United States Patent

Fischer

[15] **3,635,443**

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[54] DISPERSION HEAD FOR SOLIDS-LIQUIDS BLENDER

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[52] **U.S. Cl.** **259/3,** 259/16, 259/85

[51] **Int. Cl.** **B01f 9/08**

[58] **Field of Search**.....259/3, 14, 15, 16, 21, 22, 259/84, 85

[56] **References Cited**

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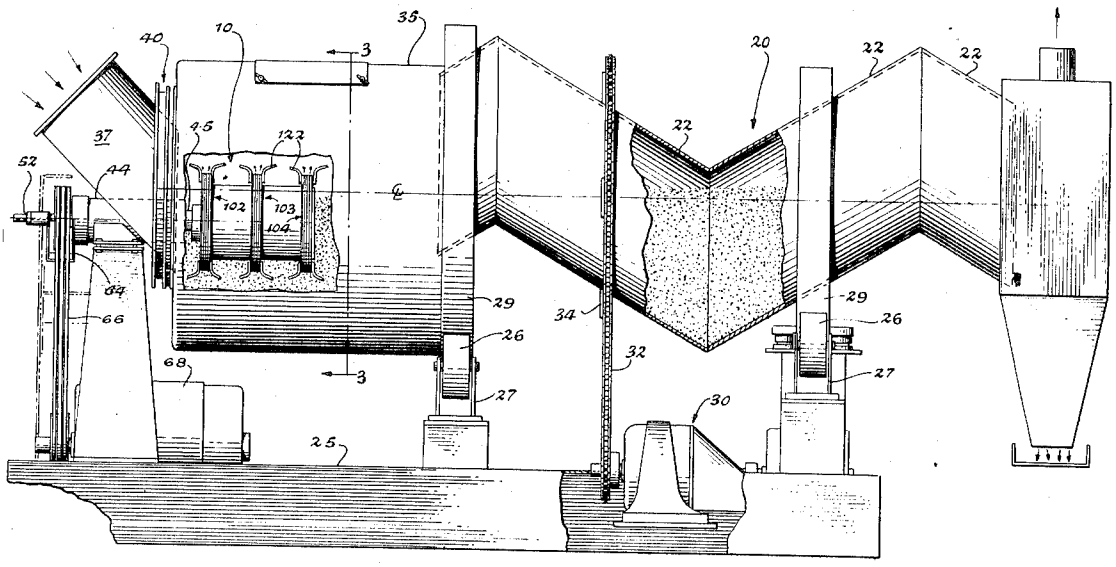
Primary Examiner—Robert W. Jenkins

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[57] **ABSTRACT**

A liquid dispersion head, which is supported on the end of a liquid supply shaft in a container, is rotated at high speed, so as to simultaneously introduce liquid into and effect agitation of dry material introduced into the container. The spray head includes a hub portion, which is mounted on the liquid supply shaft, and a liquid spray and agitating assembly, which is mounted concentrically of the hub portion and defines two or more mutually supporting liquid spray devices spaced axially of the hub portion.

