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(54)

A mixing device for loose materials

(57) The device comprises two coaxial screws (6 and 7) one internal of the other, which are commandably rotatable internally of a mixing chamber (2). The internal of the screws (7) exhibits a coaxial free space which extends in an axial direction. The screws (6 and 7) are self-supporting, without a central support shaft, and are supported by one end thereof. The external of the screws

(6) is made to rotate in a direction which will cause loose material to move from an inlet (3) towards an outlet (4) of the mixing chamber (2), while the internal of the screws (7) is made to rotate in a direction which will favour a return of the loose material from the outlet (4) towards the inlet (3). The device offers a relatively high performance.

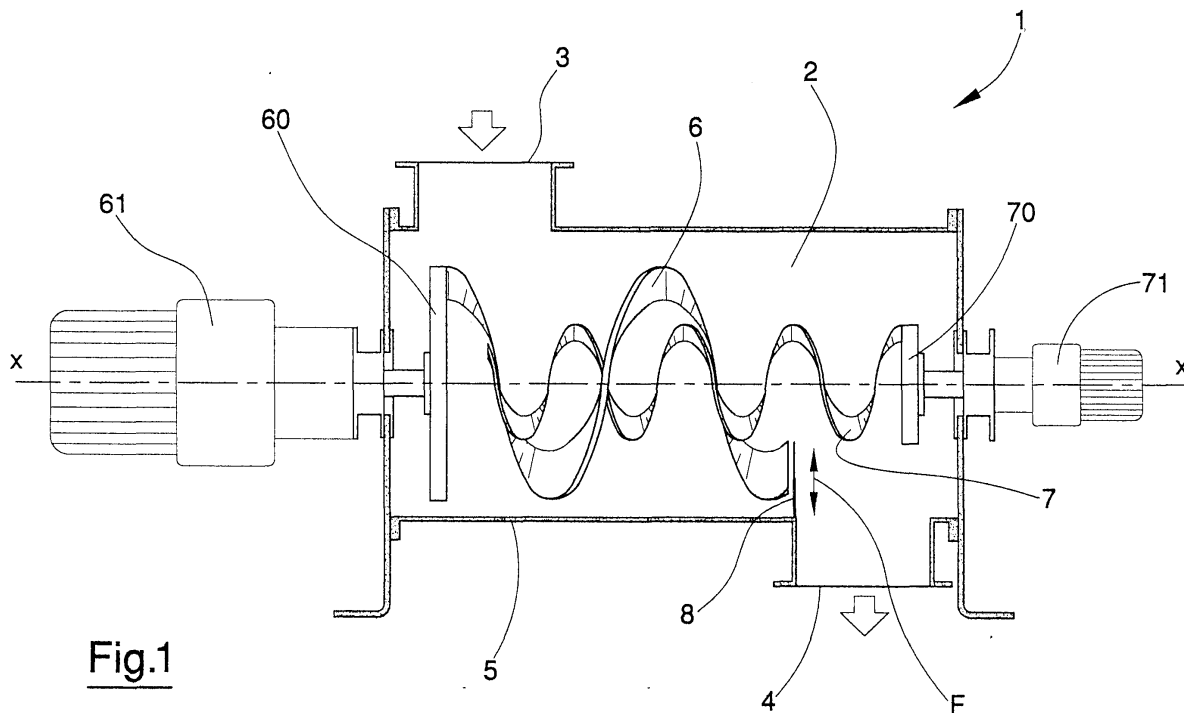


Fig.1

Description

[0001] The invention relates especially to a mixing device comprising a mixing chamber with an inlet for the material to be mixed and an outlet for the mixed material. Two coaxial and rotatable screws, one arranged internally of the other, are arranged in the mixing chamber.

[0002] A device of this type was disclosed in the publication "Mixing Technology" Bulk Solids Handling, Volume 13, No. 1, February 1993, page 81, figures 16 and 17, in which the internal screw is solidly constrained to an internal rotatable support shaft by means of a plurality of spokes or radial ribs. In this known device the screws, which are able to rotate at different speeds, both act as discharge screws in the sense that they propel the loose material towards the outlet. In the above-mentioned known device, the mixing action is enhanced by the external screw having a short end tract which tilts either to the left or the right but in any case in an opposite direction to the rest of the screw. The end tract of screw tends to send the material back towards the inlet of the mixing chamber.

