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(54) Fluid mixing

(57) A fluid mixing device comprises a housing (1) defining a T-shaped conduit with first (2) and second (3) inlets and an outlet (4). The first inlet (2) and the outlet (4) are disposed in parallel with the second inlet (3) perpendicular thereto. At the intersection of the T-junction there is a mixing tee (5) comprising a conduit (6) that connects the first inlet (2) to the outlet (4) and a dispersion ring (7) supported on a terminal portion of the conduit (6) in the outlet (4). The dispersion ring (7) has a primary aperture (8) in a central portion thereof which passes fluid from the conduit (6) and a plurality of peripheral apertures (9) that are equiangularly spaced and in communication with the first inlet (2). The device provides for improved fluid mixing.

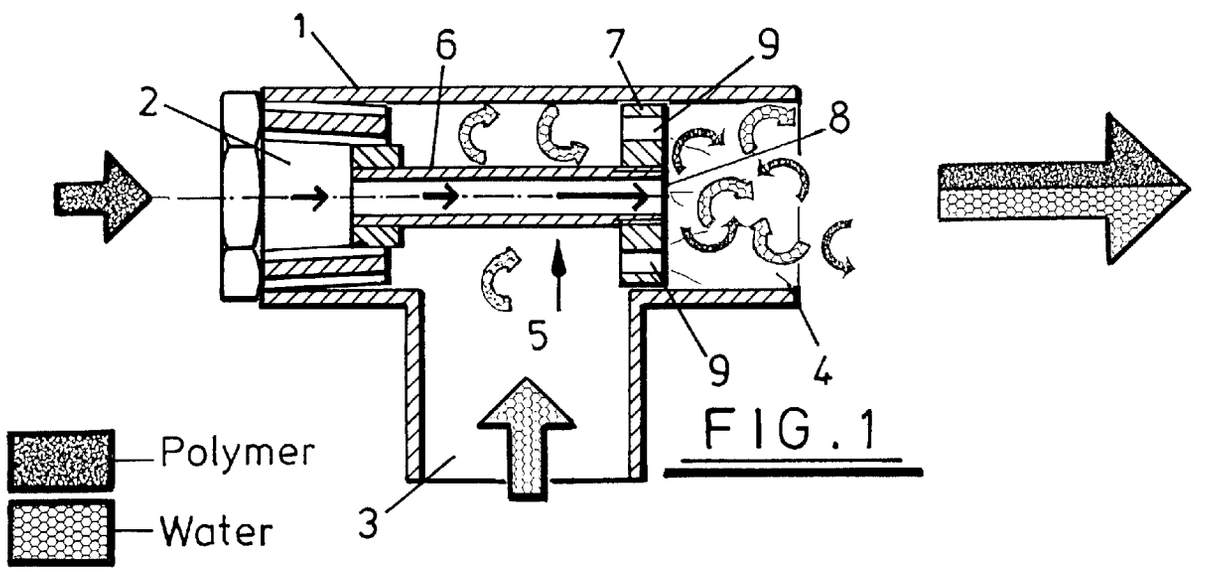

FIG. 1

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Description

The present invention relates to a device for the mixing of two or more fluids and more particularly, but not exclusively, for the mixing of a polymer solution with an additive such as water.

Mixing devices of the kind referred to above are used, for example, to mix such fluids for use in the paper manufacturing industry or in the production of effluent treatment. It is a difficult task to ensure that two fluids of this kind (which generally have different viscosities) are mixed uniformly.

Typical fluid mixing apparatus comprises a mixing block having first and second inlets which are fed respectively with a polymer solution and water from injection pumps via non-return valves. The fluids are mixed together in a T-junction conduit so that the two inlet fluid streams are combined and egress in a mixed state via an outlet. A portion of the mixed fluid is recirculated via a pump back into the mixing block for further mixing whereas the remainder is fed to an ageing tank where it is stored and agitated for a finite period of time. The mixed fluid is then ready for supply directly to the production line via a suitable pump.

It is often necessary for further mixing to be conducted in between the mixing block and the ageing tank.