10 Claims, 6 Drawing Figures



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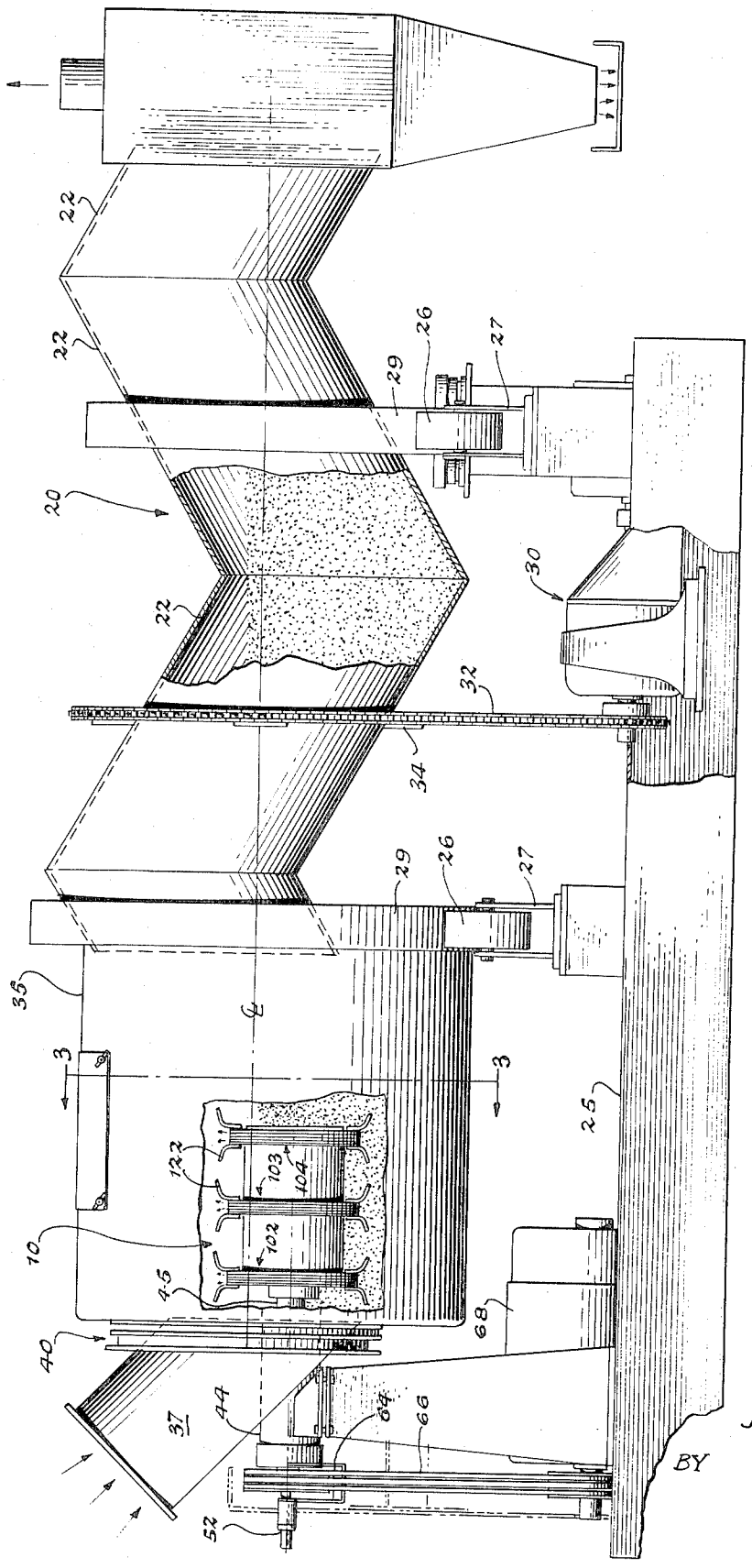


Fig. 1.

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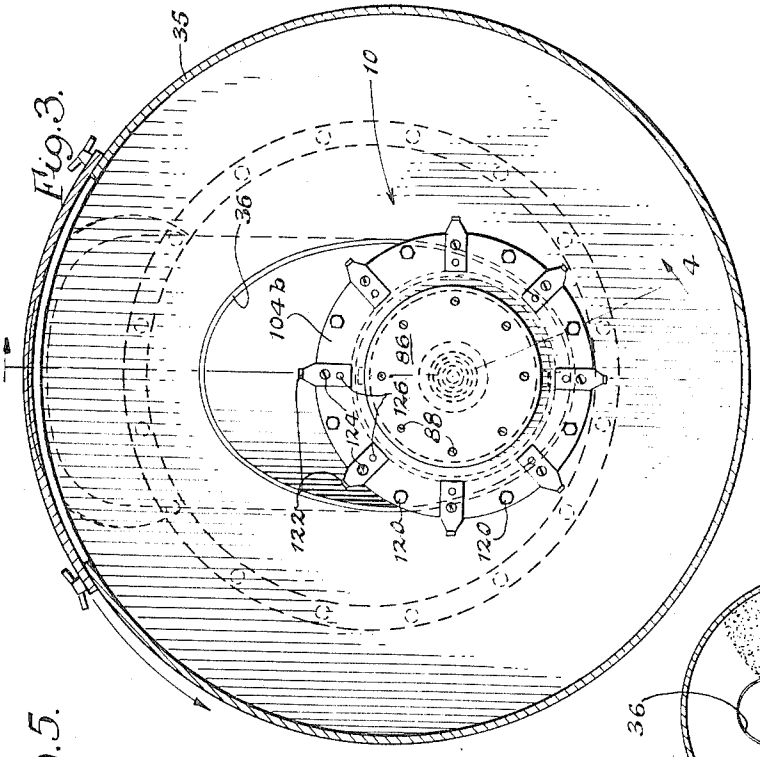


Fig. 3.

