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IMPELLER-FED DISPERSION MILL

Filed Dec. 4, 1959

2 Sheets-Sheet 1

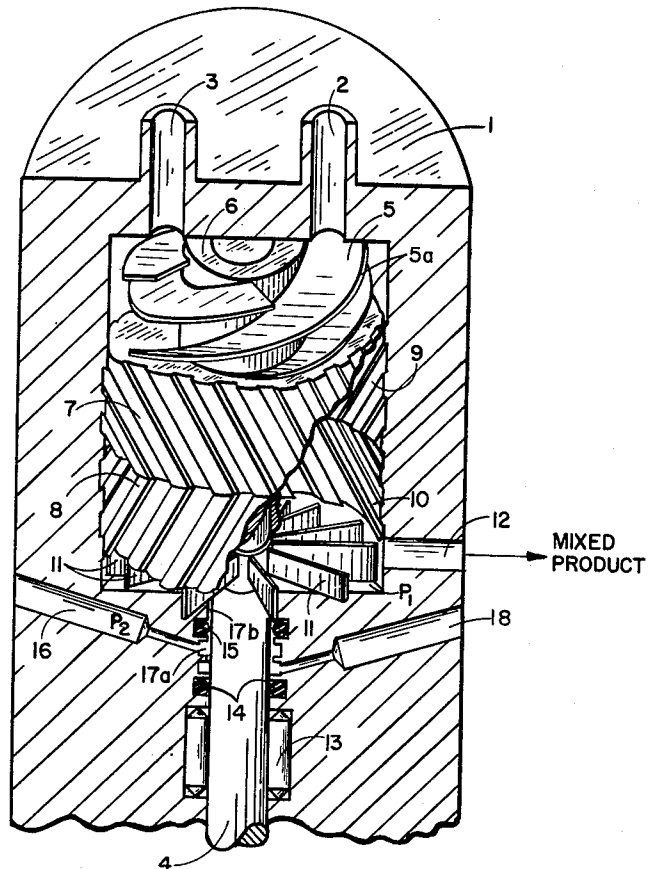


FIG. 1

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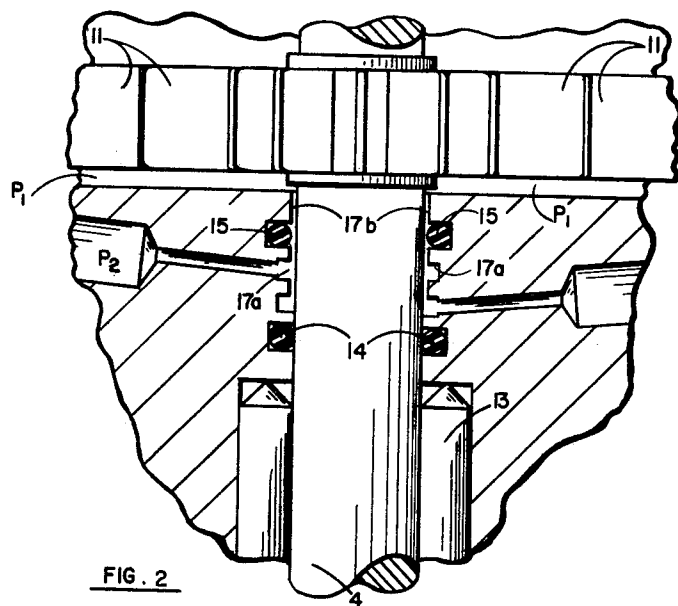
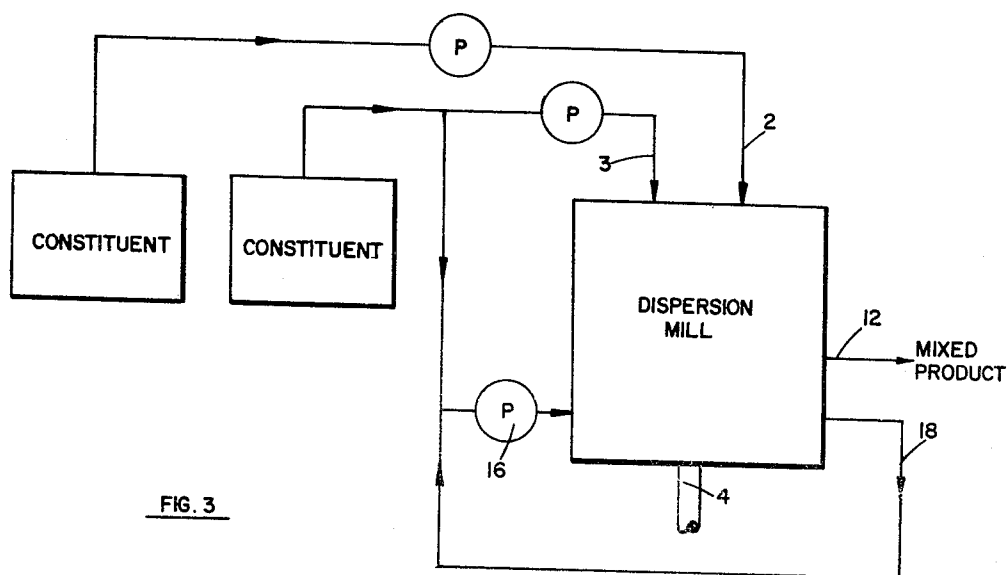
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2 Sheets-Sheet 2



