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HIGH SPEED MIXING HEAD AND TURBINE

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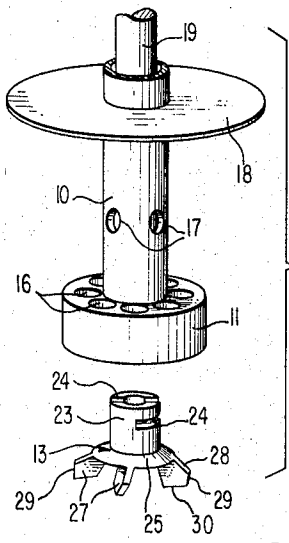


FIG. 1

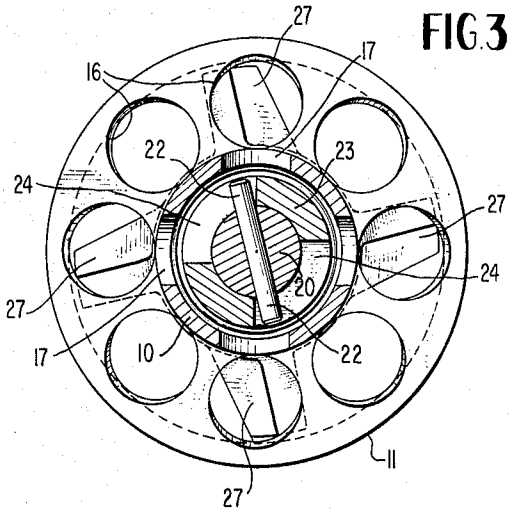


FIG. 3

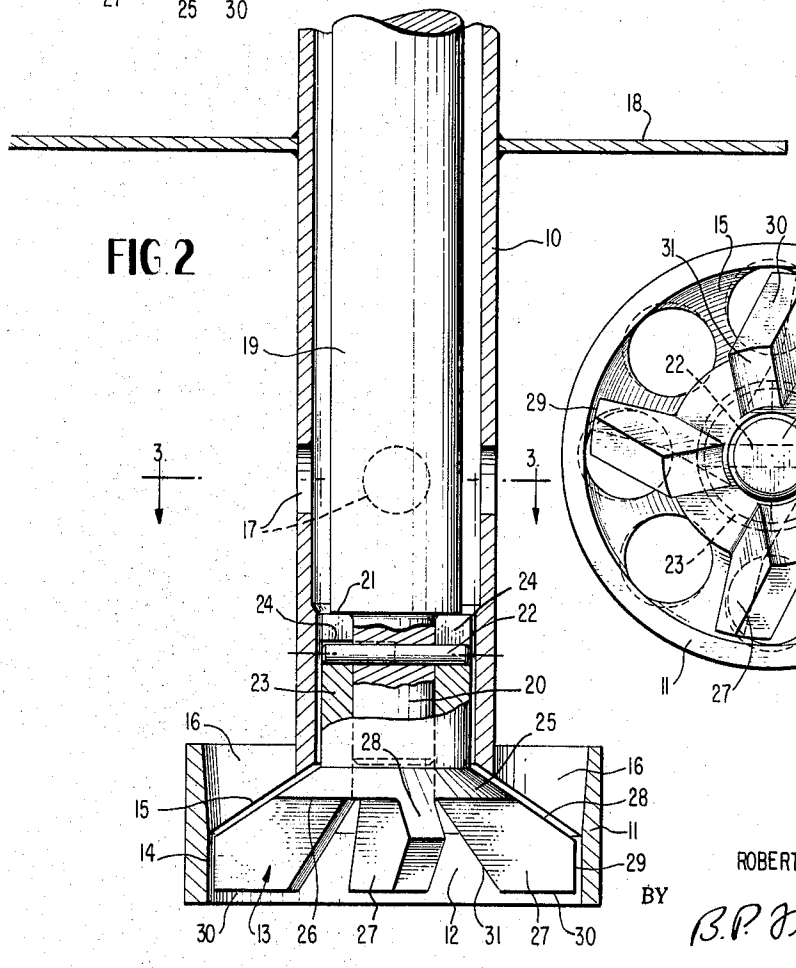


FIG. 2

FIG. 4

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HIGH SPEED MIXING HEAD AND TURBINE

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This invention relates to improvements in high speed mixers, and more particularly to an improved mixing head and turbine element for such mixers.

The main object of the invention is to provide a more efficient bladed mixing rotor or turbine for high speed mixers of the type employed to produce reconstituted milk from water, dry powdered skim milk and whole creamery butter, or for mixing and/or homogenizing like products.

Another and more specific object to provide a mixing head which has an improved shearing and dispersing action on the mixture compared to prior art mixing heads, allowing actual homogenizing of whole milk, for example.

A further object is to provide a mixing head whose major parts may be quickly detached and separated for thorough cleaning and sterilization, the head containing no screw-threads likely to collect foreign matter or germ-producing agents.