[0003] The above-mentioned known device presents some drawbacks: firstly, it is relatively poorly productive; secondly, in order to obtain a good degree of mix, the device has to be fairly long axially; furthermore, it is difficult to regulate the degree of mixture of the loose material.

[0004] The main aim of the present invention is to obviate the above-mentioned limitations and drawbacks in the prior art, by providing a device which is able to mix loose material easily and with a relatively high productivity. An advantage of the invention is to make available a device which is constructively simple and economical.

[0005] A further advantage is to provide an axially quite short device.

[0006] A further advantage is to produce a good mixture of the various components in the mix.

[0007] A still further advantage is to enable the degree of mixture to be regulated simply but precisely.

[0008] Further characteristics and advantages of the present invention will better emerge from the detailed description that follows of a preferred but non-exclusive embodiment of the invention, illustrated purely by way of nonlimiting example in the accompanying figure of the drawing, in which: figure 1 is a schematic, partially-sectioned view in vertical elevation of a device made according to the invention.

[0009] With reference to the above-mentioned figure, 1 denotes in its entirety a device for continuous mixing of loose material, either in granular or powder form. The device 1 comprises a mixing chamber 2 having an inlet 3 for the loose mixture still to be mixed and an outlet 4 for the mixed material. The mixing chamber 2 is defined by a container 5 having a cylindrical lateral wall which has a horizontal axis x-x, which container 5 is closed at either end by a wall. The inlet 3 and the outlet 4 are axially distanced from each other and are situated on the

lateral wall of the container 5 at opposite ends. The inlet 3 is arranged superiorly of the container 5; the outlet 4 is arranged inferiorly. The granular or powder material can be introduced to the container 5 from above and can exit downwards. Gravity assists the material to move from the inlet 3 to the outlet 4.

[0010] The device 1 comprises two coaxial screws 6 and 7, one arranged inside the other and both being rotatable on command inside the mixing chamber 2. The screws 6 and 7 are coaxial to the container 5. Each screw 6, 7 is made from a flat, narrow and long sheet (in which the breadth of the sheet is much smaller than the width) is and is spiral-wound. The screws 6 and 7 are treated with a known-type antiwear protection. The internal diameter of the external screw 6 is greater than the external diameter of the internal screw 7. The external screw 6 slants in one way (in the figure, towards the left) while the internal screw slants in the opposite way (in the figure, towards the right) for their entire axial length.

[0011] Both screws 6 and 7 are self-supporting and without a central support shaft. Each screw is supported at one end thereof at least. In particular, each screw has one end constrained to a respective rotatable support 60 and 70, while the other end thereof is free. The disc-shaped rotatable supports 60 and 70 are located at opposite ends of the mixing chamber 2.

[0012] Each support 60 and 70 is associated to a respective motor 61 and 71 for respectively powering the screws 6 and 7. The motors are located externally of the mixing chamber 2 and at opposite ends thereof. Each motor is preferably provided with means, of known type and not illustrated, for controlling and regulating the rotation speed of the screws. Each screw can rotate at a speed and in a direction which are independent of the other screw.

[0013] At the centre of the internal screw 7 is a coaxial empty space having a diameter which is more or less equal to the internal diameter of the internal screw 7. The empty space extends axially between two zones which are respectively near to the inlet 3 and the outlet 4 of the mixing chamber 2. The empty space internal of the internal screw 7 is cylindrical in shape and delimited at the ends by planes which are transversal to the axis x-x of the screws and which respectively pass close to the inlet 3 and the outlet 4 of the chamber 2. In use, this empty space can be filled, either in whole or in part, by the loose material as it is being mixed.

[0014] The device 1 comprises means for regulating the breadth of at least one section through which the material passes in the mixing chamber 2. The regulatable section is located between an outlet of the external screw 6 and the outlet of the mixing chamber. In this case the means for regulating the passage section comprise a movable wall 8, located internally of the mixing chamber 2, which is mobile in both senses of a direction F which is transversal to the axis x-x of the screws. The passage section regulated by the wall 8 lies perpendic-

ular to the axis x-x of the screws. In the specific case the wall 8 is arranged vertically and is slidable in vertical direction F on command of a means for movement of known type and not illustrated. The wall 8 can also be manually positioned in a vertical direction. In the example the wall 8 is predisposed immediately upstream of the outlet 4.