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IMPELLER-FED DISPERSION MILL
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 North American Aviation, Inc.
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This invention relates to an impeller-fed dispersion mill and more particularly to a dispersion mill which is capable of effectively mixing two or more preferably fluid or slurry type constituents of widely differing densities. By first partially mixing and accelerating the induced constituents by a novel propeller blade type chopping device and then subjecting the mixed constituents to a high shear region of a colloid mill, a thoroughly mixed produce is produced. A typical application for the hereinafter described dispersion mill is set forth in the assignee's application Serial Number 699,632, filed November 29, 1958, now Patent No. 3,022,149, and entitled, "Process for Dispersing Solids in Polymer."

Conventional gravity feed systems employed by most dispersing devices, such as colloid mills and homogenizers, have been built on the assumption that they could be fed partially mixed materials and then proceed to increase the degree of dispersion. When such devices feed two or more liquids of widely different densities, for example, the more dense liquid tends to plug the intake port and further mixing is made difficult if not impossible. If the more dense liquid has an appreciably higher viscosity than either the mixture or the lighter liquid, the flow rate of the dispersing mill is greatly reduced.

The present invention overcomes the conventional feed systems by providing a continuous and uninterrupted dispersion wherein two constituents of unequal densities are fed separately into an initial chopping and accelerating blade type mixer and subsequently to the high shear regions of a colloid mill.

The main object of this invention is to provide an impeller-fed dispersion mill which will effectively mix two or more constituents of widely differing densities.

Another object of this invention is to provide a novel blade chopping means which will pre-mix constituents of varying densities which mixture is subsequently subjected to the high shear regions of a colloid mill for the final mixing thereof.

A further object of this invention is to provide a novel seal arrangement for an impeller-fed dispersion mill.

These and other objects of the invention will become apparent from the following description taken in connection with the accompanying drawings, in which:

FIG. 1 shows the impeller-fed dispersion mill of the instant invention.

FIG. 2 shows the novel seal arrangement used with the impeller-fed dispersion mill of FIG. 1.

FIG. 3 shows a schematic view of the mixing operation.

The impeller-fed dispersion mill of the present invention comprises two or more pipes which introduce constituents of varying densities to a pre-conditioner or blade type chopping and accelerating device which in turn feeds the partially mixed constituents to the high shear region of a colloid mill so as to effectively complete the mixing thereof. A novel seal arrangement is provided so that the rotating parts of the premixer and colloid mills are free to rotate and the mixed constituents therein are effectively retained so that there is no danger of explosions due to the seeping of the mixed constituents into the friction creating moving parts of the mill.

Referring now more specifically to the drawings, FIG. 1 discloses the impeller-fed dispersion mill wherein a housing 1 has inlet ports 2 and 3 formed therein adapted to be supplied with two preferably liquid or slurry type constituents by pump means, for example, (FIG. 3).

Although the preferred embodiment discloses only two inlet ports it is to be understood that any number of ports may be employed depending on the specific application thereof.

A rotatable shaft 4, adapted to be actuated by a conventional type motor, extends up through the housing and into the mixing chamber of the mill. On the upper extremity of the shaft, four staggered helical type blades 5 are fixedly secured to a bushing 6 which bushing is fixedly but removably secured to shaft 4 by a conventional slot and key type coupling, for example. It is to be noted that the blades 5 are so staggered and separated so that the leading and cutting edges 5a impart a chopping action to the constituents induced through inlets 2 and 3 when the shaft is rotated in a counter-clockwise direction as viewed in FIG. 1.

The cutting edge 5a of the four blades of the preferred embodiment illustrated in FIG. 1 are so constructed so as to radially extend at approximately right angles with respect to the vertical axis of bushing 6 and approximately lie in the same vertical plane. The four cutting edges 5a are also shown circumferentially of and adjacent the upper surface of bushing 6 and approximately positioned ninety degrees with respect to the adjacent cutting edge.

