

Mixing device

The present invention relates to a mixing device according to the preamble of Claim 1.

It is known to moisten the air in greenhouses and the like. For this purpose, axial rotary blowers having a sleeved motor-driven air screw are suspended freely in the space and the swirling air flowing away out of one or more atomizing nozzles is acted upon with finely atomized water. The water pick-up by the air is, in this case, comparatively small, which requires a correspondingly large water supply (pump power, drive energy). Connected with this there is a strong mist formation. In greenhouses, mist is not a disadvantage, above all if a misty atmosphere is to be set up in the region of the plants during a specific time span.

In air-conditioning plants, on the other hand, the supply air and discharge air is guided to and from the consumer in pipes. For moistening the supply air, this is, for example, guided through an air-washer, which has a rectifier, one or more nozzle stocks with spray nozzles and a water separator one after the other in the flow direction. Assigned to the water separator are a collecting pond, a circulating pump with pipework and, if necessary, a water filter. The rectifier has the purpose of bringing the air to be moistened into a uniform, approximately laminar flow, so that a rectified airstream may be acted on with atomized water in the region of the nozzle stock. Because of the comparatively small water pick-up by such a low-turbulence airstream, the collecting pond, the circulating pump and the number of spray nozzles are to be dimensioned correspondingly large, which produces a large energy expenditure for the circulating pump.

The present invention therefore has the object of indicating a solution with which a first fluid can be mixed with a second in a flow channel at low energy expenditure.

Here, fluids can be liquids and gases and liquid or solid suspended materials, on their own or in

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conjunction with a gaseous medium.

The abovementioned object is achieved by means of the characterizing features of Claim 1.

The invention is explained by way of example, using the attached schematic drawing, in which:

- Fig. 1 shows a longitudinal section through a mixing apparatus,
Fig. 2 shows a view of a guiding device installed in Fig. 1,
Fig. 3 shows an enlarged section from the guiding device according to Fig. 2,
Fig. 4 shows a second exemplary embodiment of a guiding device,
Fig. 5 shows a second exemplary embodiment of a mixing apparatus and
Fig. 6 shows a third exemplary embodiment of a guiding device.

Fig. 1 shows a section of a flow channel 1, as it is used in a supply air channel for an air-conditioning plant. The air 2, which represents a first fluid, guided through the flow channel, is brought to the desired moisture content in a mixer 3, as described later. The mixer 3 essentially has a channel section 4, a guiding device 5 and misting nozzles 6 for water, which are fed via a conduit 7 with water under pressure or with water and compressed air. The conduit 7 is a supply conduit for a second fluid, whose opening(s) is or are formed by the nozzles 6, the emerging water mist representing the second medium to be fed to the first fluid. The guiding device 5 extends over the clear cross-section 8 of the channel section 4 and has webs 9, which limit apertures 10. By means of the apertures 10, the cross-section 8 of the channel section 4 is subdivided into a plurality of cross-section regions 12, 13, or the supply airstream 2 entering into the channel section 4 is divided into a bundle of partial flows 11 approximately parallel to the flow direction. A nozzle 6 is allocated to each of the partial flows 11, oriented axially to the flow direction, so that the





water mist enters axially into the associated partial flow 11. If each nozzle opening is additionally directed towards an impact surface, the water mist is deflected on the latter, around and radially into the partial flow 11 of the medium. It is, however, not necessary to allocate a nozzle 6 to each aperture 10. The nozzles 6 can be arranged or can be present with respect to the partial flows in any desired direction, in any desired position and number.

10 The guiding device 5 (Fig. 2 and 3), formed from a sheet metal plate, has an edge 14, with which it is flanged onto the channel section 4, so that the inner delimiting line 15 of the edge 14 is close to the inner wall of the channel section 4. The webs 9, 15 extending from edge to edge, form the rectangular apertures 10, which can also be round or oval, in which guide vanes 16 are arranged which impart a spin to the partial flow 11 generated by means of the webs 9 and induce turbulence therein. The guide vanes 16 can be 20 inserted into the apertures 10 or can be cut out from the sheet metal plate and thus be manufactured integrally with it. In the case of integral production of the guiding device 5, after cutting out the vane contour, the guide vanes 16 are rotated about their 25 radial axis into a position corresponding to the desired air deflection, in conjunction with a permanent deformation. In the middle of the apertures 10, the guide vanes 16 are connected to each other by means of an annular web 17, which forms a fixing or an 30 attachment support for a nozzle 6. By this means, all the nozzles 6 can be fastened directly on the guiding device 5, by which means the nozzle stocks necessary in known air-washers are dispensed with. Instead of the static guide vanes 16, freely rotatably mounted air 35 screw blades can also be present in the apertures 10, the blades being rotated by the partial flow flowing through and inducing turbulence in this. The guide device 5 can, if desired, also be smaller than the clear cross-section 8 of the channel section 4. In this

case, its edge 14 is fastened on the channel section 4 by means of a radial support.

The guiding device according to Fig. 4 is, in principle, constructed in the same way as that according to Figs. 2 and 3, with the differences that it is manufactured from a perforated metal sheet and, adjacent to the internal delimiting line 15 of the edge 14 to be flanged onto the channel section 4, has a coherent perforated edge zone 18 which surrounds a core 19. The perforated edge zone 18 generates a partial flow 11 in the form of a laminar sheathing flow in the corresponding cross-section region 12 (in Fig. 1) of the channel section 4. Furthermore, in the edge zone 18, no nozzles or other openings for supplying a second medium are directed into the sheathing flow generated by the edge zone 18. Thus, with this guiding device 5, the clear cross-section 8, of the channel section 4, outlined by the delimiting line 15 is specifically likewise subdivided into cross-section regions 12, 13, of which the outer (12) generate a sheathing flow and the inner (13) a core flow. The difference from the first example thus lies in the fact that the edge zone 18 has means for generating a laminar flow and no means for the supply of a second fluid. Only the apertures 10 formed by the webs 9 in the core 19 of the guiding device 15 are provided with guide vanes 16 and with an annular web 19 as nozzle fixing, which impart to the passing partial flows in the cross-section regions 13 (Fig. 1) of the channel section 4 respectively a spin or a turbulent flow. In using this guiding device 5, a laminar sheathing flow is produced in the channel section 4, surrounding a core flow which is formed by a bundle of parallel, swirled partial flows 11. This guiding device 5 produces the advantage that a high moisture content can be built up in the core flow in the channel section 4, the content being shielded from the wall of the channel section 4 by the dry laminar sheathing flow. By this means, wetting of the channel walls is largely prevented.



In the guiding device 5 according to Fig. 4, the guide vanes 16 and/or the webs 9 can also be unperforated, as in the example according to Fig. 4. Furthermore, it is possible to use a permeable surface structure having the structure of a mesh or a fabric instead of perforated metal sheet in the edge zone 18 for generating a laminar sheathing flow.

In the described exemplary embodiments, there is the possibility of varying the profile of the flow velocity of the airstream in the channel section 4, by adjusting the setting angle of the guide vanes 16 in the various apertures 10 differently.

In an air-conditioning plant, if a second airstream as second fluid are [sic] to be mixed (Fig. 5) with a first airstream 2 as first fluid, before an air-washer 20 or a heating or cooling device, it is expedient to place a mixing apparatus upstream of the moisturizing, heating or cooling device 20, a fresh-air channel 7' being guided laterally into the channel section 4 after the guiding device 5, instead of the conduit 7 and the nozzles 6. The action of this mixer is particularly effective if a guiding device 5 is also installed at the opening 6'.

In the exemplary embodiment according to Fig. 6, the guiding device 5 has a nozzle stock 21 known per se having a horizontal pressurized-water pipe 22 fastened on the channel section 4, from which pipe nozzle pipes 23 branch off vertically upwards. The spray nozzles 6 for the addition of water as second fluid are arranged on the nozzle pipes 6 at regular spacings. The guide vanes 16, which limit or cover a square or (as shown left in Figure 6) a round cross-section region, seen in the flow direction, are mounted axially on the nozzles.