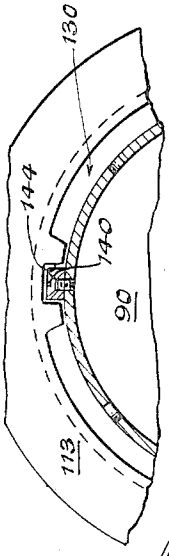


Fig. 5.

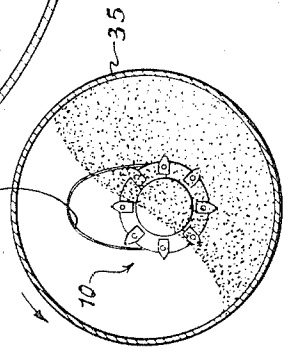


Fig. 6.

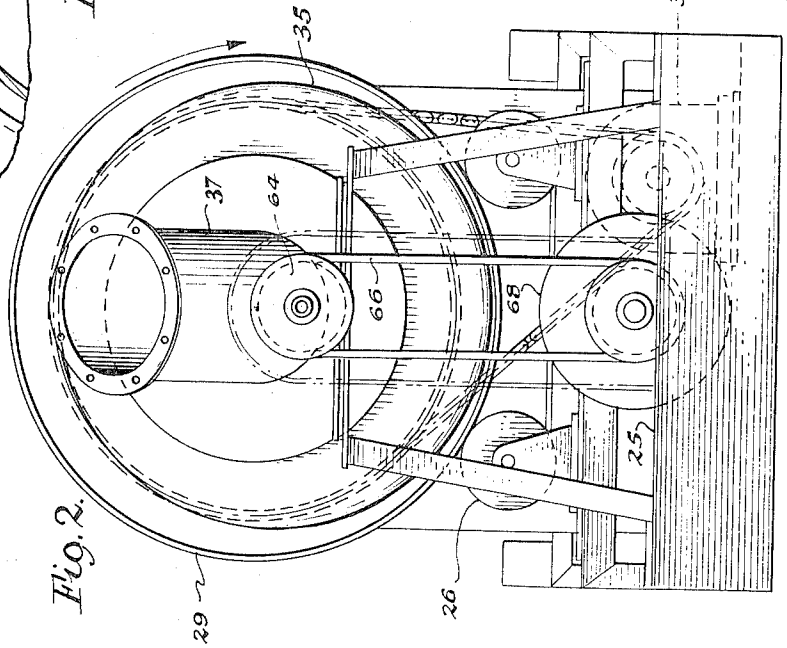


Fig. 2.

