

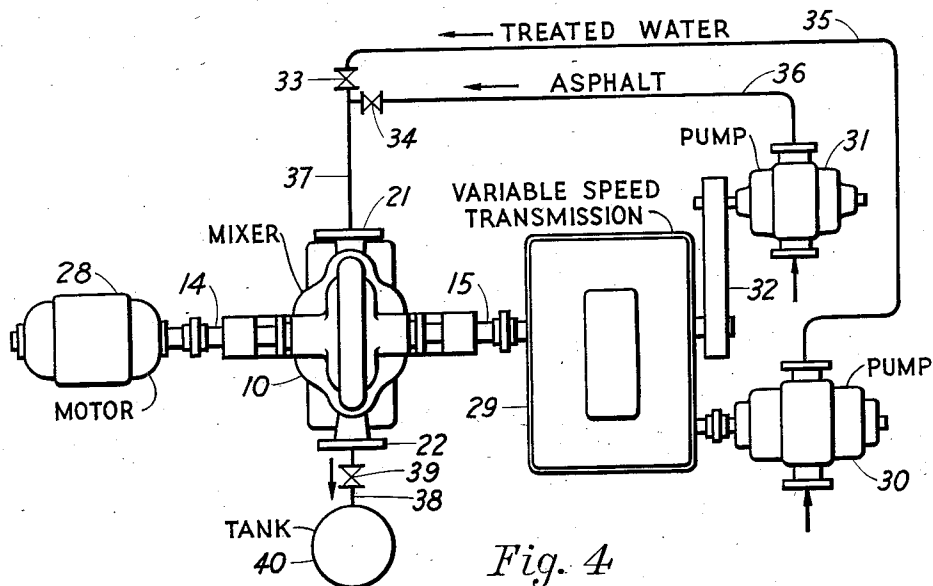
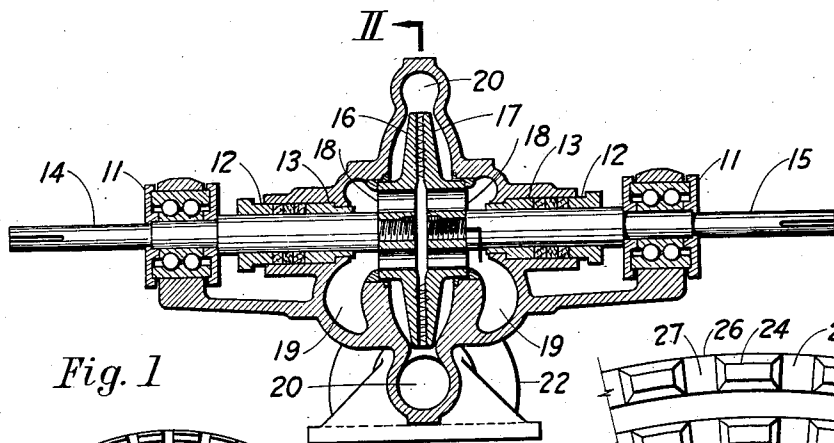
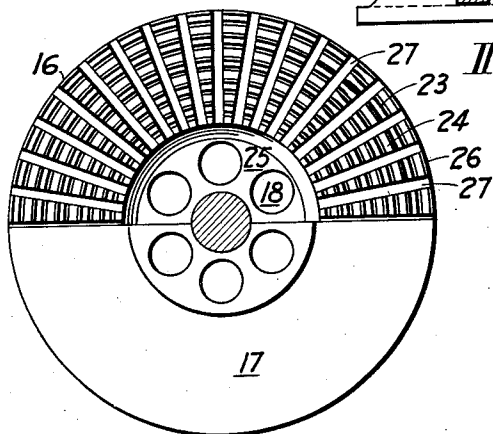
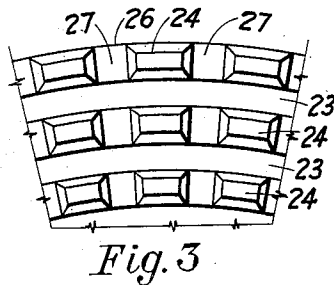
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MIXER

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MIXER

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8 Claims. (Cl. 259—10)

The invention relates to a mixer for liquids or suspensions of liquids and solids which are to be disintegrated or homogenized to form emulsions or the like, and particularly refers to an arrangement of coaxially disposed interengaging rotors, one of which is adapted to drive the other at a variable controlled speed and at the same time disperse or mix liquid or suspensions of liquids and solids which are passed between the cooperating faces of the rotors.

