Sept. 20, 1971 R. D. ZIMMERLY 3,606,270

CONTINUOUS POWER BLENDER

Filed May 14, 1970

Fig. 1

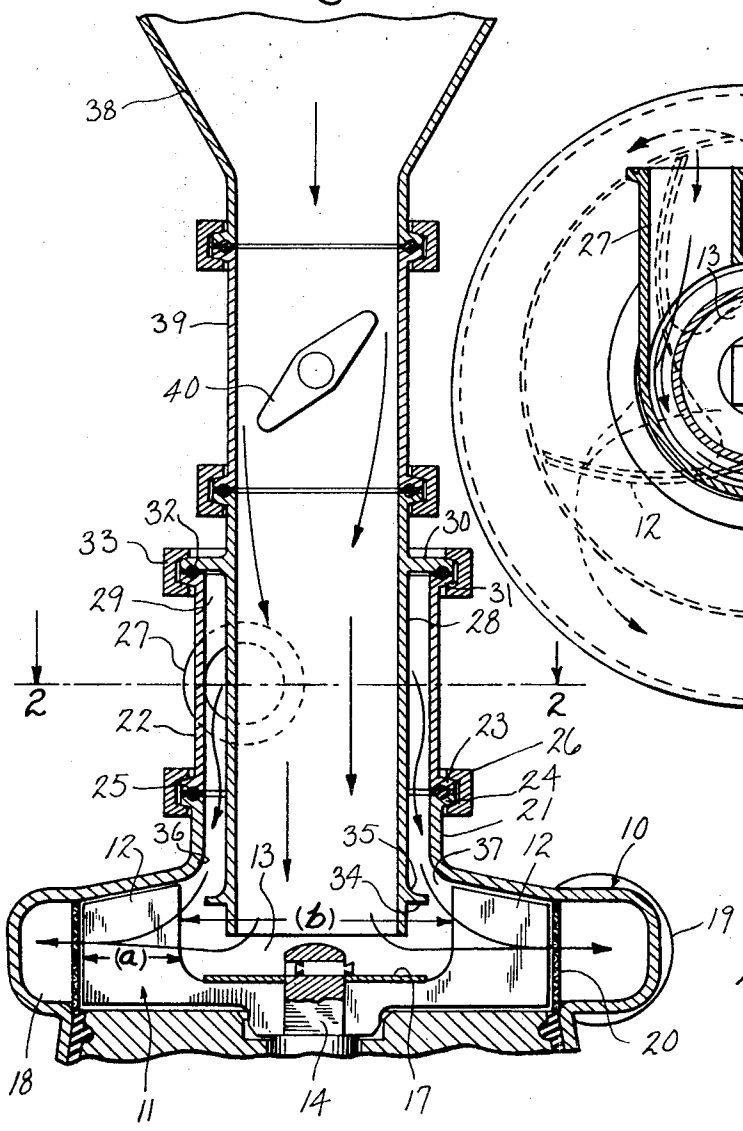


Fig. 2

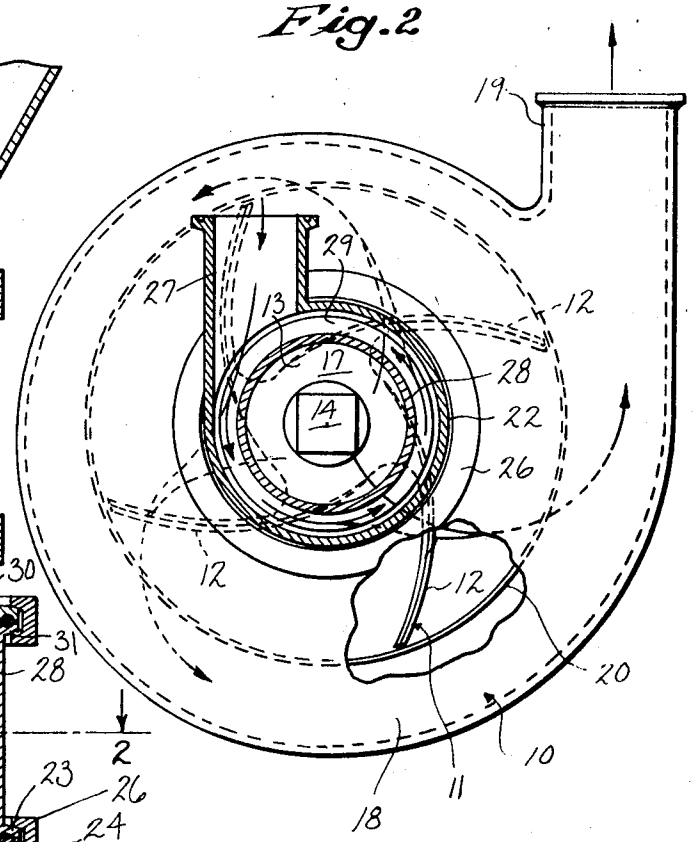


Fig. 4

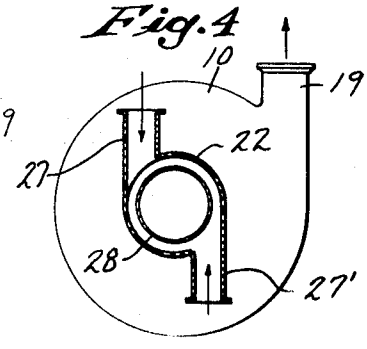
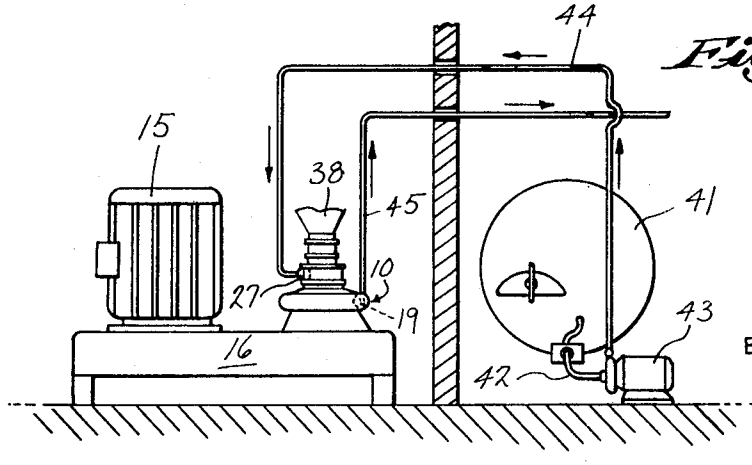


Fig. 3



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CONTINUOUS POWER BLENDER

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ABSTRACT OF THE DISCLOSURE

Particulate material from a hopper is fed through a feed tube into the eye of the impeller of a centrifugal pump and liquid is also directed into the eye by a tube which is concentric with and surrounds the first tube, both materials then traveling through the impeller together, there being a peripheral casing portion surrounding the impeller from which the mixture is discharged tangentially, and there optionally being a central screen surrounding the impeller to insure proper mixing.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention pertains to power blenders for continuously mixing powders or other particulate material with a liquid, it being particularly suitable for use in the food industry in the mixing of powders such as skim milk powders, cocoa powder, stabilizers, granulated sugar, or mixtures of such materials, with liquids such as water, the blender also being useful in the chemical industry.