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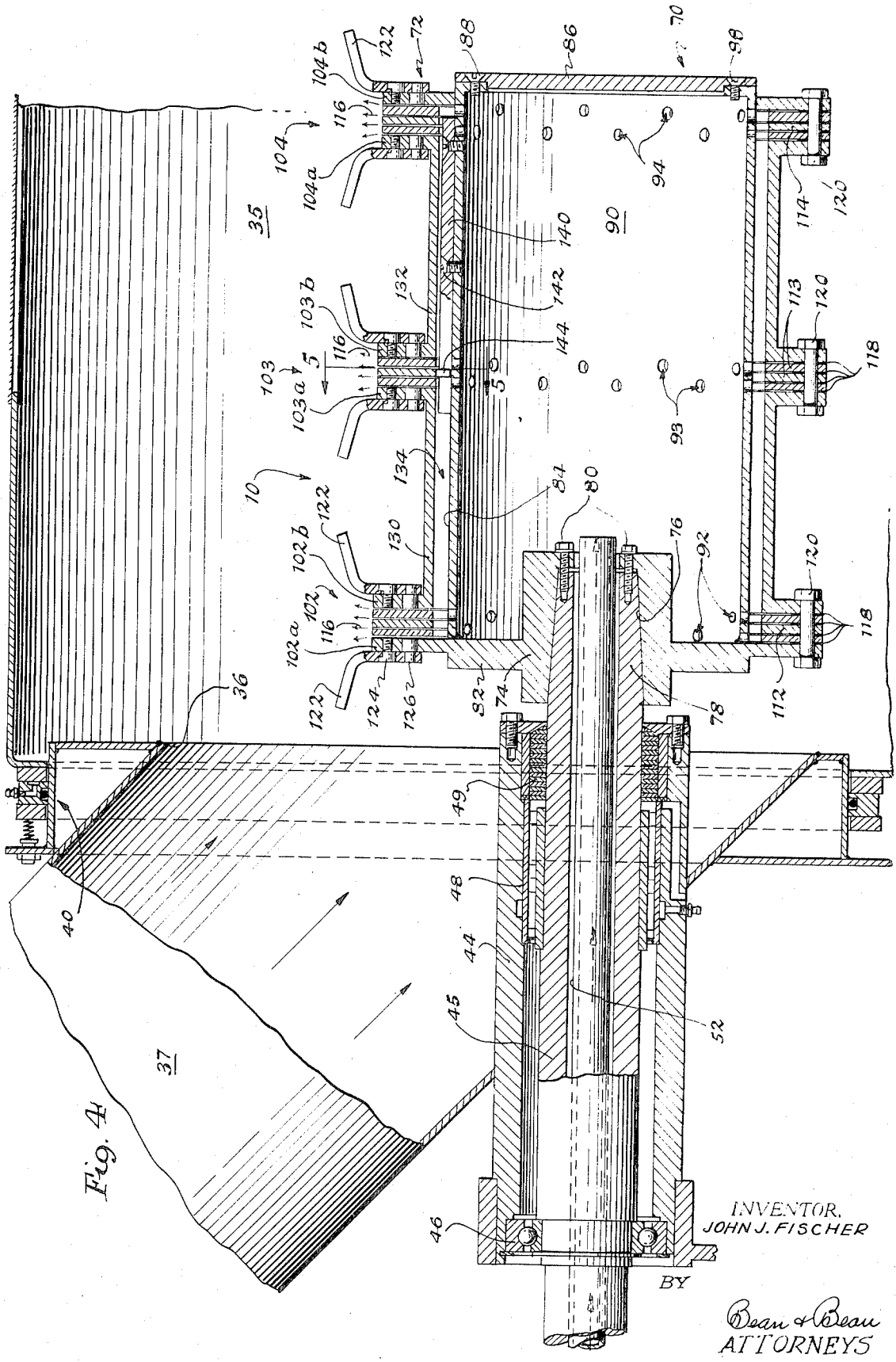


Fig. 4

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DISPERSION HEAD FOR SOLIDS-LIQUIDS BLENDER

SUMMARY OF THE INVENTION

The invention relates to an improved liquid dispersion head characterized as having the capacity for handling large quantities of liquids in continuous blending units and which possesses particular utility in solids-liquids blenders of the general type disclosed in my prior U.S. Pat. No. 3,362,688.

With prior dispersion head constructions, a great discrepancy normally exists between the solids blending and liquid dispensing capacities of the dispersion head. In this respect it will be understood that the capacity for handling or blending solids increases as the cube of the diameter of the dispersion head, whereas the liquid dispensing capacity of a single orifice or gap extending annularly of the dispersion head increases in direct proportion to such diameter. While an obvious solution is to increase the number of orifices employed in any given dispersion head, it is not practical to provide more than a limited number of orifices of any given point along the dispersion head due to material agitating and liquid distribution consideration.

The above-mentioned problem is solved in accordance with the present invention by providing a dispersion head with multiple sections, each having its own orifices and agitating blades. The construction permits the number of sections, as well as the number of orifices and the widths thereof, to be readily varied, as determined by desired solids-liquids blending operating conditions.

More specifically, the dispersion head of the present invention includes a hub portion, which serves to removably mount the head on the end of a rotatable stub drive shaft; and multisectioned assembly, which is removably supported on the hub portion and serves to define two or more liquid spray and agitating devices spaced axially of the hub portion.

The construction of the hub portion and the liquid spray assembly results in a relatively lightweight construction, as compared with prior, similarly sized dispersion head constructions and thereby serves to minimize bending loads imposed on the bearing supports of the head supporting drive shaft.

