CLAIMS

1. An apparatus for dispersing particles in a fluid, comprising:

a flow divider for receiving the fluid with the particles and for separating the fluid with the particles into a first fluid stream with some of the particles and a second fluid stream with some of the particles,

a first fluid branch for receiving the first fluid stream with some of the particles,

a second fluid branch for receiving the second fluid stream with some of the particles,

a branch joining section for receiving both the first fluid stream with the some of the particles from the first fluid branch and the second fluid stream with the some of the particles from the second fluid branch, the branch joining section having a collision zone at which the first and second fluid streams collide,

a first nozzle arranged in the first fluid branch at a position between the flow divider and the branch joining section and a second nozzle arranged in the second fluid branch at a position between the flow divider and the branch joining section, the first nozzle comprising a first orifice followed by a first fluid diverging section, the first orifice and the first fluid diverging section increasing shear of the first fluid stream to improve dispersion of the some of the particles in the first fluid stream;

the second nozzle comprising a second orifice followed by a second fluid diverging section, the second orifice and the second fluid diverging section increasing shear of the second fluid stream to improve dispersion of the some of the particles in the second fluid stream; and

an apparatus outlet though which the first and second fluid streams which have collided at the collision zone flow to exit the apparatus.

2. An apparatus according to claim 1, wherein the first nozzle comprises an intermediate flow section that is located between the first orifice and the first fluid diverging section, the intermediate flow section having a constant cross-sectional area.

3. An apparatus according to claim 1, wherein the first nozzle comprises a fluid converging section that converges towards the orifice.

4. An apparatus according to claim 1, wherein the first orifice comprises a central region and a plurality of angularly spaced-apart, outer regions around the periphery of the central region, so that a fluid flow through each of said outer regions develops a vortex flow pattern.

5. An apparatus according to claim 1, wherein the first nozzle is made of plastic and is arranged inside the first fluid branch.

6. An apparatus according to claim 1, wherein the first nozzle comprises a circumferential flange that abuts the first fluid branch so that the first nozzle is fixed relative the first fluid branch, as seen in a direction of a flow of the first fluid.

7. An apparatus according to claim 1, wherein the first fluid branch and the second fluid branch are positioned relative to each other to direct the first fluid stream and the second fluid stream towards each other at an angle of 60º - 120º, so that the first and second fluid streams meet in the collision zone by said angle.

8. An apparatus according to claim 1, wherein the first nozzle comprises an outer elongated, cylindrical surface that abuts an inner surface of the first fluid branch.

9. An apparatus according to claim 1, wherein the first fluid branch comprises a first clamp that is located at a position of the first fluid branch where an inlet of the first nozzle

is located, and a second clamp that is located at a position of the first fluid branch where an outlet of the first nozzle is located.

10. An apparatus according to claim 1, comprising a straight pipe section in which the first nozzle is located, the straight pipe section being attached to the apparatus by a first clamp and a second clamp.

11. An apparatus according to claim 1, comprising a first pressure sensing interface at an inlet of the apparatus and a second pressure sensing interface at the outlet of the apparatus.

12. An apparatus according to claim 1, comprising a pressure sensing device for indicating a differential pressure over the apparatus when the fluid is flowing through the apparatus.

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13. An apparatus for dispersing particles in a fluid, comprising:

an apparatus inlet into which is introduced the fluid with particles;

a flow divider that receives the fluid with the particles introduced into the apparatus inlet and separates the fluid with the particles into a first fluid stream with some of the particles and a second fluid stream with some of the particles;

a first fluid branch that is connected to the flow divider and that receives the first fluid stream with the some of the particles;

a second fluid branch that is connected to the flow divider and that receives the second fluid stream with the some of the particles;

a first nozzle positioned in the first fluid branch and comprising a first nozzle inlet through which the first fluid stream with the some of the particles enters the nozzle and a first nozzle outlet through which the first fluid stream with the some of the particles exits the first nozzle, the first nozzle also comprising an orifice and a fluid diverging section that expands in size towards the first nozzle outlet;

a second nozzle positioned in the second fluid branch and comprising a second nozzle inlet through which the second fluid stream with the some of the particles enters the nozzle and a second nozzle outlet through which the second fluid stream with the some of the particles exits the second nozzle, the second nozzle also comprising an orifice and a fluid diverging section that expands in size towards the second nozzle outlet;

a branch joining section connected to the first fluid branch and the second fluid branch for receiving both the first fluid stream with the some of the particles and the second fluid stream with the some of the particles, the branch joining section including a collision zone at which the first fluid stream with the some of the particles and the second fluid stream with the some of the particles collide and are subjected to shearing to produce a sheared fluid stream in which the particles are dispersed;

an apparatus outlet through which the sheared fluid stream flows;

a first pressure sensing interface at the apparatus inlet that measures pressure at the apparatus inlet;

a second pressure sensing interface at the apparatus outlet that measures pressure at the apparatus outlet; and

a control system receiving information identifying a pressure differential between the pressure measured at the apparatus inlet and the pressure measured at the apparatus outlet, and controlling a flow of the fluid with the particles introduced to the apparatus inlet based on the pressure differential so that pressure differential which produces a desired dispersion of the particles in the fluid is achieved.

14. The apparatus for dispersing particles in a fluid according to claim 13, wherein the second nozzle includes a fluid converging section that decreases in size away from second nozzle inlet, an intermediate flow section of constant size larger than a size of the orifice in the second nozzle, the intermediate flow section being positioned between the orifice of the second nozzle and the fluid diverging section of the second nozzle, the orifice of the second nozzle immediately following the fluid converging section of the second nozzle, the intermediate flow section of the second nozzle immediately following the orifice of the second nozzle, the fluid diverging section of the second nozzle immediately following the intermediate flow section of the second nozzle.

15. The apparatus for dispersing particles in a fluid according to claim 14, wherein the first nozzle includes a fluid converging section that decreases in size away from the first nozzle inlet, an intermediate flow section of constant size larger than a size of the orifice in the first nozzle, the intermediate flow section of the first nozzle being positioned between the orifice of the first nozzle and the fluid diverging section of the first nozzle, the orifice of the first nozzle immediately following the fluid converging section of the first nozzle, the

intermediate flow section of the first nozzle immediately following the orifice of the first nozzle, the fluid diverging section of the first nozzle immediately following the intermediate flow section of the first nozzle.

16. An apparatus according to claim 15, wherein the orifice in both the first nozzle and the second nozzle comprises a central region and a plurality of angularly spaced-apart, outer regions around the periphery of the central region that have a greater radial outward extent than the central region so that fluid flow through the outer regions produces a vortex flow pattern.

17. An apparatus according to claim 13, wherein the apparatus outlet is configured so that the sheared fluid stream which flows through the apparatus outlet exits the apparatus.