Description of the prior art

Heretofore it has been proposed to utilize a centrifugal pump for mixing a liquid and a particulate material but prior devices have been designed for purposes different from that for which the present invention is particularly suitable. In the FIG. 1 disclosure of the Zingg Pat. No. 3,256,181, particulate material is fed to the center of an impeller, but the liquid material is introduced tangentially into a peripheral zone which surrounds the impeller, the mixture also being discharged tangentially from this peripheral zone. The pump of the prior art was designed particularly for use where the particulate material is an earth formation propping agent, the liquid being oil, brine or water. In this type of device the powder is sucked into the impeller by the natural suction created by the mixer, and the liquid enters only in the high pressure region at the periphery of the casing and tends to stay on the periphery because of centrifugal force. In the Zingg modification of FIG. 4, the pump which corresponds to applicant's pump **43**, for feeding the liquid, is incorporated in the same casing with the blender pump, the liquid being delivered centrifugally into the outer portion of the casing to intermix with powder which is thrown centrifugally by the blender pump. Thus in neither form of the invention of the Zingg patent does mixing take place throughout the region occupied by the impeller of the blender pump. In both forms of the Zingg invention the impeller is used to accelerate the dry particulate material and force it into the liquid, with the mixing taking place only in the narrow peripheral mixing zone located at and beyond the tips of the impeller vanes. To operate properly the pressure head of the incoming liquid must be a predetermined amount less than the shut-off discharge pressure of the mixer. If the inlet pressure were greater the mixer head would flood out—if it were less the discharge flow of the mixer would be substantially reduced. Thus this prior art mixer has only a narrow mixing zone near and beyond the tips of the impeller and no mixing occurs until the particulate material reaches this zone. Thus the design

of the Zingg patent has a very restricted operating range. Also, with the Zingg type of construction, back pressure may become high enough to cause detrimental splashing of liquid into the particulate entrance tube.

Another mixer patent suitable for cement and not suitable for applicant's purpose is the patent to Owsley, No. 2,147,053. Here there is a propeller **27** and the liquid from the water conduit **22** is directed to a location around the tips of the propeller blades **27**, the inlet tube for the powder being of almost the same diameter as the propeller **27**. Here the mixing takes place principally in the conical zone **13** beyond the propeller and the action is quite different from that of the present invention where both the liquid and the particulate material are directed into the eye portion of an impeller, and where the mixing takes place during passage through the impeller as well as in a peripheral mixing zone portion immediately surrounding the impeller.

Another type of mixer which has been employed is one in which liquid is fed into the eye of a centrifugal pump by a horizontal tube, and in which powder is introduced by a hopper into the liquid tube ahead of the pump inlet, both materials entering the impeller together where they are mixed. This type of arrangement has definite disadvantages. For one thing, the powder is pulled from the hopper by the suction created by the flow of the liquid past the branch of the T through which the powder is introduced. This results in a slow rate of powder addition. Another disadvantage is that some powders, such as stabilizers which hydrolize instantly with liquids, form small dry-centered globules that are not broken up as they pass through the mixer, these globules forming before the materials reach the impeller.

SUMMARY OF THE INVENTION

The present invention provides, in a centrifugal pump, a novel arrangement whereby particulate material from a hopper is fed by a first tube into the eye of the impeller and wherein liquid is also directed into the eye of the impeller by a tube which is concentric with and which surrounds the first tube, the materials being kept separated until just before they both enter the region of the impeller, and serving to travel through the impeller together so that they are exposed to a large mixing zone which includes the area occupied by the impeller as well as the peripheral mixing zone portion which surrounds the impeller.

A further object of the invention is to provide a continuous power blender as above described which gives optimum mixing.

A further object of the invention is to provide a blender which creates a larger effective mixing zone.

A further object of the invention is to provide a blender in which liquid is directed into the liquid inlet which surrounds and is concentric with the particulate tube in a manner to impart a rotary motion to the liquid which thereby gives the liquid a velocity which is tangent to the inlet as the liquid enters the mixing zone, this velocity being in the same direction as the direction of rotation of the impeller so that less horsepower is required to move the liquid through the mixer.

A further object of the invention is to provide a construction in which the particulate tube remains dry at all flow rates within the normal limits of the mixer to thereby reduce the problems involved in sizing the supply pump to match the capacity of the mixer.