Another object of the invention is to provide a high speed mixing rotor or turbine whose individual blades are arranged and constructed in such a way that the rotor during operation is a compromise between conventional centrifugal type blades and helical propeller type blades, the rotor actually retaining the favorable characteristics of both aforementioned types while eliminating the characteristics thereof which are unfavorable in the present type of mixer.

Other specific objects and advantages of the invention will be apparent during the course of the following detailed description.

In the accompanying drawing forming a part of this application and in which like numerals are employed to designate like parts throughout the same,

FIGURE 1 is an exploded perspective view of a mixing head embodying the invention;

FIGURE 2 is an enlarged central vertical longitudinal section through the mixing head, partly in elevation;

FIGURE 3 is a horizontal transverse section taken on line 3—3 of FIGURE 2; and

FIGURE 4 is an end elevation of the mixing head.

In the drawing wherein for the purpose of illustration is shown a preferred embodiment of the invention, the numeral **10** designates a stator tube of the required length to extend near the bottom of a deep receptacle such as a five gallon or ten gallon milk can. The upper end of the stator tube, not shown, is suitably coupled during use to the stationary structure of some suitable power drive unit. The invention herein is concerned solely with the mixing head and rotor or turbine, and it is therefore unnecessary to discuss details of the entire mixing apparatus with which the head is associated.

Suitably rigidly secured by welding or the like to the lower open end of stator tube **10** is an enlarged surrounding concentric stator ring **11** which is essentially open vertically and provided with a large lower chamber or recess **12** to accommodate a mixing rotor or turbine **13** to be described in detail. The side wall **14** of chamber **12** is cylindrical and concentric with the axis of the tube **10**. The top wall **15** of the chamber **12** is conically tapered upwardly and leads to the bore of tube **10**, as shown. The upper portion of stator ring **11** has a plurality of closely circumferentially equidistantly spaced cylindrical openings **16** formed therethrough in direct

communication with the top of chamber **12**. The multiple openings **16** closely surround the stator tube **10** and are formed on a slight divergent angle therewith upwardly as best shown in FIGURES 2 and 4. The tube **10** and ring **11** constitute a rigid stationary unit during operation.

The stator tube **10** preferably has a group of drain openings **17** somewhat above the ring **11** and is equipped with a circular baffle plate **18** above the openings **17**, as shown.

Extending within the stator tube **10** in spaced coaxial relation therewith is a rotary mixer shaft **19** having a reduced lower end portion **20** and an annular shoulder **21** at the top of the portion **20**. The reduced end portion **20** has a cross pin **22** extending transvesely thereof and engaging through a diametrical through opening of the portion **20**. The pin **22** projects equidistantly on opposite sides of the shaft portion **20**, FIGURE 3.

The aforementioned mixing rotor or turbine **13** has a tubular cylindrical hub **23** which extends freely rotatably into the lower end portion of stator tube **10**, with its upper end abutting the shoulder **21**. The hub **23** has diametrically opposed L-shaped bayonet slots **24** formed therein circumferentially and opening through the upper end of the hub as shown in the drawing. These bayonet slots receive the projecting ends of cross pin **22** when the hub **23** is slipped over the reduced end portion **20** of shaft **19**, as best shown in FIGURE 2. The rotor **13** is twisted in one direction for tightening and may be tapped loose in the opposite direction readily for quick separation from the shaft **19** and the stator assembly surrounding it. This constitutes an important feature of the invention and eliminates the need for screw-threads between the hub **23** and shaft extension **20**, which is the customary arrangement. Screw-threads collect dirt and germs and they frequently bind. The present arrangement, including the bayonet slots, renders the mixing head easy to disassemble and assemble and greatly facilitates sterilization of parts and cleanliness of the apparatus in general. This is highly important in the dairy industry which constitutes a major application of the mixing head for reconstituting milk, homogenizing and the like.

The rotor **13** further comprises a conically tapered relatively thin disc portion **25** at the bottom of the hub **23** having a flat bottom face **26** perpendicular to the axis of shaft **19**. Depending integrally from the flat face **26** are a plurality of, preferably four, rotor blades **27** whose arrangement and construction constitutes the major feature of the invention. The upper edges **28** of these blades are slanted and form continuations of the tapered disc portion **25**. The edges **28** are parallel to the tapered top wall **15** of chamber **12**. The outer tips **29** of the blades are arranged close to and parallel with the cylindrical side wall **14** of ring **11** and each blade tip is a segment of a cylindrical surface having a diameter equal to the full diameter of the rotor. The lower edges **30** of the several blades are in a common plane perpendicular to the axis of rotation and the edges **30** are horizontal and are spaced slightly above the lower side of the ring **11** in assembly. They constitute sharp edges for a shearing action in liquids with minimum turbulence during high speed rotation of the rotor in the range of 10,000 r.p.m. The interior edges **31** of the blades **27** taper upwardly and are conically formed as shown. Their upper extremities terminate close to the bore of the hub **23**, as shown in FIGURE 4, for example. The edges **29** and **30** of each blade **27** form a square corner at the bottom of the rotor within the ring **11**, as shown.