Heretofore, mixers or colloid mills have utilized rapidly moving surfaces spaced with small radial clearances through which the liquids or liquids and solid materials have been passed to cause the latter to be intimately dispersed and made into emulsions or suspension. In the greater part of these devices one of the relatively moving parts has been held stationary while the other one has been driven at high speed, or both of them have been driven in opposite directions to obtain high surface speeds.

In mixing liquids of different characteristics it is essential that the proportions of the various liquids or solids be kept within narrow ranges, and it is also desirable to be able to vary the energy which is expended in mixing or agitating any given quantity of liquid to control the properties of the resultant product. Complicated systems of fluid proportioning devices have been used for feeding colloid mills and similar apparatus in intimately mixing liquids and solids and separate arrangements of variable speed controls have been used for the pumps which supply such mixers with these fluids.

This invention comprehends broadly a mixer or the like which not only involves rapidly moving interengaging surfaces spaced closely together and between which the liquids or liquids and solids are passed, but utilizes the same means for controlling the fluid supply devices to the mixer and also for controlling the degree of agitation or beating which is imparted to any given quantity of liquid or liquid and solid passing through the mixer.

In one embodiment the invention provides a type of colloid mill for forming an emulsion and also a fluid clutch which will drive at any desired speed the pumps which feed the ingredients to the mill.

It is an object of this invention to provide a colloid mill, mixer or the like that will have a minimum of moving parts and control means and will serve not only to mix or homogenize certain liquids and solids, for example asphalt and treated water, but will also drive the pumps or

other supply means in any desired proportional speed to control the nature of the emulsions or suspensions so formed.

Another object is to provide a mixer or colloid mill, together with the pumps and auxiliaries for supplying it, that will be operable from a single prime mover of unvarying speed, the apparatus being arranged to vary the relative speeds of the pumps and also of the degree of mixing, agitation, or beating which takes place between the relatively rotating parts of the mixer.

Another object is to provide an improved construction for the relatively moving parts of a mixer of this type which are adapted to be mounted in a conventional pump body without substantial alteration thereto, certain parts of the device being rotatable in the same direction through frictional drag and energy losses developed in the liquid and are controllable by throttling the discharge from the mixer.

These and other objects and advantages will be more fully apparent from the following description, and from the accompanying drawing which forms a part of this specification and illustrates a preferred embodiment of the invention.

In the drawing, Figure 1 is a longitudinal sectional view of a mixer showing the cooperating and interengaging faces of the two rotors.

Figure 2 is a transverse and part sectional view on line II—II of Figure 1 showing one arrangement of concentric and radial grooves for a rotor face.

Figure 3 is a fragmentary elevational view of an alternative form of grooves for the rotor face.

Figure 4 is a diagrammatic plan view of a mixer embodying this invention, together with a prime mover for driving it, and including means for controllably operating a pair of pumps for supplying the mixer with liquids.

Referring to the drawing and particularly Figure 1, numeral 10 designates a housing which may be similar to that of a standard double suction horizontal split case centrifugal pump. This housing is provided with the usual bearings 11, shaft packings 12, and sleeve bearings 13. Two coaxial separate shafts 14 and 15 are mounted in housing 10 and are threaded at their innermost ends to receive rotors 16 and 17, respectively. These rotors fit in the same position that is usually occupied by the impeller of a conventional pump and are provided with inlets 18 which communicate with the inlet passages 19 of the pump housing 10. The discharge passage or volute 20 for pump housing 10 is adapted to receive liquid which passes outwardly between

the interengaging faces of rotors 16 and 17. Inlet and outlet passages 19 and 20 may terminate at flanged connections 21 and 22 (Figure 4).

Rotors 16 and 17 are similar in construction and each is provided with a plurality of concentric grooves 23 separated by lands 24. In this example the grooved faces of rotors 16 and 17 are illustrated as lying in a single plane at right angles to the axis of rotation. This is primarily for convenience of installation in a conventional pump housing such as that illustrated, but rotors 16 and 17 would be concave and convex, respectively, or of other configuration as desired so long as the concentric grooves 23, separated by lands 24 are provided for the purpose which will be discussed in greater detail below.