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Patent claims

1. Mixing apparatus for mixing a first fluid with a second, having a channel section (4) of a flow channel (1) for the first medium, before which in the flow direction a guiding device (5) is arranged for influencing the flow character of the first fluid in the channel section (4), the opening (6, 6') of at least one supply conduit (7, 7') for the second fluid being directed into the channel section (4), characterized in that the guiding device (5) has at least one means (16) to induce turbulence in the first fluid along the channel section (4) in at least one cross-section region (12, 13) of the channel section (4).
2. Mixing apparatus according to Claim 1, characterized in that the openings (6, 6') are directed radially and/or axially in this cross-section region and are preferably formed by spray nozzles (6).
3. Mixing apparatus according to Claim 1 or 2, characterized in that the channel section (4) is essentially straight after the guiding device (5).
4. Mixing apparatus according to Claim 1, characterized in that the guiding device (5) subdivides the cross-section (8) of the channel section (4) into a plurality of cross-section regions (12, 13) and in that the guiding device (5) has means (16) for generating turbulent flow allocated to at least part of the cross-section regions (12, 13).
5. Mixing apparatus according to Claim 4, characterized in that the guiding device (5) has an edge zone (18) and a core (19) which subdivide the cross-section regions (12, 13) of the channel section (4) into an edge region and a core region (12 and 13) and in that the guiding device (5) has, in the region of the edge zone (18), second means to induce laminar flow in the first fluid flowing through the edge zone (18) and in that the first-mentioned means (16) of the guiding device (5) for generating turbulent flow are arranged in the core (19).

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6. Mixing apparatus according to Claim 5, characterized in that the guiding device (5) subdivides the core region of the cross-section (8) of the channel section (4) into a plurality of cross-section regions (13) and is provided, in the core (19), for each cross-section region (13), with the means (16) for generating turbulent flow in the first fluid.

7. Guiding device for mixing a gaseous fluid with a second, especially for a mixing apparatus according to one of Claims 1 to 6, which guiding device (5) can be attached to a flow channel section (4) for the first fluid, characterized in that the guiding device (5), in the installed state, subdivides the flow cross-section (8) of the channel section (4), which is oriented transversely to its axis of flow, into a plurality of cross-section regions (12, 13) and forms a bundle of partial flows parallel to the flow direction and, for at least one of these cross-section areas (13), has first means (16) for generating turbulent flow extending in the longitudinal direction of the channel section (4).

8. Guiding device according to Claim 7, characterized in that the guiding device (5) has second means (18) to generate laminar flow in one of the cross-section regions (12, 13), preferably in the edge zone (18).

9. Guiding device according to either of Claims 7 and 8, characterized in that the guiding device (5) has web-like elements (9) which subdivide at least part of the flow cross-section (8) of an adjacent channel section (4) into a plurality of cross-section regions (12, 13).

10. Guiding device according to one of Claims 7 to 8, characterized in that the first means have moving or non-moving guiding surfaces.

11. Guiding device according to Claim 10, characterized in that the movable guiding surfaces have freely rotatably supported air screw blades whose axis



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[sic] of rotation are arranged parallel to the flow axis of the guiding device (5).

12. Guiding device according to one of Claims 7 to 11, characterized in that the guiding device (5) has a body which can be installed transversely in a channel section (4) for a first fluid and extends radially with respect to its flow axis, in that this body forms a plurality of apertures (10), parallel to the flow axis, for the passage of the first fluid and in that [lacuna] has, in at least one of the apertures (10), guiding surfaces (16) for generating turbulence in the first liquid flowing through.

13. Guiding device according to Claim 12, characterized in that the guiding surfaces (16) are formed by guide vanes connected to the body in a fixed manner.

14. Guiding device according to one of Claims 7 to 13, characterized in that the body is [lacuna] plate having one or more apertures (10), preferably a plate of sheet metal, which forms the web-like element (9).

15. Guiding device according to Claim 14, characterized in that the guide vanes (16) are manufactured integrally with the plate.

16. Guiding device according to Claim 14 or 15, characterized in that the plate is perforated in the style of a perforated metal sheet (Fig. 4), whose perforations form, in the edge zone (18), the second means for generating laminar flow.

17. Guiding device according to one of Claims 14 to 16, characterized in that the guide vanes (16) in the apertures (10) are joined at their mutually facing ends by an annular element (17) formed integrally with them, the element (17) forming an attachment support for a nozzle (6).

18. Guiding device according to one of Claims 8 to 13, characterized in that the second means have a surface structure extending over the associated cross-section region (12) and having the structure of a perforated metal sheet, a fabric or a mesh.



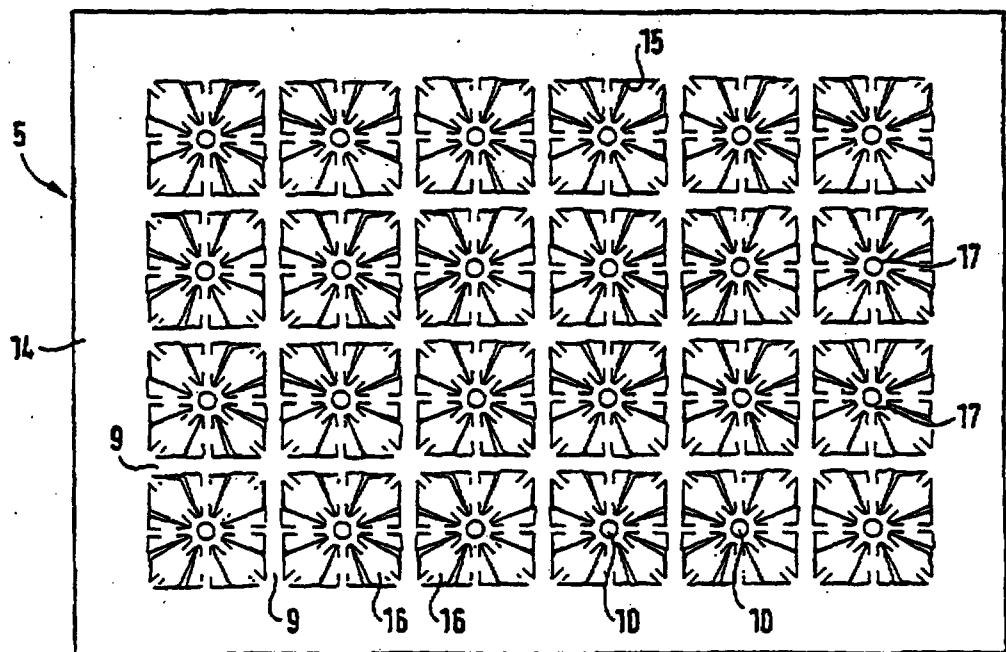
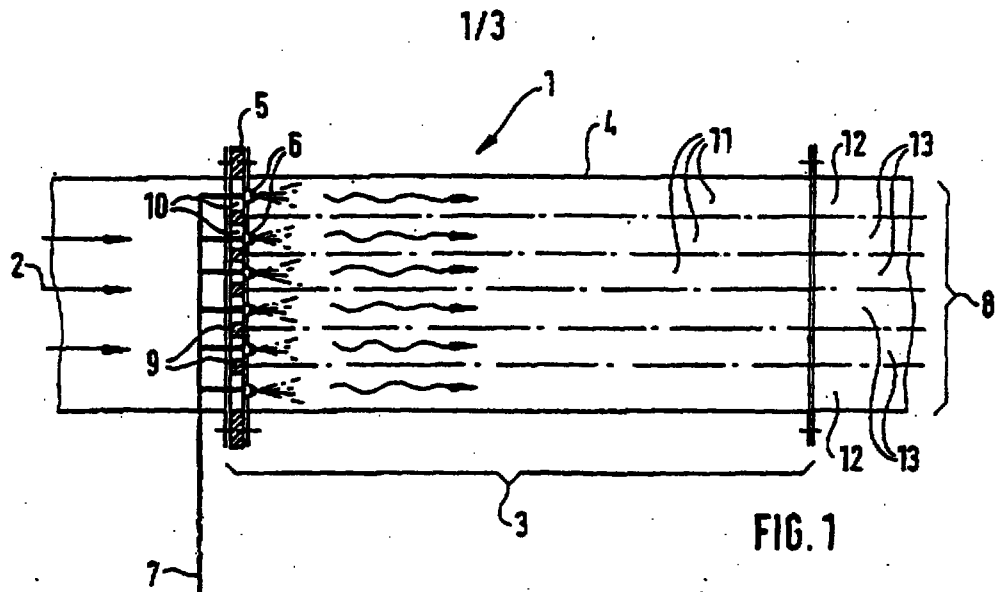
19. Guiding device according to one of Claims 7 to 13, or 18, characterized by one or more pressurized-water pipes (22, 23) equipped with nozzles (6), on which nozzles (6) the guide vanes (16) are fitted, in a fixed manner or freely rotatably supported.



