July 9, 1957 W. P. DOOLEY 2,798,698

COMBINED INJECTION AND BLENDING APPARATUS

Filed Dec. 27, 1954 2 Sheets-Sheet 1

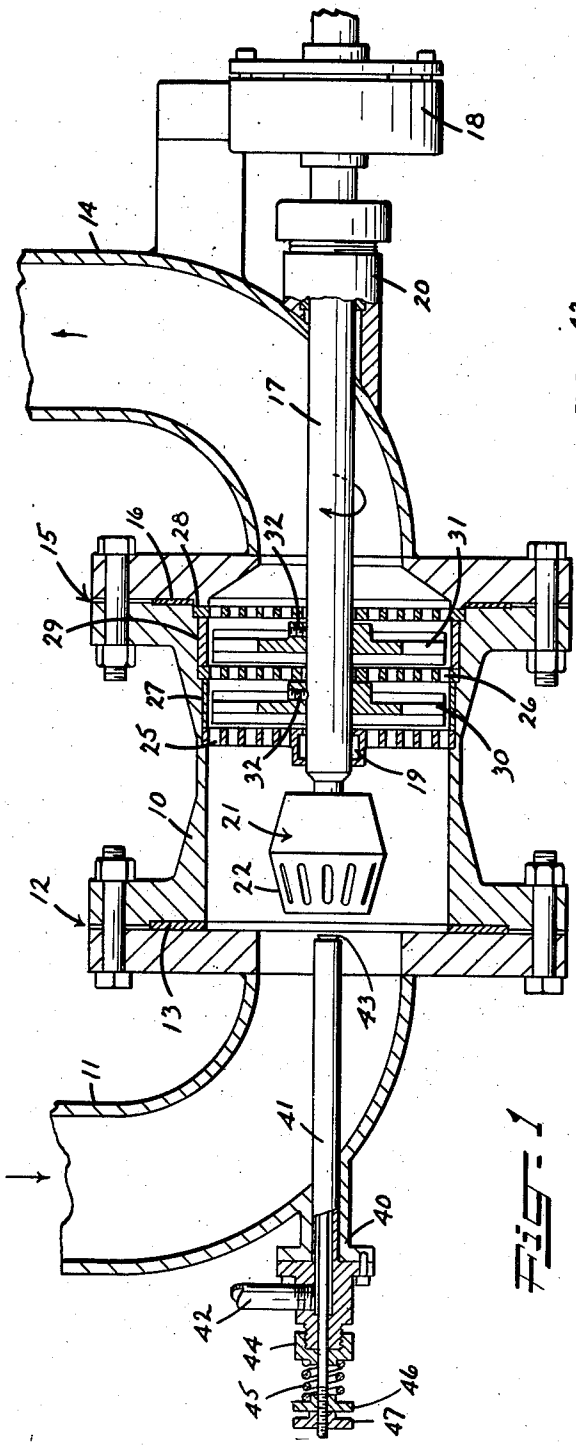

Fig. 1

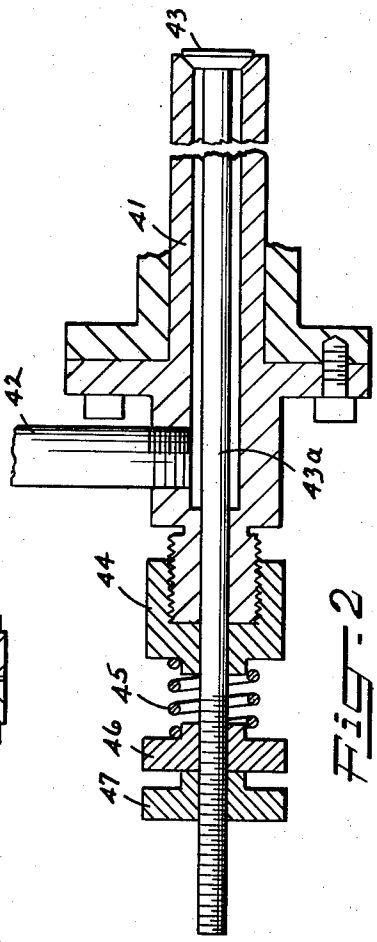

Fig. 2

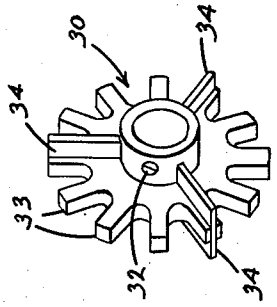

Fig. 3

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COMBINED INJECTION AND BLENDING APPARATUS

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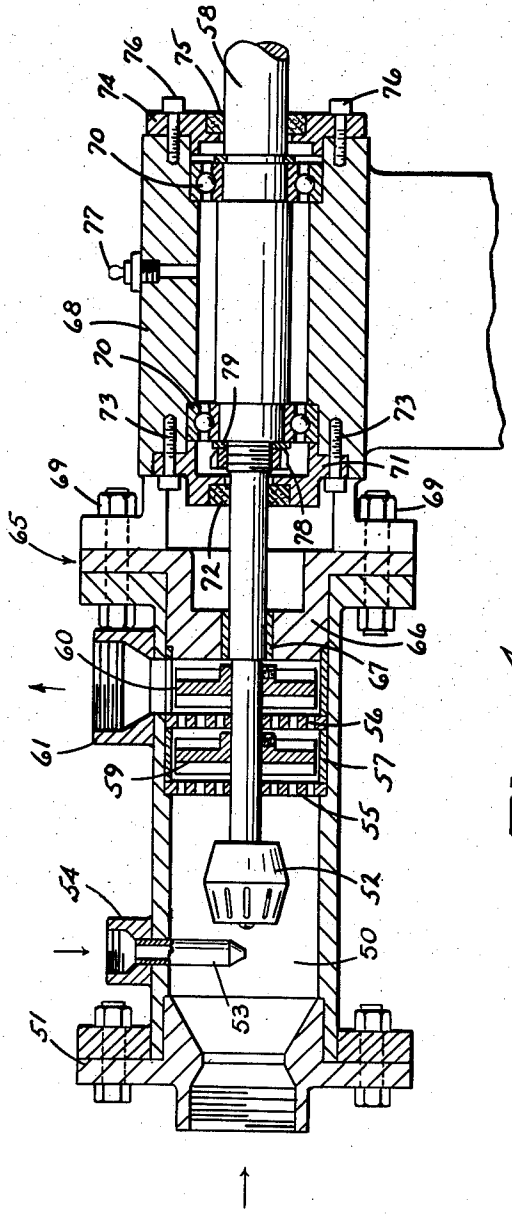

Fig. 4

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COMBINED INJECTION AND BLENDING APPARATUS

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9 Claims. (Cl. 259—9)

This invention relates to liquid injection and blending apparatus, and more particularly to a device for injecting a secondary stream of viscose into a primary stream of viscose.

The problems connected with the injection of one stream of a liquid such as viscose into a second viscose stream are, to a considerable extent, influenced by the nature of the liquid itself. Such problems have to do with the elimination of dead spots where the viscose may become stagnant or may have a tendency to set up. In addition the viscous nature of the fluid may cause a considerable pressure drop through the blending apparatus. This condition is highly undesirable since it requires one or more booster pumps in the line. The very nature of viscose is such that the injected stream tends to resist complete mixing and therefore relatively violent agitation and blending is required to achieve homogeneity.

A primary object of the invention therefore is to provide a combined injection apparatus and blender which is highly efficient in its blending characteristics and which at the same time eliminates pressure drop through the blender.

A further object of the invention is to provide a combined injection blender for viscous liquids which is self-cleaning.

A still further object of the invention is to provide an improved injection blender having no stagnant areas.

A still further object of the invention is to provide an improved injection blender having a two-stage blending element mounted on a common shaft, the first stage comprising a high speed agitator of relatively small diameter and the second stage comprising a series of rotors and stators of relatively larger diameter.