Further, the head construction of the present invention results in lower head fabricating costs, due to the identity of parts employed in forming the liquid spray assembly regardless of the number of sections employed. Moreover, reduced costs are achieved by the present head construction, which permits various sized or spray capacity heads to be quickly and easily mounted on the same drive shaft without the need for modifying same in any way.

DRAWINGS

These, as well as other advantages of the invention, will now appear from the following description taken with the accompanying drawings wherein:

FIG. 1 is a side elevational view, partly in section, of a solids-liquids blender showing the dispersion head of the invention installed;

FIG. 2 is a front end view on enlarged scale of the blender of FIG. 1;

FIG. 3 is a fragmentary sectional view on enlarged scale taken on line 3—3 of FIG. 1;

FIG. 4 is a fragmentary sectional view taken on line 4—4 of FIG. 3;

FIG. 5 is a fragmentary sectional view taken on line 5—5 of FIG. 4; and

FIG. 6 is a view similar to FIG. 3, but on a reduced scale and showing only the movement of material within the material receiving or feed chamber.

DETAILED DESCRIPTION

As by way of reference, the dispersion head of the present invention, which is generally designated as **10**, is particularly adapted for use in solids-liquids blenders of the type disclosed in my prior U.S. Pat. No. 3,362,688. Blenders of this type generally comprise a blending or mixing shell or container **20**,

which is made of metal, plastic or other suitable material and formed to provide a series of openly intercommunicating truncated tubular sections **22**, which are disposed to extend lengthwise of the blender in zigzag relation. The zigzag relationship of the tubular components **22** may be centered in one plane of may exist in any number of radially intersecting planes passing through the center line of rotation of the device, as may be preferred. In any case, the configuration of the container **20** provides in effect, a series of intercommunicating V-shaped chambers.

The container **20** is preferably mounted for rotation on a tilt table of base member **25** by means of trunnion wheels **26** carried by mounting brackets **27**. Trunnion wheels **26** engage corresponding trunnion rims **29**, which are mounted so that their centers of rotation coincide with the longitudinal centerline of the container as indicated at C.L. (FIG. 1). Rotation of the container may be effected by any suitable means, such as a motor and gearbox unit **30** driving through a belt or chain **32** trained around a sprocket **34**, which in turn is mounted on container **20** concentrically of the center line of rotation thereof.

As more fully explained in my above-mentioned prior patent, container **20** tumbles materials and in addition also moves the particles both downstream and upstream, the overall net flow being downstream. The net flow rate through a given machine depends on the rate of feed and the speed of rotation of container **20**, and on the angle of tilt at which the rotation axis is set.

The feed inlet end of the container **20** is shown as comprising a cylindrically shaped feed chamber or material receiving drum **35**, which is arranged for rotation eccentrically of the center line of container rotation. Feed chamber **35** is formed with a circular feed-receiving opening **36** through the outer end wall thereof, which is arranged concentrically with the axis of rotation of the container. A loading chute **37** is stationarily mounted upon the base **25** for the purpose of feeding material into feed chamber **35** through opening **36**, and a suitable dust seal device **40** is employed to seal the juncture of chute **37** and feed chamber **35** to prevent leakage of material therefrom.

To introduce liquid into the blender, chute **37** may be apertured, as shown in FIG. **4**, to accommodate projection therethrough of a stationary tubular housing **44**, which is fixed to the chute and rotatably mounts therein a hollow drive shaft **45**, as by means of a ball bearing device **46** and a roller bearing device **48**. A liquid-dust seal indicated at **49** is preferably provided at the inner end portion of housing **44**. At its inner end drive shaft **45** projects into the drum **35** and mounts thereon dispersion head **10** of the present invention, which will hereinafter be described in detail.

A stationary liquid feed tube **52** is arranged within drive shaft **45** for the purpose of feeding liquid under pressure from a suitable source, not shown, through shaft **45** and into head **10**. Drive shaft **45** also carries a pulley or sprocket **64**, and is hereby arranged to be driven by means of a belt **66** and motor **68** (FIG. **1**) or other suitable means.