[0015] The operation of the device, which is continuous, is described herein below.

[0016] The powder material to be mixed is introduced from above into the mixing chamber 2, through the inlet 3. The external screw 6 is commanded to rotate continuously in a direction which moves the loose material from the inlet 3 towards the outlet 4. The internal screw 7 rotates in the opposite direction, tendentially favouring the return of the loose material towards the inlet 3. In the illustrated embodiment (figure 1), looking from the right, both screws 6 and 7 rotate in an anticlockwise direction.

[0017] The material in the mixing chamber 2 is thus conveyed towards the outlet 4, not only by gravity but also by effect of the rotation of the external screw 6. The internal screw 7 contrasts the flow of material towards the outlet 4. The concomitant action of the two screws 6 and 7 causes a turbulence which favours very good mixing of the loose material.

[0018] It has been seen that the presence of a free space, which during operation can be filled by the loose material, situated in the central part of the internal screw 7 - a part which in known devices is usually occupied by the screw support shaft - improves the overall performance of the device, without compromising its structural resistance qualities.

[0019] Adjustment of the position of the wall 8 enables the time the material stays in the mixing chamber 2 to be regulated, and therefore the degree of material mixing.

[0020] An increase in the time the loose material stays in the mixing chamber 2 determines an increase in the degree of mixing. The mixing time is increased by raising the wall 8 and thus decreasing the material passage section. Obviously, by lowering the wall 8 the material passes through more quickly. The degree of mixing can also be regulated by adjusting the screw 6 and 7 rotation speed. The two screws 6 and 7 can be speed-adjusted independently of each other.

Claims

1. A mixing device for loose materials, comprising:

a mixing chamber (2) having an inlet (3) for material to be mixed and an outlet (4) for mixed material;
two coaxial screws (6) and (7), one located internally of another, which screws (6 and 7) are rotatable on command inside the mixing cham-

ber (2);

characterised in that it comprises, centrally of the internal screw (7), a free space which is coaxial to the internal screw (7), extends longitudinally in the mixing chamber (2), and has a diameter which is equal to an internal diameter of the internal screw (7).

2. The device of claim 1, characterised in that both screws (6 and 7) are self-supporting, being without a central support shaft, and are supported by at least one end thereof respectively.

3. The device of claim 1 or 2, characterised in that the free space extends axially between two zones, a first of which is located in proximity of the inlet (3) and a second of which is located in proximity of the outlet (4) of the mixing chamber (2).

4. The device of any one of the preceding claims, characterised in that a slant of the external screw (6) is either leftwards or rightwards, while a slant of the internal screw (7) is oppositely-directed, either rightwards or leftwards.

5. The device of any one of the preceding claims, characterised in that each screw (6 and 7) has one end thereof constrained to a rotatable support (60 and 70) and has another end which is free.

6. The device of claim 5, characterised in that the rotatable supports (60 and 70) are situated at opposite ends of the mixing chamber (2).

7. The device of any one of the preceding claims, characterised in that it comprises two motors (61 and 71), located externally and at opposite ends of the mixing chamber (2), each of which is destined to rotate one of the screws (6 and 7).

8. The device of any one of the preceding claims, characterised in that it comprises means for regulating a breadth of a section of passage of the material in the mixing chamber (2), the section of passage being situated between the free end of the external screw (6) and the outlet (4) of the chamber (2).

9. The device of any one of the preceding claims, characterised in that the section of passage is transversal to the axis (x-x) of the screws (6 and 7).

10. The device of claim 8 or 9, characterised in that the means for regulating comprise a mobile wall (8), located internally of the mixing chamber (2) and being mobile in a direction (F) which is transversal to the axis (x-x) of the screws (6 and 7).

11. The device of any one of the preceding claims, characterised in that each of the screws (6 and 7) is made of a flat narrow and long sheet which is wound in a spiral shape; a breadth of the sheet being much smaller than a width of the sheet.

