 and by gravity forces assisted by the action of the rotary disk 10 is caused to pass between the rotary and the stationary annular disks where dispersion of the oil in water takes place. The same applies to a suspension of a solid in a liquid, for example, a pigment in oil for paint purposes. The clearance between the two disks depends on the type and degree of dispersion desired and may vary from 0.001 of an inch upwards. The dispersed material now enters the upper chamber where it discharges through the outlet port 18 to a receiving vessel. It is to be noted that in feeding the materials into the inlet 16, the source of supply must have a gravity head sufficient to cause discharge through outlet 18, or a slight pressure may be used. Passage through the mill is also assisted by the action of the rotor.

It is to be pointed out here that in making stable dispersions of one substance in

another, the presence of a third substance is required, such as a protective colloid or emulsifying agent. Dispersators of various classes are also used to facilitate dispersion.

The applications of our invention are manifold. Among some of its general applications in addition to dispersing are extraction, mixing, blending and similar operations. It may be used in the preparation of emulsions of oils, pitches and asphalts, etc., for binding and impregnation, in road, roofing and other trades, in preparation of emulsions and suspensions for medicinals, disinfectants, insecticides and antiseptic, etc., disintegration of fibres for paper, cardboard, papier mâché, felting, etc., the dispersion of solids in liquids in the preparation of inks, paints, varnishes, enamels, etc., in the manufacture of food products such as milk homogenization, flavoring preparations and extracts, salad dressings, etc., in the preparation of fuel products such as dispersing carbonaceous materials in an oil medium, for reagent contacting purposes in chemical reactions, and wherever disintegration, dispersion, mixing or extracting is desired.

We claim as our invention:

1. In an apparatus for producing suspensions, the combination with a main frame, of a rotatable shaft supported therein, grinding means fixedly attached to the shaft and adapted to rotate therewith, a stationary element adjacent to the rotating grinding means, both having opposed non-contacting horizontal imperforate surfaces of substantial area, means mounted upon the shaft for introducing and forcing materials upwardly to be suspended between the opposed surfaces and impinging the same directly upon the walls of the apparatus, means for withdrawing the completed suspensions, and micrometric adjusting means for varying the space between the opposed horizontal rotating and stationary surfaces.

2. In apparatus for producing suspensions, the combination with a drive shaft vertically mounted, means for rotating the shaft, a plurality of superposed disks fixed so as to rotate with the shaft, a stationary element adjacent each disk, both the stationary elements and rotary disks having non-contacting opposed horizontal imperforate surfaces, the space between the opposed horizontal surfaces being successively decreased upwardly, means for forcing upwardly materials to be suspended successively through the opposed horizontal surfaces of decreasing size, and means for discharging the completed suspensions.

3. In apparatus for producing suspensions, the combination with a drive shaft vertically mounted and bearing adjacent both ends, means for rotating the shaft, a plurality of superposed disks fixed so as to rotate with the shaft, a stationary element

adjacent each disk, both the stationary elements and rotary disks having non-contacting opposed horizontal imperforate surfaces, the space between the opposed horizontal surfaces being successively decreased upwardly, means for forcing upwardly materials to be suspended successively through the opposed horizontal surfaces of decreasing size, and means for discharging the completed suspensions.

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