It is an object of the present invention to improve the quality of the mixing within a mixing block thereby eliminating the requirement for further mixing in the ageing tank or elsewhere before the mixture is fed to the production line.

According to the present invention there is provided a fluid mixing device comprising a housing having first and second inlets and an outlet, and a mixing element in said housing partially closing the outlet and having at least one primary aperture in a central portion thereof, the primary aperture being connected to said first inlet via a conduit within said housing, and a plurality of peripheral apertures which are in communication with said second inlet, wherein the mixing element is mounted on the conduit at or near one end thereof.

A first fluid admitted via the first inlet will pass through the conduit and egress via the aperture in the central portion of the mixing element whereupon it encounters a second fluid that has been admitted through the second inlet and has egressed through the peripheral apertures in the mixing element. The interaction of the two streams causes turbulence and a better quality of mixing. In particular the passage of the fluid through the peripheral apertures tends to create a vortex in the outlet adjacent the primary aperture thereby causing greater turbulence in the mixing.

The conduit may extend across the housing between the first inlet and outlet in a direction perpendicular to the second inlet.

Preferably the housing is T-shaped with the first inlet and outlet being aligned and substantially perpendicular to the second inlet. There may be a clearance around the conduit to accommodate fluid from said second inlet as it passed from said second inlet to the peripheral apertures of the mixing element.

In one embodiment there may be a plurality of first inlets and therefore a plurality of apertures in the central portion of the mixing element. The peripheral apertures are preferably equi-angularly spaced around the mixing element which may be disc shaped.

The mixing element may be rotatably mounted on the conduit and the peripheral apertures configured so that fluid incident upon them causes rotation of the mixing element relative to the conduit.

A specific embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic sectioned view of a mixing device of the present invention;
Figure 2 is a sectioned side view of a dispersion ring and conduit that forms part of the mixing device shown in Figure 1;
Figure 3 is an end view of the dispersion ring of Figure 2 in the direction of arrow Z;
Figure 4 is a part sectioned view of an alternative embodiment of the present invention;
Figure 5 is an end view of an alternative embodiment of a dispersion ring;
Figure 6 is a side view of the dispersion ring of figure 5 mounted on a conduit and shown adjacent a non-return valve.

Referring now the drawings, Figure 1 shows a T-junction conduit by which two incoming fluid streams, for example a polymer solution and water, are mixed before being fed to a production or treatment line in which the mixed solution is used.

The T-junction conduit comprises a housing 1 defining first and second annular inlets 2, 3 by which the two fluid streams are admitted and an annular outlet 4 from which the mixed solution egresses. The first inlet 2 and the outlet 4 are aligned in parallel with the second inlet 3 merging substantially perpendicularly thereto. Each of the first and second inlets 2, 3 has a non-return valve (not shown).

At the intersection of the T-junction there is disposed a removable mixing tee 5 comprising an annular conduit 6 that extends from the first inlet 2 to the outlet 4 and a dispersion ring 7. The conduit 6 is coaxial with the first inlet 2 and the outlet 4 and has a terminal portion in the outlet 4 which supports the dispersion ring 7 on its exterior surface. The dispersion ring 7 is of disc-like configuration having a central aperture 8 which fixedly receives the terminal portion of the conduit 6, and a plurality of peripheral apertures 9 that are equi-angularly spaced around the periphery of the ring 7. Each peripheral aperture 9 is radially offset from the central aperture 8 by the same distance. The dispersion ring 7 and conduit 6 are shown in detail in Figures 2 and 3.

In operation a polymer solution is fed by a pump (not shown) into the inlet 2 of the T-junction. The solution passes through the conduit 6 before egressing through the central aperture 8 of the dispersion ring 7 into the outlet 4. Water is fed into the second inlet 3 such that it flows into the junction of the T-shaped housing, passes around the outside of the conduit 6 and egresses through the peripheral apertures 9 in the dispersion ring 7. The egression of the streams of water from the peripheral apertures 9 has the effect of creating a partial vacuum in a central region of the outlet 4 thereby generating a vortex that tends to "pull" the polymer solution through the central aperture 8 and the conduit 6. The resultant turbulence from the interaction of the separate fluid streams provides good quality mixing and the mixed solution can be fed directly to the production or treatment line without the need for subsequent mixing in an ageing tank. Water is supplied to the second inlet 3 at mains pressure.