Inlets 18 communicate with the central part of rotors 16 and 17, which parts are recessed as at 25 to form a liquid inlet space entirely surrounded by the grooves and lands just mentioned. Extending outwardly from recess 25 to the periphery 26 of rotors 16 and 17 are a plurality of fluid passages 27 which intersect the grooves 23 and lands 24 to form numerous projections on the faces of the rotors. Obviously, the grooves and lands are so positioned on the adjoining faces of rotors 16 and 17 that the lands 24 of rotor 16 will be received in the lower part of the grooves of rotor 17. Actual contact is to be avoided but clearances may be relatively small, on the order of a few thousandths of an inch. The depth of passage 27 may be less than, equal to, or greater than that of grooves 23, depending upon the characteristics desired for the device.

In the example shown in Figure 2 fluid passages 27 are illustrated as being radial for convenience in machining, but they could equally well be made in any other desired form so long as they extend outwardly from recess 25 to the periphery of the rotors 16 and 17. In Figure 2 fluid passages 27 are illustrated as being square in cross-section so that their intersections with grooves 23 and lands 24 will be sharp-edged. This is desirable for certain types of operation. Grooves 23, however, are desirably of substantially trapezoidal or inwardly sloping cross-section for convenience in machining and also for ease of adjustment of the close clearances that are usually required between the two rotors.

In Figure 3, the configuration of both the fluid passages and the concentric grooves is illustrated as being trapezoidal in cross-section which provides wedge-shaped or sloping surfaces for the relatively moving projections on the two rotors. Obviously, a rounded configuration or any other form of groove shape could be provided, depending upon the characteristics of the materials which are to be handled, and the degree of mixing they are to receive.

In operation, liquids or suspensions of solid particles in liquids are admitted to inlet 21 of housing 10 from which they flow through passage 19 into the inlets 18 of rotors 16 and 17. Fluid passages 27 will act substantially as impeller passages within the rotors and will set up a hydrostatic head which augments the pressure causing the liquids to flow into and through the mixer. A prime mover, such as motor 28, is used to drive shaft 14 and impeller 16. Rotor 17 on shaft 15 will tend to rotate in the same direction due to two factors, one of which is the viscosity or fluid drag of the liquid between the rotors. The second and more important factor is the exchange of energy which takes place when a

given quantity of the fluid leaving the influence of one rotor impinges on the faces of the projections of the second rotor and give up its kinetic energy. This could be designated "fluid impact" and can be computed from the well known basic principles of kinetic energy.

If it is desired to have only a minimum of mixing or agitation or beating of the liquid passing between rotors 16 and 17, shaft 15 and rotor 17 may be permitted to rotate with only a small slip, that is, practically up to the speed of shaft 14 and rotor 16. If it is desired to expend more energy upon a given quantity of liquid passing between rotors 16 and 17, for example to increase the fineness of an emulsion, shaft 15 and rotor 17 may be retarded by any suitable means so that the slip and relative surface speed between the projections and passages on the rotor faces will be at a maximum.

In this example the function just outlined is placed to advantage by utilizing shaft 15 to drive one or more pumps which supply the liquid or liquids and solids to the mixer. In Figure 4 there is illustrated an arrangement which has been found to be very desirable, particularly in the preparation of emulsions of asphalt in treated water. In that diagram a variable speed transmission 29 is driven by shaft 15 and is adapted in turn to drive a treated water pump 30 and an asphalt pump 31, preferably of the positive displacement type. If desired, an auxiliary transmission, such as belt 32, may be placed between the variable speed transmission 29 and pump 31. Valves 33 and 34 in the treated water and asphalt supply pipes 35 and 36, respectively, together with the characteristics of the variable speed drive and the outputs of the pumps, serve to control the ratio of treated water and asphalt streams that are delivered through line 37 to the inlet 21 of mixer housing 10. The discharge line 38 from the outlet 20 of housing 10 is provided with a throttle valve 39 which controls the flow of mixed materials to tank 40.

Valve 39 is also used to control the speed of pumps 30 and 31. If the pumps are to be rotated slowly, thus feeding only a small quantity of fluid to the mixer, valve 39 is substantially closed so that a greater load is imposed on the pumps 30 and 31 slowing them down and resulting in a greater slip between rotors 16 and 17, thus delivering a large amount of energy to any given quantity of liquid passing through the mixer. This is the result of the greater torque which is required by pumps 30 and 31 working against the increased pressure drop, which places an added load on shaft 15. Conversely, if only a small degree of dispersion is to be carried out and liquid is to be passed rapidly through the mixer housing 10, valve 39 may be opened widely, thus releasing the back pressure on the pumps and permitting them to discharge greater quantities at the higher speed which shaft 15 will deliver.