The several blades extend generally radially of the axis of shaft **19** but each blade is actually offset some-

what laterally from the center of the shaft or hub **23** at its upper end where connected to the disc portion **25**. Each blade is also slanted with respect to the longitudinal axis of the rotor so that its lower end is actually offset a greater amount from the axis of rotation than the upper end of the blade. Between its upper and lower ends, the slanted blade has perfectly flat opposite major faces. The slanted or skewed arrangement of the several blades is shown quite clearly in FIGURES 2 and 4 of the drawing. The arrangement, in effect, is a compromise between straight radial centrifugal type blades and helical propeller type blades. The blade arrangement herein produces a high degree of mechanical shear in liquids, approaching the action of a straight blade in this respect, and also causes liquid to be pumped upwardly through the openings **16**, imitating the action of a helical propeller. In other words, the rotor or turbine **13** maintains the desired qualities of both mentioned types of impellers or turbines while eliminating certain undesirable characteristics of both.

During operation, the high speed mixing shaft **19** turns at about 10,000 r.p.m. The tube **10** is stationary, as is the ring **11**. The rotor **13** turns in the proper direction, counterclockwise in FIGURE 4, so that the slanted blades **27** will pump liquid up through the openings **16** and toward the stationary baffle **18**. The openings **16** produce additional shearing of the liquid causing increased dispersing of solids, such as butter solids and dry powder skim milk within water, in the making of reconstituted whole milk. Simultaneously, the sharp lower edges **30** of the blades produce a distinct shearing action which aids greatly in dispersing solids throughout the liquid. The operation of the rotor **13** within the confines of the chamber **12** causes maximum mixing and dispersion of solids with minimum turbulence and minimum aeration of the liquid within the container, such as a milk can, which receives the mixing head. In short, the mixing head including the improved turbine or rotor effects precisely the ideal combination of shearing action, pumping and mixing action all within the confines of the ring **11**. The mixing head is capable, for example, of homogenizing whole fresh milk. It is capable of producing reconstituted milk from fresh water, creamery butter and skim powdered milk, the end product closely resembling whole fresh milk. It is thought that the advantages and features of the mixing head will be readily apparent to those skilled in the art without the necessity for any further detailed description. In general, the invention provides a mixing head and a mixing turbine of increased efficiency and improved mode of operation compared to the prior art.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of the invention or scope of the subjoined claims.

Having thus described my invention, I claim:

1. In a high speed mixing head, a stator tube, a stator ring on the lower end of said tube rigid therewith and having a forward main chamber and a plurality of circumferentially spaced generally axial relatively small openings leading from said chamber and opening through the other end of said ring in surrounding relation to said tube, said ring having an internal conically tapered wall at the juncture of said openings and chamber, a mixing rotor disposed bodily within said chamber and having plural circumferentially spaced blades including inclined converging edges arranged close to and parallel to said

tapered wall, said blades also having square corners whose angular edges are parallel respectively to the side wall of said chamber and the forward end of the stator ring, a hub element integral with and carrying said blades and projecting into the bore of the stator tube, a rotary shaft within the stator tube interfitting with said hub element, and a bayonet slot and pin connection between the hub element and shaft to allow ready separation and easy cleaning of the mixing head parts.

2. The invention as defined by claim **1**, and wherein said relatively small openings diverge slightly from said stator tube in a rearward direction from said openings.

3. The invention as defined by claim **1**, and a baffle plate carried by the stator tube and projecting radially thereof and spaced axially upwardly from the stator ring, said baffle plate serving to limit turbulence caused by liquid pumped through said openings by said blades.

4. A mixing head for high speed mixing equipment comprising a stator ring and a stator tube carrying said ring, said ring having a forward unobstructed main chamber and a plurality of rear circumferentially spaced openings leading from said chamber through the rear of said ring and surrounding said tube, a rotary mixing shaft extending within said tube and having a forward reduced portion therein, a tubular hub coupled with said reduced portion inside of said tube, and a plurality of generally radial slanted blades rigid with said hub projecting forwardly thereof and lying within the confines of said chamber immediately forwardly of said openings, said blades having forward shearing edges parallel to the ends of said ring and peripheral edges parallel to the bore of said ring, the rear edges of said blades lying in closely spaced relation to the forward ends of said openings, and the rear edges of said blades and forward ends of said openings being inclined and converging with respect to the central axis of said ring.

5. A mixing head for high speed mixing equipment comprising a stator ring and a stator tube carrying said ring, said ring having a forward unobstructed main chamber and a plurality of rear circumferentially spaced openings leading from said chamber through the rear of said ring and surrounding said tube, a rotary mixing shaft extending within said tube, a mixing turbine hub coupled with said shaft inside of said tube, and a plurality of generally radial slanted blades rigid with said hub projecting forwardly thereof and lying within the confines of said chamber immediately forwardly of said openings, said blades having forward shearing edges parallel to the ends of said ring and peripheral edges parallel to the bore of said ring, the rear edges of said blades lying in closely spaced relation to the forward ends of said openings, and the rear edges of said blades and forward ends of said openings being inclined and converging with respect to the central axis of said ring.

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