A further object of the invention is to provide a blender which has a relatively large operating range.

A further object of the invention is to provide a construction wherein the liquid and particulate material are maintained out of contact with each other until immediately before they enter the mixing zone. Thus, when

using powders of a type which hydrolize instantly, the formation adjacent the inlet of objectionable globules which would remain in the final product is prevented.

A furher object of the invention is to provide a construction in which a screen may be employed around the impeller to reduce splashing when handling certain types of particulate materials, and to provide for more efficient mixing action.

A further object of the invention is to provide a blender which creates a higher vacuum so that particulate material is sucked in at a higher rate.

A further object of the invention is to provide a blender which operates at higher discharge heads without causing detrimental splashing in the mixer, which can be operated over a wider range of flows, and in which there is no particular ratio required between the pressure head of the supply and the mixer discharge head, as the two are independent.

With the above and other objects in view, the invention consists of the improved continuous power blender, and all of its parts and combinations, as set forth in the claims, and all equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, in which the same reference numerals designate the same parts in all of the views:

FIG. 1 is a fragmentary vertical sectional view through the improved blender, the lower portion of the pump being broken away;

FIG. 2 is a sectional view taken approximately on the line 2—2 of FIG. 1;

FIG. 3 is a partially diagrammatic view in elevation showing a typical installation, parts being broken away; and

FIG. 4 is a view similar to FIG. 2 showing a modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more particularly to the drawing, the improved power blender includes a pump casing **10** having an impeller **11** therein. The impeller includes curved impeller blades **12** which are so cut and shaped at the center as to provide a deep eye recess **13**. The impeller is mounted on a drive shaft **14** which is suitably driven by a motor **15** (see FIG. 3), there being suitable transmission means within the base housing **16** between the motor and pump shaft **14**. A disk **17**, which may be separate or an integral part of the impeller, and which has an opening through which the upper end of the drive shaft extends, covers the bottom of the eye recess **13**. The casing **10** has a peripheral portion **18** which is beyond the tips of the impellers, and a discharge outlet **19** connects tangentially with said peripheral portion. A screen **20** may be mounted in the casing to surround the impeller for a purpose to be hereinafter discussed. This screen may or may not be used, depending upon the particular type of particulate material being blended.

The top of the pump casing **10** has an axial inlet extension **21**, of less diameter than the diameter *b* of the eye recess, to which a short fitting **22**, usually termed a "Dutchman," is detachably connected, there being an annular flange **23** on the lower end of the fitting **22**, and there being a flange **24** at the upper end of the tubular inlet extension **21** with a suitable gasket **25** between the flanges **23** and **24**. A suitable clamping ring **26** may be used to detachably couple the parts together. The tubular fitting **22** has a tangential inlet portion **27** by means of which liquid may be introduced through the line **44**.

Positioned concentrically within the tube **22** is a feed tube **28** for particulate material. It is of such diameter that there is a hollow cylindrical liquid space **29** of substantial capacity between the tubes **28** and **22**. Intermediate the length of the particulate feed tube **28** is an outwardly-projecting flange **30** which is adapted to be supported on a flange **31** at the upper end of the fitting **22**, there being a gasket **32** therebetween. A suitable clamping ring **33** may be used to detachably couple the parts together. The feed tube **28** is therefore suspended concentrically within the tube **22** in such a manner that its lower end projects into the eye **13** of the impeller a distance nearly half the depth of the casing portion **10** at this location, the lower end of the tube **28** being substantially below the upper edges of the impeller blades **12** and below the lower end of the inlet opening. Projecting from the exterior of the tube **28** a short distance above its lower end is an annular flange **34**, the upper portion of the flange having a radius **35** in cross section which approximately matches the radius **36** at the lower end of the pump casing inlet, the flange being spaced well below the portion **36** of the pump casing to provide an annular passageway **37** through which liquid from the tube **22** is directed at substantially right angles into the impeller blades.