The blades 5 are helically formed on bushing 6 to extend downwardly in a spiral fashion and terminate adjacent the lower surface of bushing 6 so as to provide a ramp type passage.

The above construction alleviates the possibility of a fluid coupling, when fluid type constituents are utilized, between the constituents entering ports 2 and 3 and provides an effective chopping action thereto. It is to be further noted that the aforescribed blade construction imparts a constant downward force to the constituents so as to provide a near positive feeding action.

Although FIG. 1 discloses four such staggered blades, it is to be understood that any desired number may be employed depending on the specific application.

Also removably fixed to shaft 4 by a conventional coupling are helical type gears 7 and 8 which cooperate with the helical type gear teeth 9 and 10 respectively, formed on the housing 1 and cooperate therewith to provide a high shear region for mixing constituents and at the same time allow passage therethrough. Propeller type blades 11 are connected to and radially project from shaft 4 at approximately right angles to the longitudinal axis of shaft 4 to discharge the mixed product through outlet 12. The blades may be removably secured to a bushing similar in construction to bushing 6, if so desired. Although the illustrated embodiment of FIG. 1 discloses ten such blades, it is to be understood that any desired number may be employed to effectively discharge the mixed product for any specific application.

As disclosed in the preferred embodiment of FIG. 1, the rotatable shaft 4 is mounted on needle type bearings 13, although it is to be understood that the shaft 4 may be supported and rotated on any other type of conventional bearings.

When the shaft 4 rotates there is a certain amount of friction and heat resulting therefrom. Accordingly, in the mixing of rocket motor propellants, it could prove very damaging to permit the highly combustible propellant materials being mixed in the mixing chamber to come in contact therewith.

To alleviate the possibility of the aforementioned contact, FIG. 2 discloses a positive seal 14 and a flushed seal 15 surrounding and cooperating with rotatable shaft 4 so as to provide an effective sealing arrangement. Although seal 14 provides a near positive closure between the bearing 13 and the mixing chamber of the mill, flushed seal 15 is constructed slightly loose on rotatable shaft 4.

An inlet port 16 formed in housing 1 is connected to a clearance formed of circumferential grooves 17a and passage 17b between rotatable shaft 4 and housing 1. A flushing material which is preferably identical with that of one of the constituents being induced into inlet 2 or 3 is induced into inlet port 16 and is free to flow into the mixing chamber of the mill. The pressure P_2 in the inlet port 16 is regulated by conventional pump means, for example, so that it will be maintained at a greater pressure than that of P_1 , the pressure in the mixing chamber. An outlet port 18 is provided to re-circulate the overflowing flushing constituents to inlet port 16. A schematic showing of the aforescribed construction is illustrated in FIG. 3.

From the above described construction, it is readily apparent that if it is desired to mix two constituents of different densities so as to form a polymer emulsion such as described in the above mentioned application, for example, the passage 16 is supplied with one of the constituent liquids or slurry vehicles under a pressure P_2 which pressure exceeds the pressure P_1 in the mixing chamber. Consequently, a small continual flow of the constituent tends to flush the loose seal 15 and effectively prevents the lodging of oxidizer particles and/or polymerizable materials at the seal shaft junction.

Such an arrangement provides for a seal flushing agent which is not alien to the mixing constituents so as to cause contamination thereof. The utilization of one of the liquid constituents as the flushing agent further makes possible the use of a non-positive type seal 15. The above described novel seal arrangement also provides for the prevention of the washing out of the bearing lubrications at 13 thus assuring a safeguard against possible explosions.

Although the invention has been described and illustrated in detail, it is to be understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claim.

I claim:

A dispersion mill comprising:
a housing having a mixing chamber therein,
at least two inlet ports formed in said housing at a first

end thereof connected to said chamber and adapted to introduce constituents to be mixed therein,
a shaft extending into said chamber through a second end of said housing and rotatably mounted on bearing means adjacent said housing,
chopping means mounted on the extremity of said shaft adjacent said inlet ports and adapted to pre-mix and accelerate the introduced constituents,
helically shaped high shear means mounted adjacent said blade means and adapted to complete the mixing of the introduced constituents,
means on said housing operatively connected between said mixing chamber and said bearing means for preventing the mixed constituents in the mixing chamber from contacting said bearing means, said means on said housing comprising a first seal fixed to said housing surrounding said shaft adjacent said bearing means and a second seal lying in a clearance formed in said housing adjacent to and connected to said mixing chamber, said second seal being loosely mounted on said rotatable shaft,
an inlet port connected to said mixing chamber by said clearance formed in said housing and adapted to supply a flushing agent to said second seal and to said chamber whereby said flushing agent is adapted to flow to said chamber and away from said bearing means,
means for discharging the mixed constituents.

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