

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.

5 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,

10 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,

15 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, 25 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 30 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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