The particulate material may be contained in a hopper **38** which is connected by a pipe section **39** with the upper end of the feed tube **28**. A suitable valve **40** may be used in the tubular section **39** to control the flow of particulate material by suction and gravity from the hopper.

FIG. 3 shows a portion of a typical system embodying the improved blender. Here there is a storage tank **41** from which liquid is fed by a line **42** to the inlet of a feed pump **43**. The latter feeds the liquid through the line **44** to the liquid inlet **27** for the improved blender **10**. Liquid may also be fed by gravity from a suitable storage tank supplying sufficient head for such feeding. The discharge **19** from the blender may be connected with a discharge line **45** which may lead to suitable processing or storage equipment.

FIG. 4 discloses a modification illustrating that a plurality of liquid feed tubes **27** and **27'** may communicate tangentially with the liquid inlet tube **22**, two of such tubes being illustrated in FIG. 4. In this way several different liquids may be introduced to be mixed in the blender with the particulate matter.

Operation

In operation, the feed pump **43** or the head from a storage tank at a higher level delivers liquid to the blender inlet **27** with an hydraulic head which is less than the discharge head from the outlet **19** of the blender. With the impeller **11** in operation, and with the valve **40** set to feed a desired amount of particulate material, the latter will be deposited by the blender pump suction and by gravity into the eye portion **13** of the rotating impeller **11**. At the same time the liquid from the annular space **29** will be directed by the flange portion **35** toward the impeller blades, as indicated by the arrows in FIG. 1. Due to the fact that the liquid inlet **27** (FIG. 2) enters the tube **22** tangentially the liquid emerges from the lower end of the casing inlet with a rotary motion which is in the same direction as the direction of rotation of the impeller. Thus less horsepower is required to actually move the liquid through the mixer. The annular flange **34** gives direction to the liquid and, due to the fact that the lower end of the tube **28** projects a substantial distance below the flange and into the eye of the impeller, there is no possibility of liquid backing up and prematurely fouling up the particulate material before the two ingredients enter the mixing zone. The action of the impeller will draw the particulate material into the mixing zone where mixing of the two materials will start as soon as they enter the region of the impeller blades **12**. The mixing zone will therefore extend in a radial direction for the entire distance *a* (FIG. 1). In blenders where the liquid is admitted to the peripheral mixing portion within the housing part **18**, mixing only takes place in the peripheral zone near the tips of the blades. For use with certain types of materials it is desirable to use the screen **20**.

When this is employed it aids in assuring proper mixing and also reduces splashing.

With this design the liquid and particulate material are kept in separated condition until just before they enter the mixing zone *a*. This prevents the formation of globules of particulate material which could then pass through the mixer without being broken up. With the present invention both materials travel through the impeller together and are exposed to mixing action in a mixing zone *a* which has maximum radial extent to give optimum mixing results.

It is to be noted that both materials are introduced separately into the eye of the impeller and are kept separated until mixing occurs, as distinguished from mixers where one or both materials are introduced directly to the impeller blades, or where both materials contact each other before mixing, or into a peripheral zone beyond the tips of the blades.

The improved design serves to closely control the direction of flow of the liquid. In addition, the fact that the inlet tube **27** enters the concentric tube **22** in a tangential manner causes the liquid to have a rotary motion in the tube **22**, which rotary motion carries into the casing **10** and is in the same direction as the direction of rotation of the impeller. Thus, less horsepower is required to move the liquid through the mixer.

The design results in the particulate feed tube **28** remaining dry at all flow rates within the normal limits of the mixer. This greatly reduces the problems involved in sizing the supply pump to match the capacity of the mixer.

Also this design gives this blender a considerably larger operating range than is true in mixers of the prior art.

The present mixer is particularly useful in the food and chemical industries where powders are employed which have a tendency to stick to or build up on wetted surfaces. The present design eliminates splashing of liquid into the powder inlet to solve this problem. The screen **20**, when used, also serves to reduce splashing. The present blender creates a higher vacuum and, therefore, particulate matter is sucked in at a higher rate, increasing the speed of production.