It will be understood that motor **68** rotates dispersion head **10** at high speed, such that it will disperse feed liquid in finely divided spray or film form into the dry feed material; the parts being so dimensioned and arranged that the dispersion head **10** normally resides inside the body of dry material milling around within the feed chamber **35**, as indicated in FIG. **6**. Hence, the dispersion head will not only disperse finely divided liquid feed material into the dry feed, but it will also agitate or churn the dry material as the latter flows to and fro in the feed chamber **35**, due to disposition of the feed chamber center line eccentrically of its center of rotation.

Now referring particularly to FIG. **4**, it will be seen that the dispersion head of the present invention generally includes a hub portion **70**, which is supported on shaft **45**; and a liquid spray and agitating assembly **72**, which is supported on the hub portion.

Specifically, hub portion **70** includes a mounting hub **74**, which is provided with a conically shaped through opening **76** adapted to receive a like configured end portion **78** of shaft **45** or fitting fixed to such shaft. Mounting bolts **80** may be employed to fix mounting hub **74** on shaft end portion **78** and tighten the liquid seal or tapered lock formed by the conically-shaped surfaces thereof. Hub portion **70** also includes a rigid annular flange **82**, which extends radially from mounting hub **74**; a relatively thin walled cylindrical portion **84**, which is fixed to flange **82** and disposed concentrically of mounting hub **74**; and an end closure plate **86**, which is removably connected to the free end of cylindrical portion **84**, as by bolts **88**.

As thus constructed, hub portion **70** defines a chamber **90** arranged in flow communication with feed tube **52**. It will be understood that upon rotation of head **10**, liquid received within chamber **90** forms a thin layer or film on the cylindrical inner surface of cylindrical portion **84**, which is thereafter discharged radially through groups of discharge openings **92–94** spaced axially of cylindrical portion **84**. The use of groups of relatively small, circular openings insures uniform distribution of liquid in a direction axially of chamber **90**.

Hub, **74** flange **82** and cylindrical portion **84** may, if desired, be formed as a one piece metal casting. However, as will be described, hub portion **70** is preferably formed of separate pieces welded or otherwise fixed together.

In the illustrated embodiment of head **10**, assembly **72** includes three liquid spray and agitating devices **102–104**, which are spaced axially of cylindrical portion **84** in radial alignment with groups of discharge openings **92–94**, respectively. Of course, the number of groups of discharge openings will be determined by the number of spray devices, which will in turn be determined by the length of receiving chamber **35** and/or the amount of liquid desired to be added to the material being treated. Whereas, the construction of head **10** admits to providing two or more liquid spray and agitating devices, three or more devices will be employed in most installations.

Devices **102–104** include annularly extending mounting flanges **102*a*–104*b***, which cooperate with one or more annularly extending spacer plates **112–114** sandwiched therebetween, so as to define annularly extending liquid spray orifices through which liquid is discharged, as indicated by arrows **116**. The separation between the mounting flanges and/or the spacer plates and thus the widths of the several spray orifices is determined by the thicknesses of relatively thin spacer elements **118**, through which are passed mounting flange and spacer plate clamping bolts **120**, as indicated in FIG. **4**. Alternatively, bolts **120** may be replaced by friction fitted key pins and devices **102–104** clamped against mounting flange **102*a*** providing closure plate **86** with an annular rim, which is arranged to clampingly engage mounting flange **104*b*** when bolts **88** are tightened.

For any given number of spray devices, the amount of liquid discharged thereby may be readily controlled by varying the rotational speed of the dispersion head, the number of spacer plates and the spacing between the spacer plates and/or mounting flanges. However, as a practical matter, inasmuch as the fineness of the liquid spray is determined by the width of the spray orifices and the peripheral velocity of head **10**, control of the amount of liquid discharged is more readily effected by varying the number of spacer plates and/or spray devices. This can be readily accomplished due to the novel arrangement for supporting the spray and agitating assembly to be hereinafter described.

To augment the dry feed material churning effect hereinafter described, pluralities of radially extending material agitating blades **122** are affixed to mounting flanges **102*a*–104*b*** by bolts **124** and mounting guide pins **126**. As best shown in FIGS. **3** and **4**, blades **122** extend radially of the axis of rotation of head **10**, but have their free outer ends disposed in planes canted relative to such axis. Thus, upon rotation of head **10**, blades **122** effect a particularly vigorous agitating action on the material within receiving chamber **35**, and liquid is sprayed into the dry material in those areas of the material subject to maximum agitation. However, it will be understood that where minimum attrition of the material being treated is desired, blades **122** may be omitted.