A still further object of the invention is to provide a combined injection blender for viscose in which one of the rotor elements acts as a centrifugal pump to offset pressure drop in the device.

Further objects will be apparent from the specification and drawings in which:

Figure 1 is a longitudinal sectional view through a combined injection blender constructed in accordance with the present invention;

Figure 2 is an enlarged sectional view showing the injection device used in the construction of Figure 1;

Figure 3 is a perspective of one of the rotor elements; and

Figure 4 is a longitudinal sectional view of a modified form of combined injection blender.

The invention comprises essentially the provision of a primary fluid housing having a plurality of alternating stator and rotor elements therein. The rotor shaft is provided with a preliminary agitating element which initially directs the secondary stream in all directions through a preliminary mixing chamber. The secondary stream is delivered to a zone immediately in front of and in line with the axis of the preliminary agitator. In one form of the apparatus, the primary flow takes place axially through the rotor and stator elements and in another form the last rotor discharges the mixed primary and secondary liquids tangentially through a discharge port at right angles to the axis of the rotor shaft.

Referring now more particularly to the drawings, the apparatus shown in Figures 1–3 comprises a housing **10** having a relatively large circular bore. The intake end of housing **10** is connected to the intake elbow **11** by means of a flanged connection **12** having a suitable gasket **13**. The outlet end of housing **10** connects to curved outlet elbow **14** through flanged connection **15** having gasket **16**. The blending or mixing structure is completely contained in housing **10** and comprises a rotor shaft **17** which extends through elbow **14** and is journaled in outboard bearing assembly **18** and inboard bushing **19**. A stuffing box **20** is provided between the bearing assembly **18** and the elbow **14** as shown in Figure 1. The extreme end of shaft **17** carries a high speed agitating element **21** having a hollow construction with a fluid shearing surface **22**. This element is well known as an independent mixing device and forms no part of the present invention apart from its combination with the remaining structure. The discharge end of housing **10** is counterbored to receive in sequence the first stator element **25** which carries the bushing **19**; the next stator element **26** which is of slightly larger diameter, and retains a spacing collar **27**; and the third stator element **28** of still larger diameter which in turn retains a spacing collar **29**. All of the stators and collars are held in position by the flanged connection **15**. Each stator contains a series of perforations preferably arranged in concentric rows to permit passage of the liquid and to break up the initially mixed streams into relatively fine streams. Shaft **17** carries two rotors **30** and **31** which in the present instance are of identical construction as shown in Figure 3. Each rotor has a solid hub that is keyed to shaft **17** by set screws **32, 32** and the periphery of the rotors comprises a plurality of spokes **33, 33** having a substantially rectangular cross section. In addition to the spokes, I provide three sets of vanes **34, 34** which act as shear elements to vigorously break up and mix the individual streams delivered through the perforations of the stators. As shown in Figure 1, the first rotor **30** is positioned between stators **25** and **26** whereas the second rotor **31** is positioned between stators **26** and **28**.

The primary liquid stream such as viscose is delivered to housing **10** through inlet **11**. The secondary liquid such as a delusterant or a coloring fluid is delivered through the injector assembly connected to inlet **11** so that the tip or discharge end of the injector terminates in close axial spaced relation to the agitator **21**. The injector assembly (Figure 2) comprises a housing **41** to which the secondary fluid is carried by means of a pipe or conduit **42**. A spring loaded valve **43** extends axially through housing **41** and prevents backing up of the primary fluid into housing **41** should the pressure in the housing fall below the pressure of the primary stream. Valve stem **43***a* extends through the gland assembly **44** and is adjustably spring loaded by means of a compressing spring **45** and nuts **46, 47**. It will thus be understood that the primary liquid stream is delivered in an axial direction to the blending elements in housing **10** and that the secondary stream is likewise delivered in line with the primary stream to a zone directly at the intake of the agitating element **21**. This device turns at a speed of approximately 3500 R. P. M. so that there is vigorous preliminary agitation in the inlet zone of chamber **10**. The initially mixed streams then pass through the various rotor and stator stages and are discharged axially in a completely homogeneous state through the discharge elbow **14**.