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12. The device of any one of the preceding claims, characterised in that the external screw (6) can be made to rotate in a direction which favours an advancing of the loose material from the inlet (3) towards the outlet (4), while the internal screw (7) is made to rotate in a direction which favours a return of the loose material from the outlet (4) to the inlet (3).

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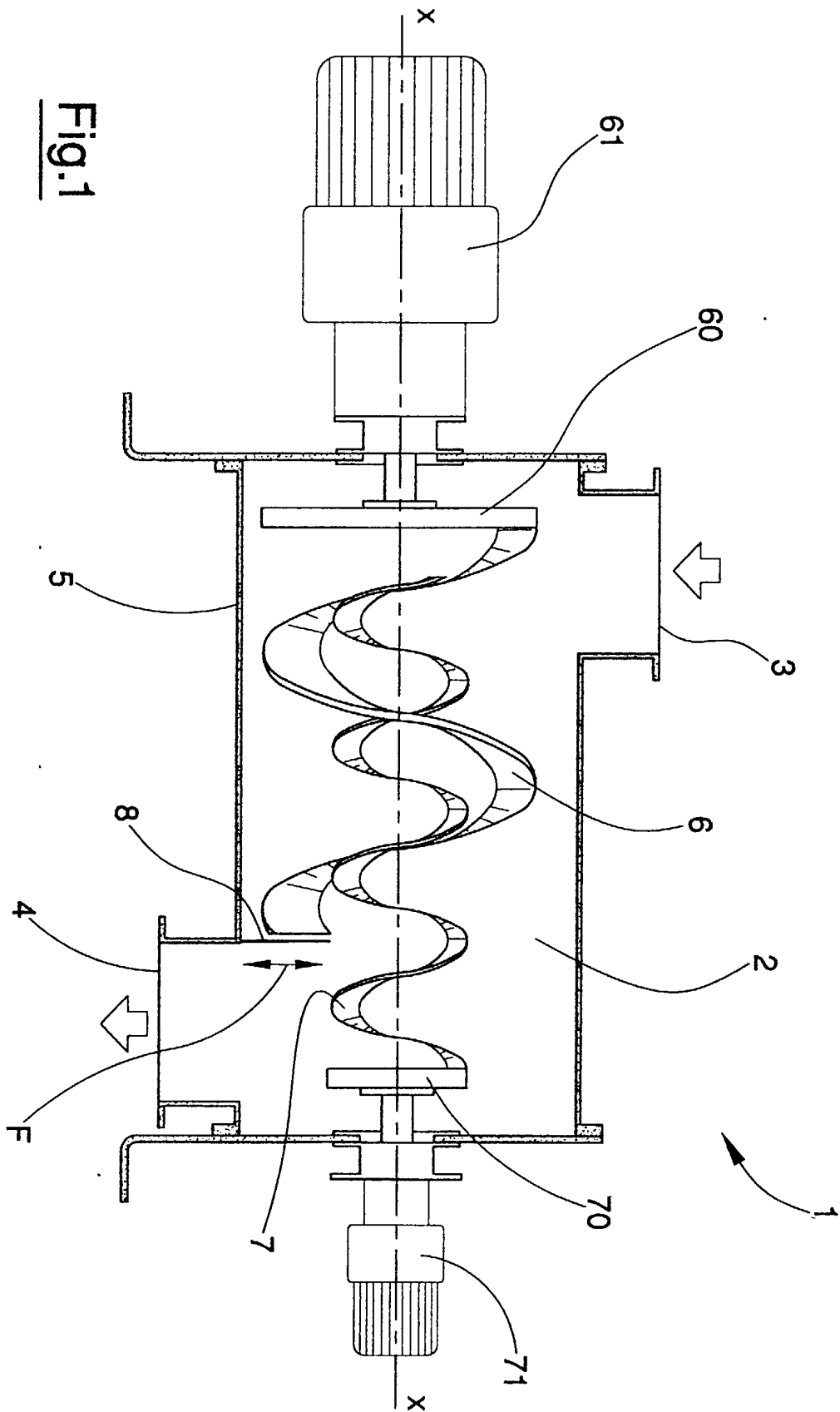


Fig. 1