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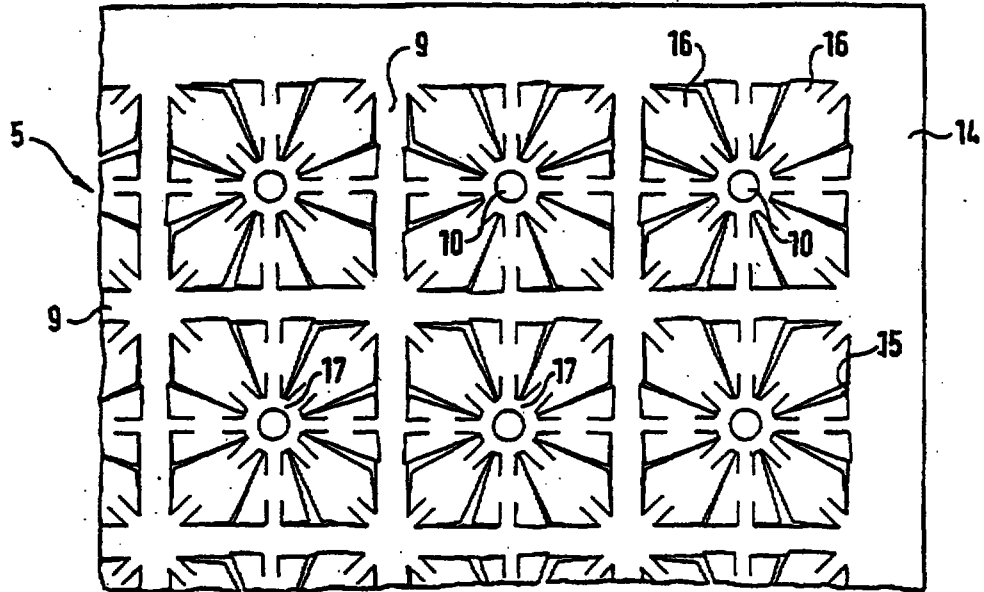


FIG. 3

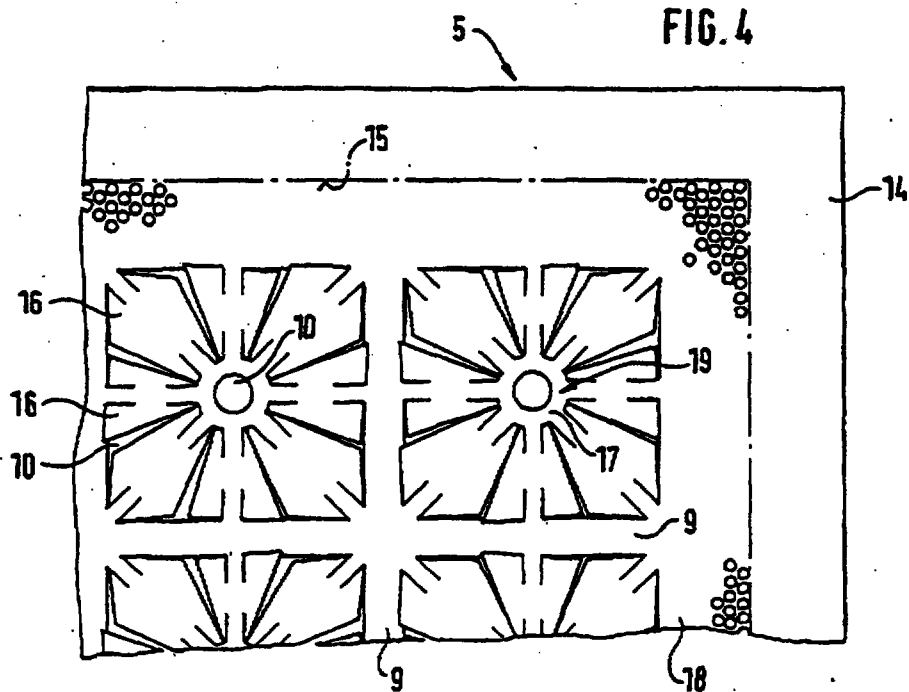


FIG. 4

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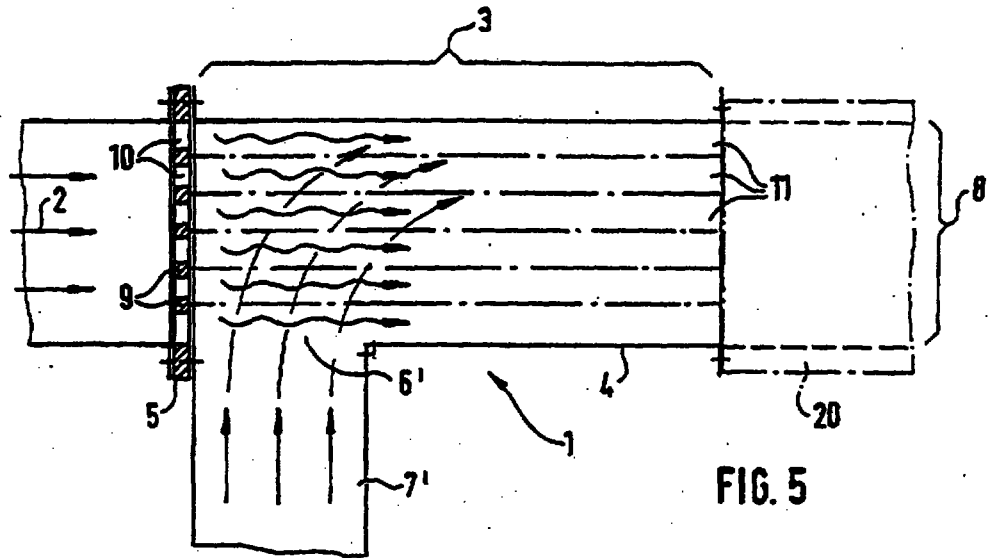
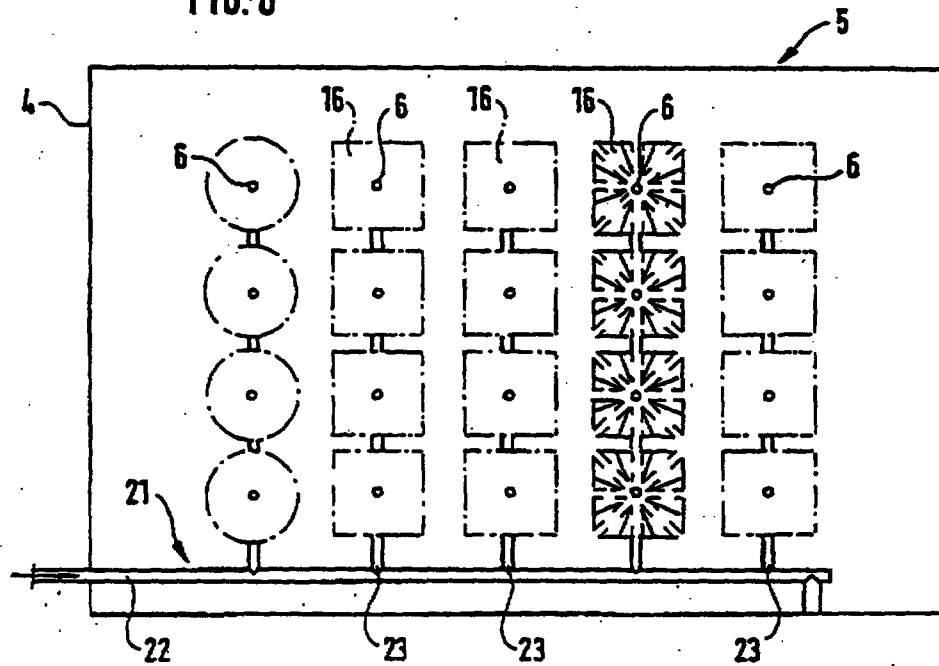


FIG. 6



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Mixing device

The present invention relates to a mixing device according to the preamble of Claim 1.

It is known to moisten the air in greenhouses and the like. For this purpose, axial rotary blowers having a sleeved motor-driven air screw are suspended freely in the space and the swirling air flowing away out of one or more atomizing nozzles is acted upon with finely atomized water. The water pick-up by the air is, in this case, comparatively small, which requires a correspondingly large water supply (pump power, drive energy). Connected with this there is a strong mist formation. In greenhouses, mist is not a disadvantage, above all if a misty atmosphere is to be set up in the region of the plants during a specific time span.

In air-conditioning plants, on the other hand, the supply air and discharge air is guided to and from the consumer in pipes. For moistening the supply air, this is, for example, guided through an air-washer, which has a rectifier, one or more nozzle stocks with spray nozzles and a water separator one after the other in the flow direction. Assigned to the water separator are a collecting pond, a circulating pump with pipework and, if necessary, a water filter. The rectifier has the purpose of bringing the air to be moistened into a uniform, approximately laminar flow, so that a rectified airstream may be acted on with atomized water in the region of the nozzle stock. Because of the comparatively small water pick-up by such a low-turbulence airstream, the collecting pond, the circulating pump and the number of spray nozzles are to be dimensioned correspondingly large, which produces a large energy expenditure for the circulating pump.