The T-junction conduit and the mixing tee 5 are manufactured typ+ ically from polyvinylchloride but may be constructed from any other suitable material, for example, stainless steel, carbon steel or polypropylene. They may be installed easily into both existing and new pipelines.

A more detailed embodiment is shown in figure 4. Parts corresponding to those shown in figures 1 to 3 are indicated by the same reference numerals increased by 100 and are not further described except insofar as they differ from their counterparts of figures 1 to 3.

The housing 101 is in the form of a cylindrical conduit with a side port into which is fitted an annular inlet collar 110 which forms the second inlet 103. The outlet 104 is similarly fitted with an annular collar 111 which is selected to be of a certain size to enable connection of the mixing device to the outlet pipework (not shown). The collar is sealed to the housing 101 by means of an O-ring 112 and retaining ring 113.

The removeable mixing tee 105 is manufactured in this embodiment from a single piece of material so that the dispersion ring 107 is integral with the conduit 106. The end of the conduit 106 opposite the dispersion ring 107 is externally threaded so as to receive a non-return pressure operated valve 114. This valve 114 ensures that the polymer solution is only injected into the mixing device when it is at a certain predetermined pressure. The arrangement prevents the polymer being sucked into the first inlet 102 by virtue of the vacuum created in the outlet 104 during the mixing process.

In an alternative embodiment (not shown) there may be provided two or more first inlets, conduits and central apertures to enable the mixing of two or more polymer solutions with the water.

In a further alternative embodiment (not shown) the apertures 9 in the dispersion ring 7 are inclined to the longitudinal axis of the conduit 6 and inlet 2, and the dispersion ring 7 is rotatably mounted on the conduit 6. In use when water passes through the T-junction conduit the dispersion ring 7 rotates about conduit 6 thereby creating a circular turbulence to provide improved mixing.

An embodiment of a rotating mixing tee is shown in figures 5 and 6. The dispersion ring 207 has a plurality of slots 215 machined into its surface that faces the inlet 202. Each slot 215 has a width substantially similar to the diameter of the peripheral apertures 209 and extends radially from a peripheral aperture 209 to the edge of the ring 207. Figure 6 shows the dispersion ring 207 rotatably mounted on the conduit 206 and axially retained between a shoulder 216 machined into the exterior surface of the conduit 206 and a nut 217 that is threaded on to the end of the conduit 206. In use the polymer solution is deflected by a baffle (not shown) placed in the inlet so as to impinge on the dispersion ring 207 at an angle that is non-coaxial with the peripheral apertures 209. The impact of the solution against edges of the slots 215 causes the ring 207 to rotate on the conduit 206 thereby creating conditions for improved mixing.

The quality of the mixing can be adjusted by careful designing of the size of the central and peripheral apertures, the spacing of the peripheral apertures from the central apertures and the number of peripheral apertures. By making the mixing tee removeable different sized tees can be used in the same housing to meeting the flow rate requirements.

The outlet of the mixing device may be connected to a pipe that has one or more right-angled elbows to encourage turbulent flow and further mixing.

Claims

1. A fluid mixing device comprising a housing having first and second inlets and an outlet, and a mixing element in said housing partially closing the outlet and having at least one primary aperture in a central portion thereof, the primary aperture being connected to said first inlet via a conduit within said housing, and a plurality of peripheral apertures which are in communication with said second inlet, wherein the mixing element is mounted on the conduit at or near one end thereof.

2. A fluid mixing device according to claim 1, wherein the conduit extends across the housing between the first inlet and outlet in a direction substantially perpendicular to the second inlet.

3. A fluid mixing device according to claim 1 or 2 in which the housing is T-shaped with the first inlet and outlet aligned and perpendicular to the second inlet.