This blender can be used for various purposes but is particularly suitable for use in the food industry. It can be successfully employed for continuously manufacturing a chocolate syrup or the like where it is necessary to add corn starch, stabilizers, milk powders, or flavoring powders through the feed tube **28** while directing water or other liquid dairy products from the line **44** of FIG. 3 into the blender. The device may also be employed to add flavorings through the center feed pipe **28** which are to be mixed with unfrozen ice cream mix which is being pumped through the liquid inlet. The blender may also be employed in the manufacture of puddings where stabilizers, corn starch, flavorings, or the like are admitted through the feed tube **28** to be mixed with liquids admitted through the concentric tube **22**. While it is particularly useful in the blending of liquids and powders, the blender may also be employed to add nitrogen gas, for example, to peanut butter, the peanut butter being the liquid which is admitted through the inlet **22** and the gas being suitably fed in at a location within the feed pipe **28**. Similarly carbonation may be fed through the feed tube **28**, and liquid beverages through the liquid inlet **22**. Thus, carbonation may be added to soft drinks or to beer.

It is to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

What I claim is:

1. In a power blender having a casing with a top inlet and with a bottom, having a drive shaft projecting into said bottom, and having an impeller mounted on said drive shaft for rotation in the casing, there being an annular discharge zone within said casing surrounding the impeller and said casing having an outlet projecting tangentially from said annular discharge zone, the improvement comprising the impeller having a recessed eye portion of substantial depth in the top thereof, an inlet tube for liquid under pressure communicating with the casing inlet over said eye portion, and a particulate feed tube disposed within said liquid inlet tube, there being an annular liquid space between the latter and said liquid inlet tube whereby liquid and particulate material are both delieverd together into the eye of the impeller to be blended during passage through the impeller.

2. A power blender as claimed in claim **1** in which the eye portion of the impeller has a greater diameter than the top inlet opening of the casing.

3. A power blender as claimed in claim **1** in which the impeller includes a plurality of upright blades which are cut out centrally to form said recessed eye portion, said eye portion having a bottom of a diameter exceeding the diameter of the particulate feed tube rotatable with the impeller.

4. A power blender as claimed in claim **1** in which the inlet tube for liquid is disposed axially of the impeller and in which there is an inlet for liquid communicating tangentially with said axial inlet tube portion.

5. A power blender as claimed in claim **1** in which the inlet tube for liquid is disposed axially of the impeller and in which there are a plurality of inlets for liquid communicating tangentially with said axial inlet tube portion.

6. A power blender as claimed in claim **1** in which the particulate feed tube has a lower end which projects into the eye portion of the impeller a substantial distance below the casing inlet and below the top of the impeller.

7. A power blender as claimed in claim **6** in which there is an outwardly projecting annular flange surrounding a lower end portion of said particulate feed tube in a position spaced below the casing inlet for directing liquid into the impeller blades.

8. A power blender as claimed in claim **7** in which the upper portion of said flange joins the particulate feed tube on a radius.

9. A power blender as claimed in claim **1** in which there is a screen within the casing surrounding the impeller through which materials being mixed must pass to enter the annular discharge zone.

10. A power blender as claimed in claim **1** in which the liquid inlet tube has an outwardly projecting upper end flange, and in which the particulate feed tube has an outwardly projecting flange spaced below its upper end which seats upon the flange of the liquid tube, and in which there is means for detachably coupling said flanges together.

References Cited

UNITED STATES PATENTS

2,147,053	2/1939	Owsley	259—151
2,875,897	3/1959	Booth	259—96
3,256,181	6/1966	Zingg	259—8
3,316,843	5/1967	Vaughan	259—96
3,423,075	1/1969	Knudsen	259—96
3,503,846	3/1970	Nardi	259—8

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U.S. Cl. X.R.

259—96