The present invention therefore has the object of indicating a solution with which a first fluid can be mixed with a second in a flow channel at low energy expenditure.

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Here, fluids can be liquids and gases and liquid or solid suspended materials, on their own or in conjunction with a gaseous medium.

The abovementioned object is achieved by means
5 of the characterizing features of Claim 1.

The invention is explained by way of example, using the attached schematic drawing, in which:

Fig. 1 shows a longitudinal section through a mixing
apparatus,

10 Fig. 2 shows a view of a guiding device installed in Fig. 1,

Fig. 3 shows an enlarged section from the guiding device according to Fig. 2,

Fig. 4 shows a second exemplary embodiment of a
15 guiding device,

Fig. 5 shows a second exemplary embodiment of a mixing apparatus and

Fig. 6 shows a third exemplary embodiment of a guiding device.

20 Fig. 1 shows a section of a flow channel 1, as it is used in a supply air channel for an air-conditioning plant. The air 2, which represents a first fluid, guided through the flow channel, is brought to the desired moisture content in a mixer 3, as described
25 later. The mixer 3 essentially has a channel section 4, a guiding device 5 and misting nozzles 6 for water, which are fed via a conduit 7 with water under pressure or with water and compressed air. The conduit 7 is a supply conduit for a second fluid, whose opening(s) is
30 or are formed by the nozzles 6, the emerging water mist representing the second medium to be fed to the first fluid. The guiding device 5 extends over the clear cross-section 8 of the channel section 4 and has webs 9, which limit apertures 10. By means of the apertures
35 10, the cross-section 8 of the channel section 4 is subdivided into a plurality of cross-section regions 12, 13, or the supply airstream 2 entering into the channel section 4 is divided into a bundle of partial flows 11 approximately parallel to the flow direction.



A nozzle 6 is allocated to each of the partial flows 11, oriented axially to the flow direction, so that the water mist enters axially into the associated partial flow 11. If each nozzle opening is additionally
5 directed towards an impact surface, the water mist is deflected on the latter, around and radially into the partial flow 11 of the medium. It is, however, not necessary to allocate a nozzle 6 to each aperture 10. The nozzles 6 can be arranged or can be present with
10 respect to the partial flows in any desired direction, in any desired position and number.

The guiding device 5 (Fig. 2 and 3), formed from a sheet metal plate, has an edge 14, with which it is flanged onto the channel section 4, so that the
15 inner delimiting line 15 of the edge 14 is close to the inner wall of the channel section 4. The webs 9, extending from edge to edge, form the rectangular apertures 10, which can also be round or oval, in which guide vanes 16 are arranged which impart a spin to the
20 partial flow 11 generated by means of the webs 9 and induce turbulence therein. The guide vanes 16 can be inserted into the apertures 10 or can be cut out from the sheet metal plate and thus be manufactured integrally with it. In the case of integral production
25 of the guiding device 5, after cutting out the vane contour, the guide vanes 16 are rotated about their radial axis into a position corresponding to the desired air deflection, in conjunction with a permanent deformation. In the middle of the apertures 10, the
30 guide vanes 16 are connected to each other by means of an annular web 17, which forms a fixing or an attachment support for a nozzle 6. By this means, all the nozzles 6 can be fastened directly on the guiding device 5, by which means the nozzle stocks necessary in
35 known air-washers are dispensed with. Instead of the static guide vanes 16, freely rotatably mounted air screw blades can also be present in the apertures 10, the blades being rotated by the partial flow flowing through and inducing turbulence in this. The guide



device 5 can, if desired, also be smaller than the clear cross-section 8 of the channel section 4. In this case, its edge 14 is fastened on the channel section 4 by means of a radial support.

5 The guiding device according to Fig. 4 is, in principle, constructed in the same way as that according to Figs. 2 and 3, with the differences that it is manufactured from a perforated metal sheet and, adjacent to the internal delimiting line 15 of the edge
10 14 to be flanged onto the channel section 4, has a coherent perforated edge zone 18 which surrounds a core 19. The perforated edge zone 18 generates a partial flow 11 in the form of a laminar sheathing flow in the corresponding cross-section region 12 (in Fig. 1) of
15 the channel section 4. Furthermore, in the edge zone 18, no nozzles or other openings for supplying a second medium are directed into the sheathing flow generated by the edge zone 18. Thus, with this guiding device 5, the clear cross-section 8, of the channel section 4,
20 outlined by the delimiting line 15 is specifically likewise subdivided into cross-section regions 12, 13, of which the outer (12) generate a sheathing flow and the inner (13) a core flow. The difference from the first example thus lies in the fact that the edge zone
25 18 has means for generating a laminar flow and no means for the supply of a second fluid. Only the apertures 10 formed by the webs 9 in the core 19 of the guiding device 15 are provided with guide vanes 16 and with an annular web 19 as nozzle fixing, which impart to the
30 passing partial flows in the cross-section regions 13 (Fig. 1) of the channel section 4 respectively a spin or a turbulent flow. In using this guiding device 5, a laminar sheathing flow is produced in the channel section 4, surrounding a core flow which is formed by a
35 bundle of parallel, swirled partial flows 11. This guiding device 5 produces the advantage that a high moisture content can be built up in the core flow in the channel section 4, the content being shielded from the wall of the channel section 4 by the dry laminar



sheathing flow. By this means, wetting of the channel walls is largely prevented.

In the guiding device 5 according to Fig. 4, the guide vanes 16 and/or the webs 9 can also be unperforated, as in the example according to Fig. 4. Furthermore, it is possible to use a permeable surface structure having the structure of a mesh or a fabric instead of perforated metal sheet in the edge zone 18 for generating a laminar sheathing flow.

In the described exemplary embodiments, there is the possibility of varying the profile of the flow velocity of the airstream in the channel section 4, by adjusting the setting angle of the guide vanes 16 in the various apertures 10 differently.

In an air-conditioning plant, if a second airstream as second fluid are [sic] to be mixed (Fig. 5) with a first airstream 2 as first fluid, before an air-washer 20 or a heating or cooling device, it is expedient to place a mixing apparatus upstream of the moisturizing, heating or cooling device 20, a fresh-air channel 7' being guided laterally into the channel section 4 after the guiding device 5, instead of the conduit 7 and the nozzles 6. The action of this mixer is particularly effective if a guiding device 5 is also installed at the opening 6'.

In the exemplary embodiment according to Fig. 6, the guiding device 5 has a nozzle stock 21 known per se having a horizontal pressurized-water pipe 22 fastened on the channel section 4, from which pipe nozzle pipes 23 branch off vertically upwards. The spray nozzles 6 for the addition of water as second fluid are arranged on the nozzle pipes 6 at regular spacings. The guide vanes 16, which limit or cover a square or (as shown left in Figure 6) a round cross-section region, seen in the flow direction, are mounted axially on the nozzles.





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Patent claims

1. Mixing apparatus for mixing a first fluid with a second, having a channel section (4) of a flow channel (1) for the first medium, before which in the flow direction a guiding device (5) is arranged for influencing the flow character of the first fluid in the channel section (4), the opening (6, 6') of at least one supply conduit (7, 7') for the second fluid being directed into the channel section (4), characterized in that the guiding device (5) has at least one means (16) to induce turbulence in the first fluid along the channel section (4) in at least one cross-section region (12, 13) of the channel section (4).
2. Mixing apparatus according to Claim 1, characterized in that the openings (6, 6') are directed radially and/or axially in this cross-section region and are preferably formed by spray nozzles (6).
3. Mixing apparatus according to Claim 1 or 2, characterized in that the channel section (4) is essentially straight after the guiding device (5).
4. Mixing apparatus according to Claim 1, characterized in that the guiding device (5) subdivides the cross-section (8) of the channel section (4) into a plurality of cross-section regions (12, 13) and in that the guiding device (5) has means (16) for generating turbulent flow allocated to at least part of the cross-section regions (12, 13).
5. Mixing apparatus according to Claim 4, characterized in that the guiding device (5) has an edge zone (18) and a core (19) which subdivide the cross-section regions (12, 13) of the channel section (4) into an edge region and a core region (12 and 13) and in that the guiding device (5) has, in the region of the edge zone (18), second means to induce laminar flow in the first fluid flowing through the edge zone (18) and in that the first-mentioned means (16) of the guiding device (5) for generating turbulent flow are arranged in the core (19).