A modified form of combined injection blender is shown in Figure 4 which is particularly useful where

minimum pressure drop through the blender is indicated. In this form the housing **50** has an inlet flanged coupling **51** through which the primary stream enters the housing. The secondary stream is delivered to a point or zone directly in front of the preliminary agitator **52** through an injector nozzle **53**. However, although the zone at which the secondary fluid is discharged is the same as that shown in Figure 1 in the modified form, the secondary fluid enters housing **50** from the side through a boss **54** rather than in an axial direction. The blending stages in the form of Figure 4 comprise the first stator **55** separated from the second stator **56** by means of a collar **57**. This form has only two stators, however, and the shaft **58** is not journaled in either of the stators. The first rotor **59** is positioned between stators **55** and **56**, and the second rotor **60** is in line with the discharge fitting **61** at right angles to the axis of the rotors and shaft. In this way it will be seen that the rotor **60** functions in addition to its mixing action as a centrifugal pump to boost the discharge pressure from the blender and thus eliminate the necessity for installing a secondary booster pump in the line should the pressure drop be considered excessive. This tangential rather than axial outlet also permits the entire shaft and rotor assembly to be carried in very adequate outboard supports.

The flange joint assembly **65** comprises an intermediate cap **66** for the housing **50** which is provided with a bushing **67** that may be lubricated by the viscose or liquid in chamber **50**. The bearing housing **68** is also supported at the flange assembly **65** by the connecting bolts **69**, **69**. Annular ball bearing assemblies **70**, **70** are positioned in axial spaced relation in housing **68** to carry the radial loads imposed by the weight of the agitator **52** and the rotors **59** and **60**. The inner cap **71** having a lubricant seal **72** is secured to the housing **68** by cap screws **73**, **73**, and the outer cap **74** having a lubricant seal **75** is connected to the housing **68** by cap screws **76**, **76**. Lubricant is introduced to the enlarged bore of the housing and thence to the bearings **70** through a grease fitting **77**. The inboard bearing is retained on shaft **58** by means of a nut **78** and lock washer **79**.

The combined injection blender, as described above, is admirably suited for use with relatively thick viscous liquids such as viscose. It is simple, effective and the two stages provide exceptionally effective blending for the addition of any desired secondary fluid which may be an additive intended to accomplish an improved physical characteristic in the extruded filaments, a delusterant or a pigmented mixture for coloring purposes only. Depending upon the particular installation, the design may be modified to operate as a booster pump if the elimination of pressure drop through the device is important. Low cost, adequate capacity and elimination of stagnant areas together with very complete blending are important features of the design.

Having thus described my invention, I claim:

1. A combined injection blender comprising a housing, means for admitting a first liquid to one end of said housing, a first-stage rotary agitator in said housing being of substantially smaller diameter than the bore of the housing, a second-stage agitator in said housing, said second-stage agitator comprising a plurality of rotors and interspersed stators of substantially the same diameter as the bore of the housing, a common shaft on which said first and second-stage agitators are mounted, and a secondary injection nozzle terminating in close axial spaced relation to the first-stage agitator at a point between said agitator and said first liquid injection means.

2. Apparatus in accordance with claim 1 in which the shaft is partially journaled in one of the stators.

3. Apparatus in accordance with claim 1 in which the shaft is cantilever journaled exteriorly of the housing.

4. Apparatus in accordance with claim 1 in which the injection nozzle enters the housing concentrically and axially to the shaft.

5. Apparatus in accordance with claim 1 in which the injector nozzle enters the housing at right angles to the centerline of the shaft.

6. Apparatus in accordance with claim 1 in which the housing has a discharge conduit extending in an axial direction therefrom.

7. Apparatus in accordance with claim 1 in which the housing has a tangential discharge conduit in line with one of the rotors.

8. Apparatus in accordance with claim 1 in which the rotors have peripheral spokes of rectangular cross section, and a plurality of radially extending vanes substantially wider than the width of the spokes.

9. Apparatus of claim 1 comprising means for lubricating the shaft with the material being blended.

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