A particularly important feature of the present invention is the novel arrangement for mutually supporting devices **102–104** and mounting same on hub portion **70**. To this end, spray device **102** is fixed for rotation with mounting hub **74**, as by forming mounting flange **102*a*** integrally with or otherwise fixing it for rotation with annular flange **82**, whereas spray device **103** is fixed for rotation with spray device **102** and spray device **104** is fixed for rotation with spray device **103** by means of bridging sleeves **130** and **132**, which join mounting flanges **102*b*–103*a*** and **103*b*–104*a***, respectively. As desired, bridging sleeves **130**, **132** may be weld affixed or formed integrally with their associated mounting flanges.

As will be apparent from viewing FIG. **4**, bridging sleeves **130**, **132** are disposed concentrically of cylindrical portion **84** and cooperate with mounting flanges **102*a*** and **104*b*** to define annular chamber **134** through which liquid passes from groups of discharge openings **92–94** to the spray orifices defined by devices **102–104**. In this connection, an effective fluid seal is formed between mounting flange **104*b*** and the outer surface of cylindrical portion **84** by providing a close sliding fit therebetween. By slip fitting mounting flange **104*b*** on cylindrical portion **84**, the former may be easily removed and reinstalled when it is desired to add or remove spacer plates or spacing elements in order to vary the amount of liquid to be sprayed.

Referring to FIGS. **4** and **5**, it will be understood that preferably both, but at least one, of spray devices **103**, **104** are also fixed for rotation with the free end of cylindrical portion **84** by a keylock arrangement comprising a key bar **140** fixed to cylindrical portion **84**, as by screws **142**, and cooperating key bar receiving recesses **144** provided in one or more of spacer plates **113**, **114**. By this arrangement, assembly **72** and cylindrical portion **84** cooperate to resist torsion forces set up during the agitating operation and transfer same directly to mounting hub **74** via rigid flange **82**. As a result, each of assembly **72** and cylindrical portion **84** is permitted to be formed of relatively light weight construction in order to minimize the bending loads imposed on the bearings of drive shaft **45**. Moreover, this construction requires only a short length of shaft **45** to extend beyond its support bearings into chamber **35**, regardless of the number of spray devices employed. This results in greatly reduced bending loads as compared with dispersion head constructions of the type disclosed by my prior patent, wherein each spray device is independently mounted on the drive shaft.

Also, by fixing dispersion head **10** to the end of shaft **45**, a dispersion head having any desired number of spray devices may be mounted without the need for modifying the drive shaft in any way, and the dispersion head may be quickly and easily removed as a unit from the drive shaft for purposes of maintenance and adjustment, as desired.

The construction of the present invention also results in low fabricating and assembly costs, due to the identity of parts employed in forming assembly **72**, regardless of the number of spray devices employed. Where cylindrical portion **84** is welded to flange **82**, even greater economies are achieved, since the only component required to be fabricated in more than one size in order to produce a head having different numbers of spray devices is the cylindrical portion.

Although only one form of the present invention has bee illustrated and described in detail hereinabove, it will be understood that various changes may be made therein without departing from the spirit of the invention.

I claim:

1. In a solids-liquids blender including a container for receiving material, shaft means for conveying liquid inwardly of said container, a dispersion head mounted on said shaft means inwardly of said container for feeding liquid from said shaft means to said material, and means for relatively rotating said dispersion head and said container to effect agitation of

said material, the improvement wherein said dispersion head comprises in combination:

hub means, said hub means defining a chamber extending axially of said hub means and liquid discharge openings extending radially outwardly from said chamber;

means for mounting said hub means adjacent one end of said chamber coaxially on an end of said shaft means extending inwardly of said container to position said chamber in fluid communication with said shaft means;

a liquid feed assembly; and

means for mounting said assembly on said hub means concentrically outwardly thereof, said assembly including at least two liquid feed means spaced apart axially of said hub means and defining annularly arranged orifices through which liquid discharged through said openings is fed to said material within said container.

2. An improvement according to claim 1, wherein said assembly mounting means includes first means to removably fix a first of said feed means for rotation with said hub means adjacent said one end of said chamber and second means to removably fix a second of said feed means for rotation with said hub means adjacent another end of said chamber, and said assembly includes means to fix said second means for rotation with said first feed means.