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6. Mixing apparatus according to Claim 5, characterized in that the guiding device (5) subdivides the core region of the cross-section (8) of the channel section (4) into a plurality of cross-section regions (13) and is provided, in the core (19), for each cross-section region (13), with the means (16) for generating turbulent flow in the first fluid.

7. Guiding device for mixing a gaseous fluid with a second, especially for a mixing apparatus according to one of Claims 1 to 6, which guiding device (5) can be attached to a flow channel section (4) for the first fluid, characterized in that the guiding device (5), in the installed state, subdivides the flow cross-section (8) of the channel section (4), which is oriented transversely to its axis of flow, into a plurality of cross-section regions (12, 13) and forms a bundle of partial flows parallel to the flow direction and, for at least one of these cross-section areas (13), has first means (16) for generating turbulent flow extending in the longitudinal direction of the channel section (4).

8. Guiding device according to Claim 7, characterized in that the guiding device (5) has second means (18) to generate laminar flow in one of the cross-section regions (12, 13), preferably in the edge zone (18).

9. Guiding device according to either of Claims 7 and 8, characterized in that the guiding device (5) has web-like elements (9) which subdivide at least part of the flow cross-section (8) of an adjacent channel section (4) into a plurality of cross-section regions (12, 13).

10. Guiding device according to one of Claims 7 to 8, characterized in that the first means have moving or non-moving guiding surfaces.

11. Guiding device according to Claim 10, characterized in that the movable guiding surfaces have freely rotatably supported air screw blades whose axis



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[sic] of rotation are arranged parallel to the flow axis of the guiding device (5).

12. Guiding device according to one of Claims 7 to 11, characterized in that the guiding device (5) has a body which can be installed transversely in a channel section (4) for a first fluid and extends radially with respect to its flow axis, in that this body forms a plurality of apertures (10), parallel to the flow axis, for the passage of the first fluid and in that [lacuna] has, in at least one of the apertures (10), guiding surfaces (16) for generating turbulence in the first liquid flowing through.

13. Guiding device according to Claim 12, characterized in that the guiding surfaces (16) are formed by guide vanes connected to the body in a fixed manner.

14. Guiding device according to one of Claims 7 to 13, characterized in that the body is [lacuna] plate having one or more apertures (10), preferably a plate of sheet metal, which forms the web-like element (9).

15. Guiding device according to Claim 14, characterized in that the guide vanes (16) are manufactured integrally with the plate.

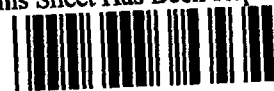
16. Guiding device according to Claim 14 or 15, characterized in that the plate is perforated in the style of a perforated metal sheet (Fig. 4), whose perforations form, in the edge zone (18), the second means for generating laminar flow.

17. Guiding device according to one of Claims 14 to 16, characterized in that the guide vanes (16) in the apertures (10) are joined at their mutually facing ends by an annular element (17) formed integrally with them, the element (17) forming an attachment support for a nozzle (6).

18. Guiding device according to one of Claims 8 to 13, characterized in that the second means have a surface structure extending over the associated cross-section region (12) and having the structure of a perforated metal sheet, a fabric or a mesh.



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19. Guiding device according to one of Claims 7 to 13, or 18, characterized by one or more pressurized-water pipes (22, 23) equipped with nozzles (6), on which nozzles (6) the guide vanes (16) are fitted, in a
5 fixed manner or freely rotatably supported.

MIXING DEVICE

Abstract

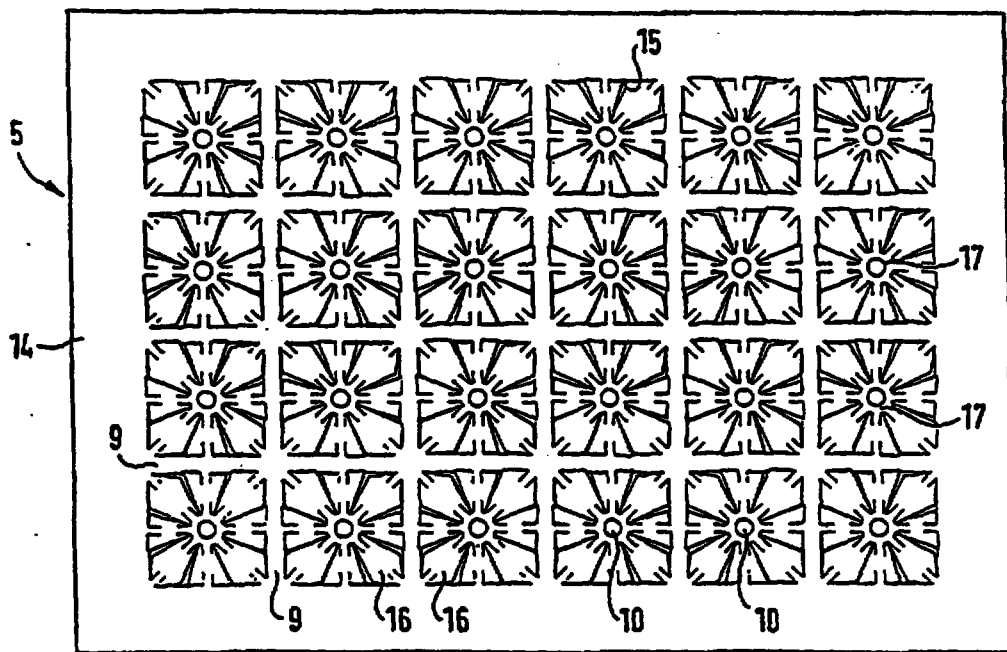
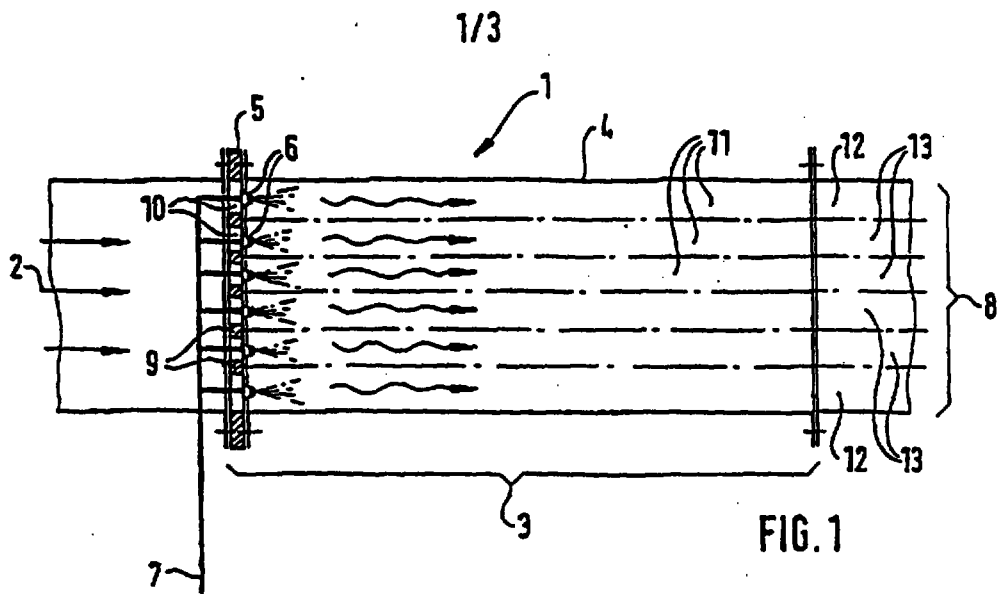
Mixing apparatus for mixing a first gaseous medium with a second, having a channel section of a flow channel for the first medium, before which in the flow direction a guiding device (5) is arranged for influencing the flow character of the first medium in the channel section. In this case, the opening of at least one supply conduit for the second medium is directed into the channel section. To improve the intermixing of both media it is provided that the guiding device (5) has at least one means (16) to induce turbulence in the first medium along the channel section (4) in at least one cross-section region (12, 13) of the channel section (4).