4. A fluid mixing device according to any preceding claim in which there is a clearance between the conduit and the housing via which fluid from said second inlet flows through to the peripheral apertures.

5. A fluid mixing device according to any preceding claim which there are a plurality of first inlets connected to a plurality of primary apertures in the central portion.

6. A fluid mixing device according to any preceding claim in which the peripheral apertures are equi-angulary spaced around the mixing element.

7. A fluid mixing device according to any preceding claim in which the mixing element is disc shaped and the central aperture receives a terminal portion of the conduit.

8. A fluid mixing device according to any preceding claim in which the peripheral apertures are each radially spaced from the primary aperture by substantially the same distance.

9. A fluid mixing device according to any preceding claim wherein the mixing element is rotatably mounted on said conduit.

10. A fluid mixing device according to claim 9, wherein the peripheral apertures have their axis inclined to a longitudinal axis of the first inlet.

11. A fluid mixing device according to any preceding claims wherein the mixing element and conduit are removable.

12. A fluid mixing device substantially as hereinbefore described with reference to the accompanying drawings.

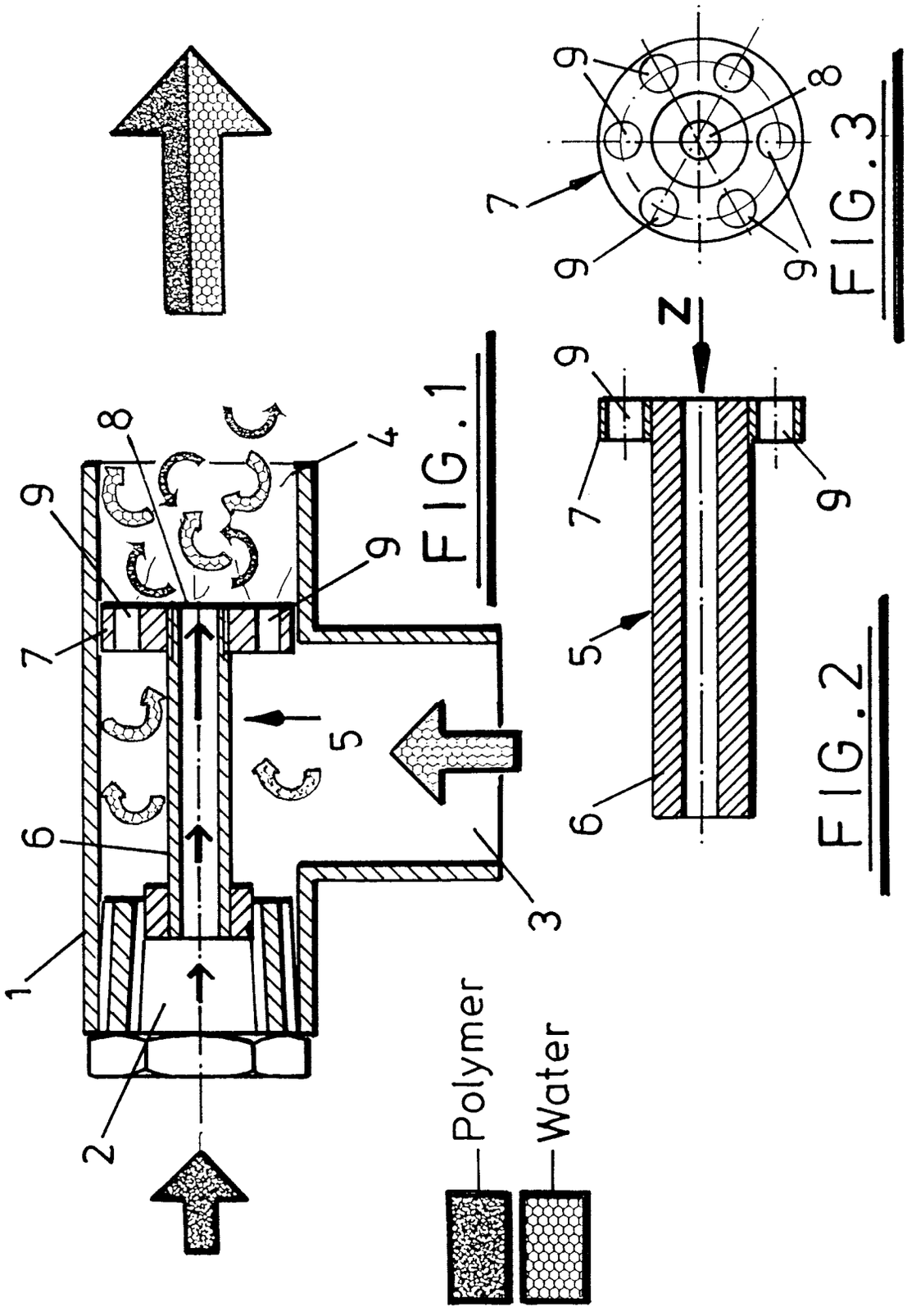

FIG.1

FIG.2

FIG.3

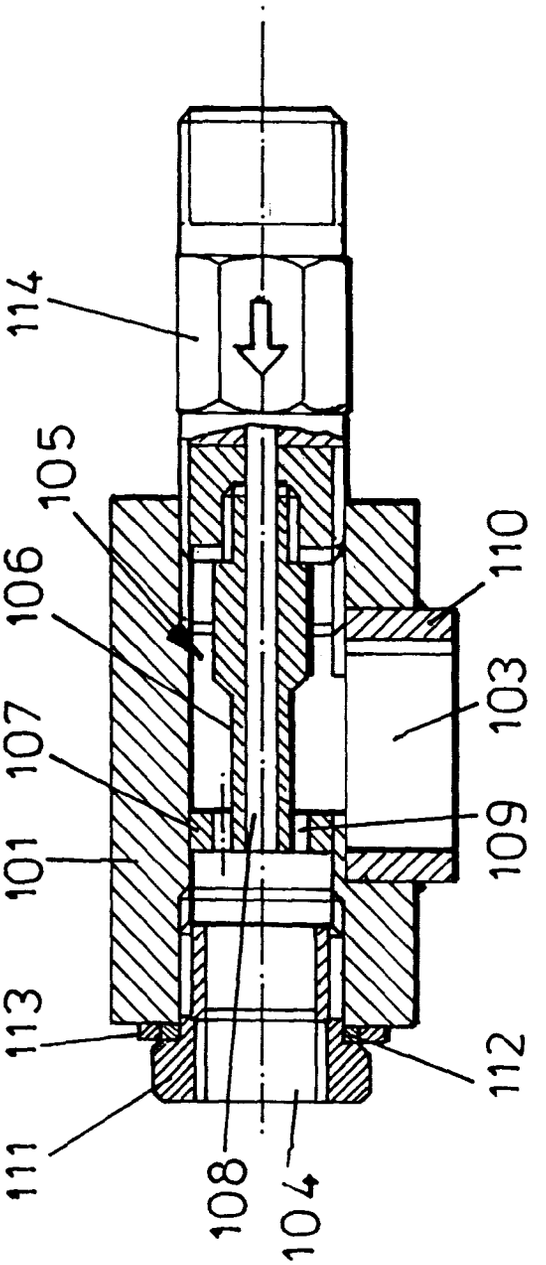

FIG. 4

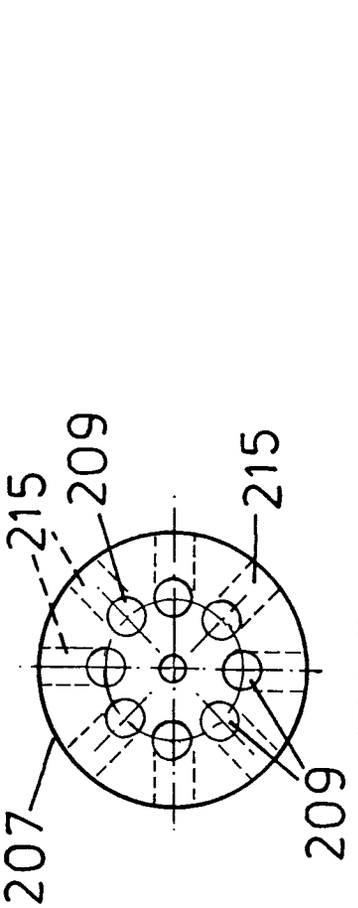

FIG. 5

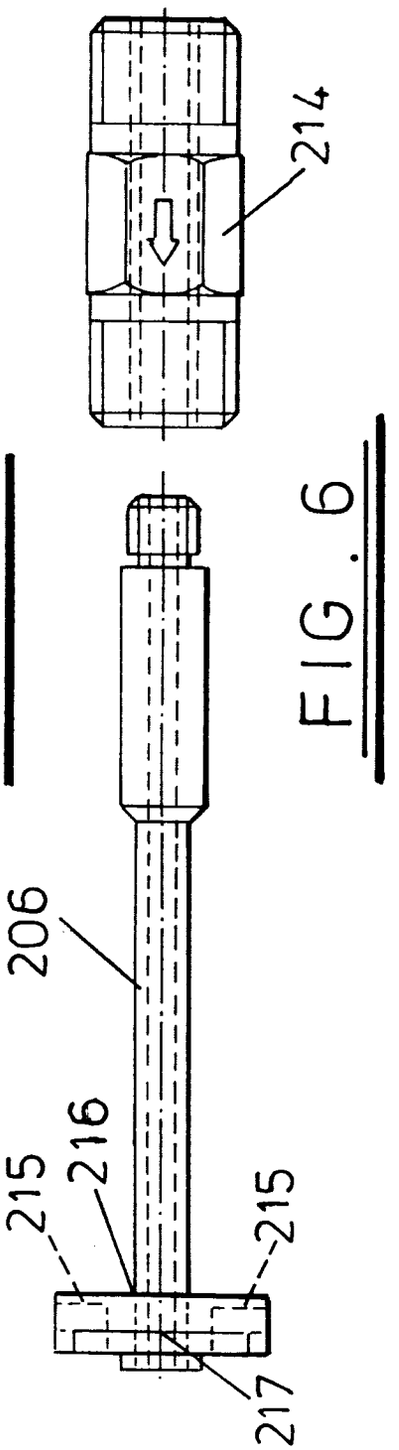

FIG. 6

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PARTIAL EUROPEAN SEARCH REPORT

which under Rule 45 of the European Patent Convention shall be considered, for the purposes of subsequent proceedings, as the European search report

Application Number EP 98 30 4498

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 3 680 781 A (LINCOLN ROLAND L) 1 August 1972 * figure 2 *	1-4,6-8	B01F5/04 B01F7/10
X	US 3 770 208 A (MUELLER G) 6 November 1973 * figure *	1-4,7,8	
X	EP 0 580 547 A (HILTI AG) 26 January 1994 * figure 2 *	1,2,7,8	
X	CH 652 046 A (COCA COLA CO) 31 October 1985 * claims 1-3; figure *	1,2,4, 6-8,10	
X	FR 2 201 121 A (JARRIN ANDRE) 26 April 1974 * figure 3 *	1,2,4, 6-8,10	
X	US 2 252 076 A (JUTERBOCK EDWIN) 12 August 1941 * figure 1 *	1,4,6-8	
	-/--		TECHNICAL FIELDS SEARCHED (Int.Cl.6) B01F

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims.

Claims searched completely :

1-11

Claims searched incompletely :

Claims not searched :

12

Reason for the limitation of the search:

Only claims 1-11 paid

Place of search	Date of completion of the search	Examiner
MUNICH	23 July 1998	Kanoldt, W

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C07)

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PARTIAL EUROPEAN SEARCH REPORT

Application Number
EP 98 30 4498

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	US 5 388 906 A (RAO SUNDAR M) 14 February 1995 * abstract; figures 1-12 *	1-11	
A	GB 770 220 A (DUNLOP) * figures 1-4 *	9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

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