3. An improvement according to claim 1, wherein said assembly includes at least three feed means, said assembly mounting means includes first means to removably fix a first of said feed means for rotation with said hub means adjacent said one end of said chamber and second means to removably fix at least one of said second and third said means for rotation with said hub means adjacent another end of said chamber, and said assembly includes means to removably affix said third feed means for rotation with said second feed means and said second feed means for rotation with said first feed means.

4. An improvement according to claim 1, wherein said hub means includes a hub portion mounted coaxially on said end of said shaft means, an annular flange fixed to and extending radially from said hub portion, a cylindrical portion fixed to said annular flange concentrically of said hub portion and plate means removably affixed to said cylindrical portion remotely of said annular flange, said hub portion, annular flange, cylindrical portion and plate means bounding said chamber, said openings extending radially through said cylindrical portion, and being arranged in groups spaced axially of said cylindrical portion in radial alignment with said orifices; and said hub mounted means includes a conically shaped through opening arranged axially of said hub portion, a conically shaped surface portion on said end of said shaft means and bolt means for fixing said hub portion onto said shaft means, said conical surfaces being arranged in a friction tight fluid sealed relationship upon tightening of said bolt means.

5. An improvement according to claim 1, wherein said feed means each include first and second annular mounting flanges removably fixed together, said orifices of each said feed means being arranged intermediate said first and second mounting flanges thereof, said first flange of a first of said feed means being mounted adjacent said one end of said chamber, and said assembly including bridging sleeves extending axially between and fixed to second and first flanges of adjacent feed means.

6. An improvement according to claim 5, wherein said feed means each additionally include at least one orifice bounding annular spacer plate clampingly secured intermediate said mounting flanges thereof.

7. In a solids-liquids blender including a container for receiving material, shaft means for conveying liquid inwardly of said container, a dispersion head mounted on said shaft means inwardly of said container for feeding liquid from said shaft means to said material, and means for relatively rotating said dispersion head and said container to effect agitation of said material, the improvement wherein said dispersion head comprises in combination:

hub means, said hub means including a hub portion mounted coaxially on an end of said shaft means extending inwardly of said container, an annular flange fixed to and extending radially from said hub portion, a cylindrical portion fixed to said annular flange concentrically of said hub portion and plate means fixed to said cylindrical portion remotely of said annular flange, said hub portion, annular flange, cylindrical portion and plate means bounding said chamber, said cylindrical portion having openings extending radially therethrough;

means for mounting said hub portion on said end of said shaft means to position said chamber in fluid communication with said shaft means;

a liquid feed assembly including a series of liquid feed means and bridging means, said feed means defining annularly arranged orifices through which liquid discharged through said openings is fed to said material within said container, each said feed means including first and second annular mounting flanges, and at least one orifice bounding annular spacer plate arranged intermediate said mounting flanges, and a first means of said series having a first mounting flange thereof fixed to said annular flange, said bridging means including sleeve members fixed to said second and first mounting flanges of adjacent feed means to space said feed means axially of said cylindrical portion;

means to removably clamp said mounting flanges and spacer plate in assembled condition;

key means to removably fix at least one other feed means of said series to said cylindrical portion remotely of said annular flange.

8. An improvement according to claim 7, wherein said key means includes a key bar fixed to the radially outer surface of said cylindrical portion and extending axially thereof and key bar receiving recess formed in said spacer plate of said one other feed means.

9. An improvement according to claim 7, wherein said second mounting flange of a last feed means of said series is slideably supported by the radially outer surface of said cylindrical portion to form a liquid seal therewith and to cooperate with said first mounting flange of said first feed means to maintain said assembly concentric of said outer surface of said cylindrical portion.

10. An improvement according to claim 9, wherein said key means includes a key bar fixed to the radially outer surface of said cylindrical portion and extending axially thereof and key bar receiving recess formed in said spacer plate of said one other feed means; said hub mounting means includes a conically shaped through opening arranged axially of said hub portion, a conically shaped surface portion on said end of said shaft means and bolt means for fixing said hub portion onto said shaft means, said conical surfaces being arranged in a friction tight fluid sealed relationship upon tightening of said bolt means; and said openings being arranged in groups spaced axially of said cylindrical portion in radial alignment with said orifices.

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