(Fig. 2)

This Sheet Has Been Replaced



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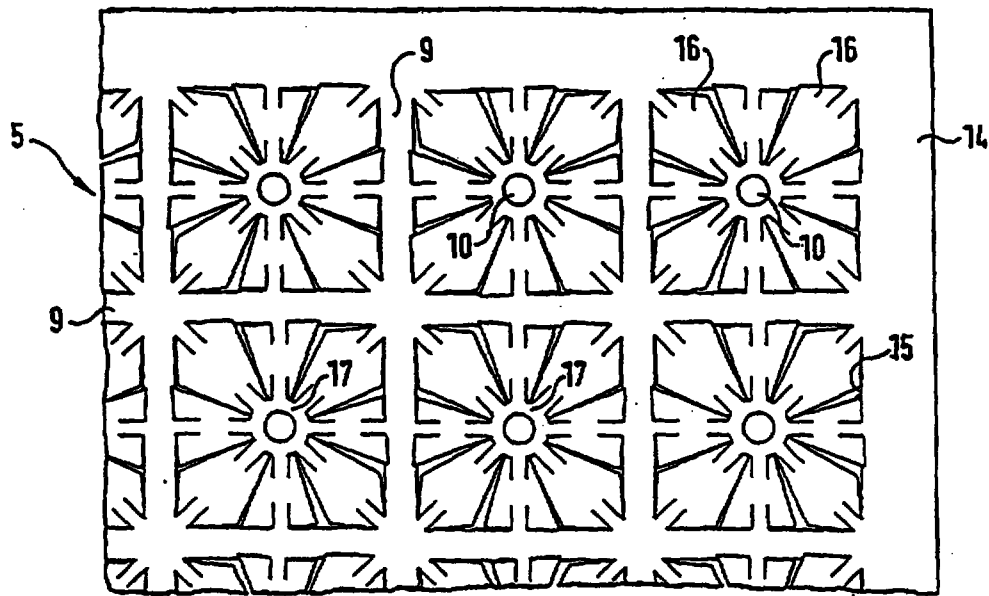
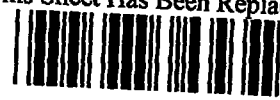


FIG. 3

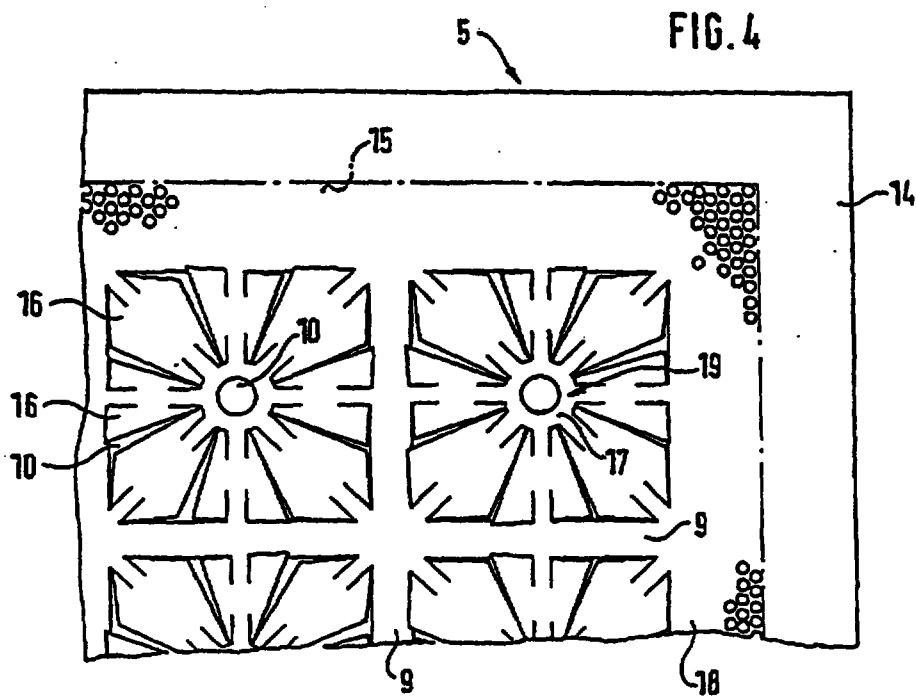


FIG. 4

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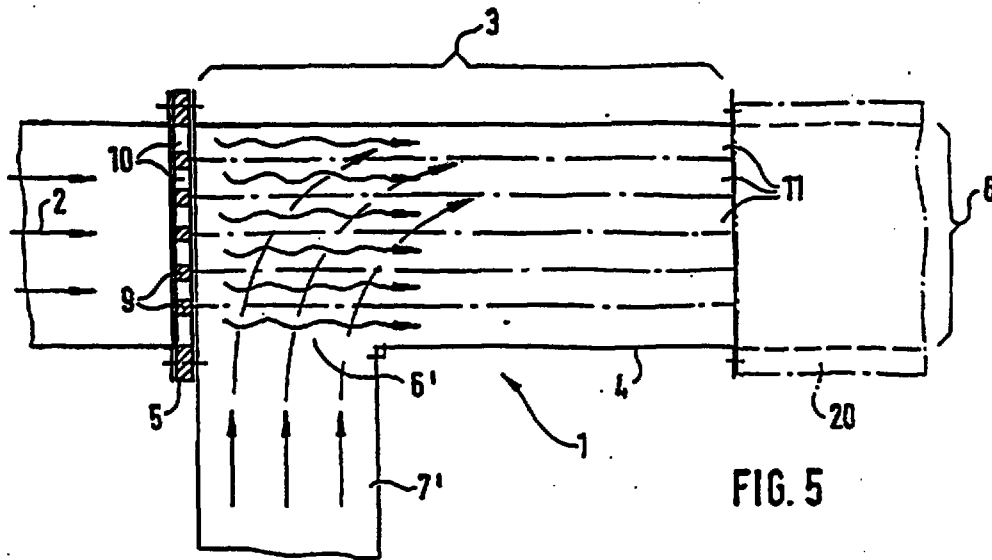
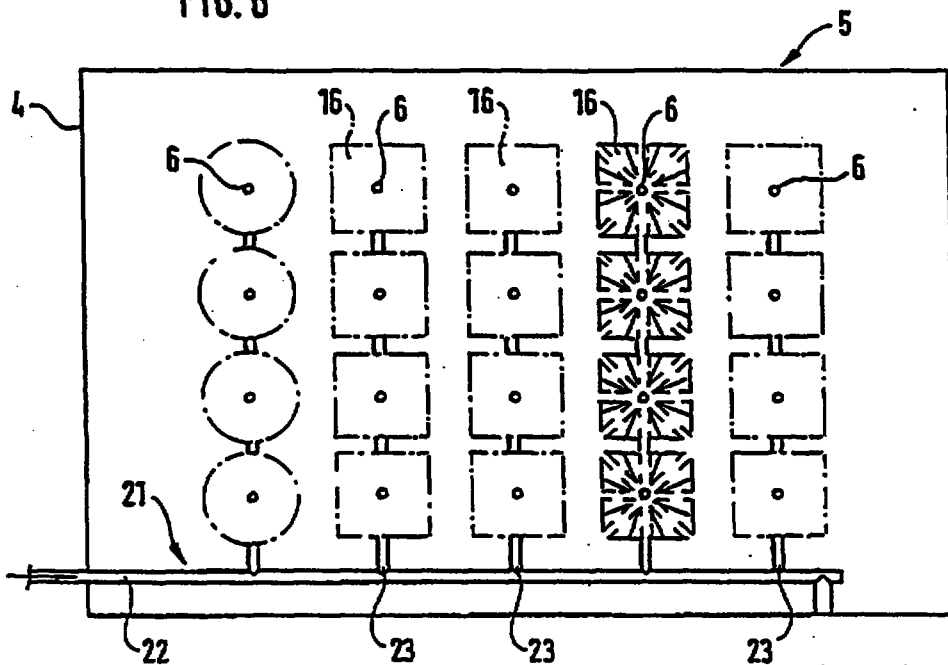


FIG. 5

FIG. 6



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MIXING DEVICE

The present invention relates to a mixing device or an air washer in accordance with the preamble to claim 1.

Known from document EP-A2-0 251 196 is an air washer which comprises a jet with which a fluid is sprayed into the air stream. In addition to and downstream of the jet, the air washer comprises in the direction of flow of the air stream a guiding apparatus which has on the outlet side which is substantially in the form of a paraboloid of revolution. The guiding apparatus has the following function and operates in the following manner: the inflowing air enters the guiding apparatus through a comparatively narrow cross-section which widens outwardly. According to the continuity condition, this means a deceleration of the air inside the guiding apparatus in which the liquid mist is disposed. As a result, the relative velocity between the throughflowing air and the emerging liquid is retained for still longer which is conducive particularly to the exchange and absorption of the liquid.

A disadvantage of this prior art air washer resides in the fact that liquids and solids become constantly deposited on the surface of the guiding apparatus resulting in the latter becoming dirty and micro-organisms accumulating. In addition to the highly undesirable accumulation of micro-organisms, the expense of constant cleaning is essential on grounds of hygiene, the air washer having to be shut down during cleaning, which results in operation being interrupted.