There are two factors which enter into the action of this device, namely, the time that the materials are exposed to the disintegrating action of the relatively moving rotors, which is a function of the flow rate, and is important from the standpoint of any chemical reactions which may take place; and the intensity of agitation or impact of the projections of the rotors on the liquids which is related to the amount of energy expended upon a unit volume of liquid passed between the rotors.

Another and quite desirable application of this

invention, in addition to the manufacture of emulsions, such as bituminous emulsions, is in the field of oil treating, particularly in the dispersion of isoparaffins and olefins with a catalyst such as sulfuric acid, to make alkymers or high antiknock gasolines. For this purpose the housing 10, rotors 16 and 17 and shafts 14 and 15, as well as pumps 30 and 31, would be constructed of suitable corrosion resistant materials that are well-known to those skilled in this art.

The embodiment shown in this example utilizes interengaging concentric projections on the opposed faces of rotors 16 and 17. The dimensions of these may be varied as desired, depending upon the materials handled, the degree of beating or agitation required, and the torque that is to be transmitted from one rotor to the other to turn the undriven rotor and any pumps or the like connected thereto. Under certain circumstances it may be desirable to use very shallow projections or even to omit them entirely, leaving smooth opposed surfaces between the rotors.

In conclusion, it will be appreciated that an improved form of mixer disintegrator or colloid mill has been devised which has proved to be extremely flexible and economical in operation and has advantages which are not present in those types heretofore used. The principal one of these, aside from that of using only a single prime mover for both the mixer and the fluid pumps supplying the latter, appears to reside in the variable slip which is possible between the two rotors, thus permitting the degree of dispersion or mixing to be controlled with a minimum of auxiliary equipment. Although a single embodiment of this invention has been illustrated and described, it is obvious that numerous changes could be made without departing from that invention, and all such modifications and changes that come within the scope of the appended claims are embraced thereby.

I claim:

1. A liquid mixer or the like, comprising two coaxial spaced rotors with opposed end faces, a liquid inlet for the space between said rotors, means for driving only one of said rotors, and means for retarding the rotation of the undriven rotor to provide a controlled slip between said rotors due to fluid passing between said rotors, said last named means comprising pump means for supplying liquid to said mixer.

2. In combination with a liquid mixer or the like, said mixer comprising a housing, two independent coaxial rotors with opposed faces in said housing, means for introducing liquid into said housing between said faces to be acted upon by said rotors, a first shaft rotatably mounted in said housing for one of said rotors, said shaft adapted to be driven by a suitable power source,

a second shaft rotatably mounted in said housing for the other of said rotors; pump means for supplying liquid to said mixer, means connecting said second shaft to said liquid supply means to drive the same, and means for varying the speed of operation of said liquid supply means, so constructed and arranged that liquid passing between the opposed faces of said rotors will transmit torque from one to the other to cause rotation of said second shaft in the same direction and at a rate slower than that of said first driven shaft.

3. A combination according to claim 2, in which said rotors have opposed end faces provided with interengaging concentric rows of projections thereon to cause fluid impact therebetween.

4. A combination according to claim 2, in which said speed varying means for said liquid supply means comprises a variable speed means between said second shaft and said liquid supply pump means.

5. A combination according to claim 2, in which said speed varying means for said liquid supply means comprises flow restricting means for the liquid passing through said mixer to vary the load imposed upon said second shaft by said pump means and to vary the degree of action of said rotors upon the liquid passed between them.

6. In combination with a liquid mixer or the like, said mixer comprising a housing, two independent coaxial rotors with opposed faces in said housing, means for introducing liquids to be mixed into said housing between said faces to be acted upon by said rotors, a first shaft rotatably mounted in said housing for one of said rotors, said shaft adapted to be driven by a suitable power source, a second shaft rotatably mounted in said housing for the other of said rotors; a plurality of pumps for supplying liquids to said mixer to be mixed therein, means connecting said second shaft to said pumps to drive the same, and means for separately varying the outputs of said pumps to control the ratio of liquids supplied to said mixer, so constructed and arranged that liquids passing between the opposed faces of said rotors will transmit torque from one to the other to cause rotation of said second shaft and said pumps.

7. A combination according to claim 6, in which the means for separately varying the output of said pumps comprises a variable speed gear between said second shaft and one of said pumps.

8. A combination according to claim 6, in which the means for separately varying the output of said pumps comprise flow control means in the outlets of said pumps.

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