In greenhouses and the like, it is known to humidify the air. For this purpose, axial rotary blowers with a jacketed motor-driven impeller are freely suspended in the room and the emergent turbulent air is exposed to finely atomised water from one or a plurality of atomising jets. The absorption of water by the air is in this case comparatively small and requires a correspondingly large supply of water (pump delivery, driving energy). This also entails considerable mist formation. In greenhouses, this is above all no drawback if it is intended to maintain a misty atmosphere in the plant area for a certain period of time.

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☒	Claim(s)	: paged ... to paged ...
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In air conditioning systems on the other hand, the feed air and the waste air is carried to and away from the consumer unit through pipes. For the feed air to be humidified, it is passed for instance through an air washer which comprises serially in the direction of flow a rectifier, one or a plurality of jet assemblies with spray jets and a water separator. Associated with the water separator are a collecting tank, a recirculating pump with pipe lines and possibly a water filter. The purpose of the rectifier is to bring the air which is to be humidified into a uniform and approximately laminar flow so that in the region of the jet assembly a correctly directed or rectified stream of air can be exposed to atomised water. By reason of the comparatively low level of water absorption by such a turbulent air stream, the collecting tank, the recirculating pump and a number of spray jets have to be correspondingly large which means that the energy costs to run the recirculating pump are substantial.

Therefore, the present invention is based on the problem of indicating a solution by which a first fluid can be mixed with a second in a flow duct for minimal energy cost.

The fluid in this case will be liquids and gases as well as liquid or solid matter in suspension alone or in conjunction with a gaseous medium.

The aforementioned problem is resolved by the characterising features of claim 1.

The invention will be explained by way of example with reference to the accompanying diagrammatic drawings, in which:

- Fig. 1 is a longitudinal section through a mixing device or air washer;
- Fig. 2 is a view of a guiding apparatus installed in Fig. 1;
- Fig. 3 is an enlarged detail from the guiding apparatus in Fig. 2;
- Fig. 4 shows a second embodiment of guiding apparatus, and
- Fig. 5 shows a second embodiment of guiding apparatus.

Fig. 1 shows a detail from a flow duct 1 such as is used in a feed air duct for an air conditioning system. The air 2 guided through the flow duct and which represents a first fluid is, as described later, brought to the desired humidity content in a mixer or air washer 3. The mixer 3 has essentially one channel portion 4, a guiding apparatus 5 and nebulising jets 6 for water which are fed with pressurised water or with water and compressed air through a pipe 7. The pipe 7 is a feed pipe for a second fluid, its mouths being formed by the jets 6, the emerging water mist representing the second medium which is to be fed to the fluid. The guiding apparatus 5 extends over the clear cross-section 8 of the channel portion 4 and comprises webs 9 which define through-ways. The through-ways subdivided the cross-section 8 of the channel portion 4 into a plurality of cross-sectional zones 12, 13 or alternatively the stream 2 of feed air entering the channel portion 4 is subdivided into a bundle of partial streams 11 substantially parallel with the direction of flow. A jet 6 is associated with each of the partial streams 11 and is orientated axially in relation to the flow direction, so that the water mist enters the associated partial stream 11 axially. However, it is not necessary to associate one jet 6 with each aperture 10. The jets 6 can be disposed or provided in any direction, in any position and number with reference to the partial streams.

The guiding apparatus 5 (Figs. 2 and 3) formed from a sheet metal panel comprises an edge 14 by which it is flanged onto the channel portion 4 so that the inner boundary line 15 of the edge 14 is close to the inside wall of the channel portion 4. The webs 9 extending from edge to edge form the rectangular through-ways which may also be round or oval and in which are disposed guide blades 16 which impart a twist to the partial stream 11 generated by the webs 9, inducing turbulence in them. The guide blades 16 may be inserted into the apertures 10 or may be cut out of the sheet metal panel and therefore supplied integrally with it. In the case of one-piece production of the guiding apparatus 5, then after the blade contour has been cut out, the guide blades 16 are turned about their radial axis into a position corresponding to the desired air deflection so that a lasting deformation results. In the middle of the through-ways, the guide blades 16 are connected to one another by an annular web 17, which passes around an aperture 10 and forms a

firing or mounting bearing for a jet 6. Consequently, all jets 6 can be fixed directly on the guiding apparatus 5 so that it is possible to dispense with the jet assemblies needed on prior art air washers. If required, the guiding apparatus 5 can also be smaller than the inside cross-section 8 of the channel portion 4. In this case, its edge 14 is fixed to the channel portion 4 by a radial brace.

The guidance apparatus in Fig. 4 is in principle constructed in the same way as that in Figs. 2 and 3, the differences being that it is made from a perforated sheet and then has a cohesive perforated marginal zone 18 which engages around a core 19 on the edge 14 which is to be flanged onto the channel portion 4. The perforated marginal zone 18 generates in the corresponding cross-sectional area 12 (in Fig. 1) of the channel portion 4 a partial stream 11 in the form of a laminar flow. Furthermore, there are no jets or other mouths in the marginal zone 18 for supplying a second medium into the flow generated by the marginal zone 18. Consequently, with this guidance apparatus 5, the inside cross-section 8 of the channel portion 4 which is circumscribed by the boundary line 15 is indeed likewise sub-divided into cross-sectional zones 12, 13 of which the outer one (12) generates a by-pass flow while the inner (13) generates a core flow. The difference in respect of the first example therefore resides in the fact that the marginal zone 18 comprises means of generating a laminar flow and no means for feeding a second fluid. Only the through-ways formed in the core 19 of the guidance apparatus 5 by the webs 9 are provided with guide blades 16 and with an annular web 17 as a jet mounting which imparts a respective twist or turbulent flow to the passing partial flows entering the cross-sectional zones 13 (Fig. 1) of the channel portion 4. When the guiding apparatus 5 is in use, a laminar by-pass flow is created in the channel portion 4 and this encloses a core flow which is formed by a bundle of parallel and turbulent partial streams 11. This guidance apparatus 5 has the advantage that a high moisture content can be built up in the core flow in the channel portion 4 and this is screened from the wall of the channel portion 4 by the dry laminar by-pass flow. This substantially prevents the channel walls becoming wet.

In the case of the guiding apparatus 5 shown in Fig. 4, the guide blades 16 and/or the webs 8 may also be non-perforated as in the example shown in Fig. 4. Furthermore, it is possible in the marginal zone 18, for generating a laminar by-pass flow, instead of perforated sheet, to provide a permeable flat structure having a screen or woven structure.

In the case of examples of embodiment described, there is a possibility of changing the profile of the flow velocity of the air stream in the channel portion 4 by variously adjusting the angle of incidence of the guide blade 16 in the various through-ways.

In the case of the example of embodiment shown in Fig. 5, the guiding apparatus 5 comprises a per se known jet assembly 21 with a horizontal pressurised water pipe 22 fixed on the channel portion 4 and from which jet pipes 23 branch vertically upwardly. On the jet pipe 23, at regular intervals, there are spray jets 4 for supplying water as the second fluid. Mounted axially on these jets are the guide blades 16 which, viewed in the direction of flow, define or mask a rectangular or (as indicated on the left in Fig. 5), a circular cross-sectional area.



Patent claims

1. An air washer for humidifying air in air conditioning systems or the like, comprising a flow channel (1) with a channel portion (4) which establishes a direction of flow, a guiding apparatus (5) disposed to extend at right-angles to the channel portion (4) and with atomising jets (6) for supplying a fluid, in particular water, characterised in that the guiding apparatus (5) comprises a plurality of adjacently disposed and superposed ports with fixed guide blades (16), the guide blades (16) being so disposed that a twist is imposed upon the air flowing through them in order to form a bundle of turbulent partial flows (11) in the channel portion (4) and in that in their respective centres the ports comprise a continuous aperture (10) extending in the direction of flow and in which there is an atomising jet (6) projecting beyond the guide member (5) in the direction of flow and in that the atomising jet (6) is surrounded by no additional guide means projecting beyond the atomising jet (6) in the direction of flow.

2. An air washer according to claim 1, characterised in that the atomising jets (6) are directed radially and/or axially into a respective area of the cross-section of a partial flow (11).

3. An air washer according to claim 1 or 2, characterised in that the channel portion (4) following the guiding apparatus (5) is substantially straight.

4. An air washer according to one of claims 1 to 3, characterised in that the guiding apparatus (5) sub-divides the cross-section (8) of the channel portion (4) into a plurality of cross-sectional zones (12, 13) and in that the guiding apparatus (5) has in at least one part of the cross-sectional zones (12, 13) guide blades (16) for generating a turbulent flow.



5. An air washer according to claim 4, characterised in that the guiding apparatus (5) comprises a marginal zone (18) and a core (19) which sub-divides the cross-sectional zones (12, 13) of the channel portion (4) into a marginal zone and core zone (12, 13 respectively) and in that the guiding apparatus (5) has in the region of the marginal zone (18) means of inducing a laminar flow on the first fluid flowing through the marginal zone (18) and in that the guide blades (16) of the guiding apparatus (5) are disposed in the core (19) to generate a turbulent flow.

6. An air washer according to claim 5, characterised in that the guiding apparatus (5) sub-divides the core zone of the cross-section (8) of the channel portion (4) into a plurality of cross-sectional zones (13) and in that each port in the core (19) is provided with guide blades (16) to create a turbulent flow in the cross-sectional zones (13) in the first fluid.

7. An air washer according to one of claims 1 to 6, characterised in that the guiding apparatus (5) comprises an insertable member comprising a plurality of ports parallel with the axis of flow and through which the first fluid can pass and in that in at least one of the ports there are guide blades (16) to create turbulence in the through-flowing first fluid and which are preferably rigidly connected to the member.

8. An air washer according to one of claims 1 to 6 or 7, characterised in that the guiding apparatus (5) or member is a plate comprising one or more ports and preferably consisting of sheet metal, whereby, if there are several ports, the ports are isolated from each other by web-like elements (9).

9. An air washer according to claim 8, characterised in that guide blades (16) provided in the ports are produced in one piece with the plate.



10. An air washer according to claim 8 or 9, characterised in that the plate is perforated in the manner of a perforated plate, holes in the marginal zone (18) constituting the means of generating a laminar flow.

11. An air washer according to one of claims 1 to 10, characterised in that the guide blades (16) in the ports are at their mutually facing ends connected by a ring element (17) integrally formed with them and which constitutes a fixing mounting for an atomising jet (6).

12. An air washer according to one of claims 5 to 11, characterised in that the means of generating a laminar flow are a flat structure extending over the associated cross-sectional zone (12) and taking the form of a perforated plate, an interwoven structure or mesh.

13. An air washer according to one of claims 1 to 12, characterised by one or a plurality of pressurised water pipes (22, 23) provided with atomising jets (6), the guide blades (16) being rigidly mounted on the atomising jets (6).

MIXING DEVICE

Abstract

Mixing apparatus for mixing a first gaseous medium with a second, having a channel section of a flow channel for the first medium, before which in the flow direction a guiding device (5) is arranged for influencing the flow character of the first medium in the channel section. In this case, the opening of at least one supply conduit for the second medium is directed into the channel section. To improve the intermixing of both media it is provided that the guiding device (5) has at least one means (16) to induce turbulence in the first medium along the channel section (4) in at least one cross-section region (12, 13) of the channel section (4).

(Fig. 2)

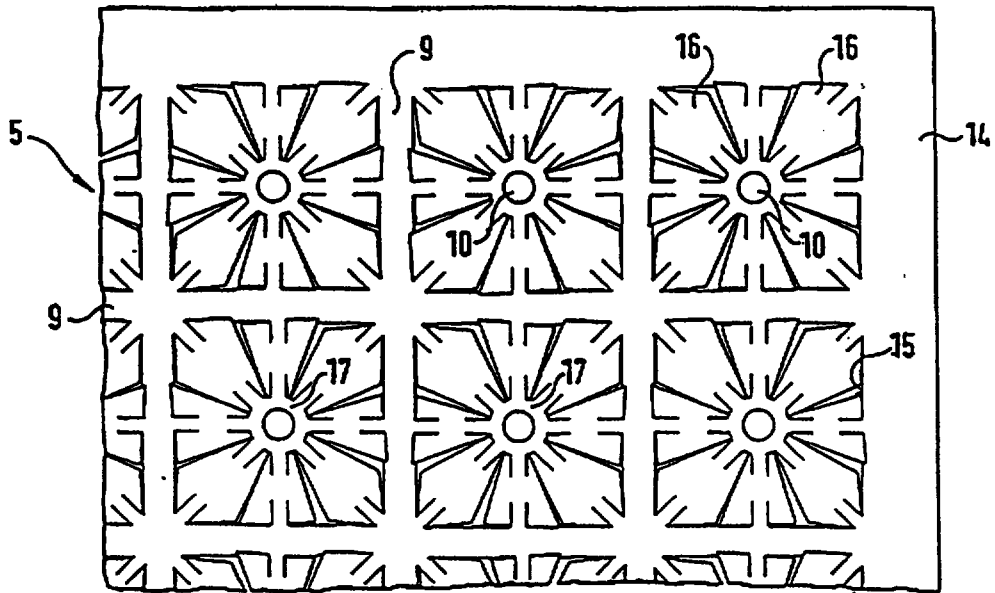


FIG. 3

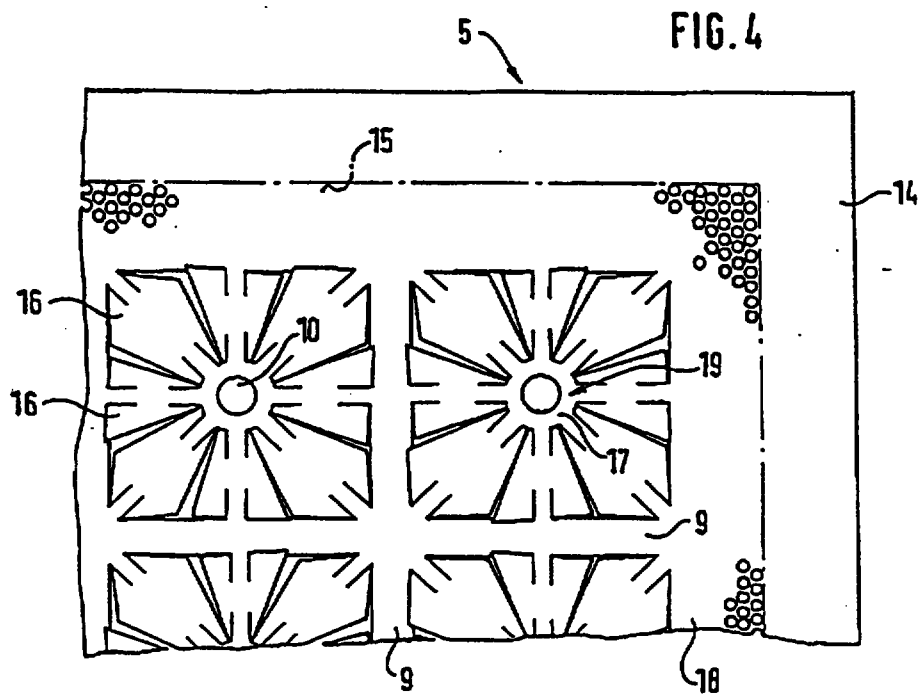


FIG. 4

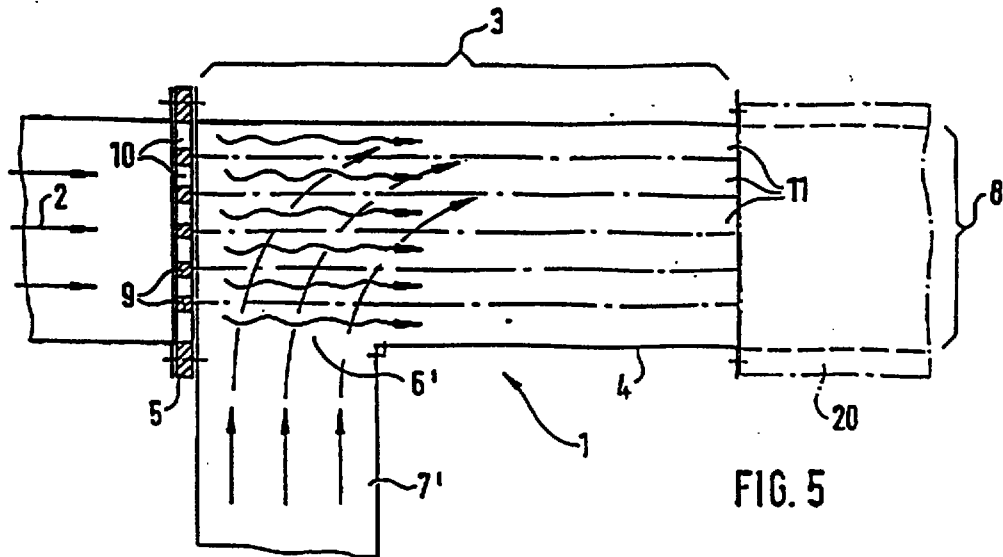


FIG. 5