PATENT SPECIFICATION (11) 1 561 799

1 561 799

(21) Application No. 40743/76 (22) Filed 1 Oct. 1976
(31) Convention Application No. 2 545 078 (32) Filed 8 Oct. 1975 in
(33) Fed. Rep. of Germany (DE)
(44) Complete Specification published 5 March 1980
(51) INT. CL.³ B01F 7/02
(52) Index at acceptance
B1C 11 12 14 18A1 5 6 9

(54) APPARATUS FOR THE MIXING OF GRANULAR AND/OR PULVERENT MATERIALS

(71) We, MOTAN GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG, a West German Company of Max-Eyth-Weg 42, 7972 Isny, West Germany, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention concerns apparatus for mixing granular and/or pulverent materials.

Apparatus is known for mixing granular and/or pulverent materials which comprises a housing forming a mixing chamber and a rotary mixing tool, having a peripheral face, a lower free end, and an inclined fixed longitudinal axis, within the mixing chamber, wherein at least a part of the peripheral face of the mixing tool is arranged in spaced disposition relative to a surface to define a gap therewith, the width of the gap being so dimensioned that upon rotation of the mixing tool the material to be mixed is conveyed along the gap against gravitational forces.

According to the present invention apparatus of this known kind is characterised in that the housing defines a closable outlet opening centered substantially on the axis of rotation of said tool and at the said lower free end of the tool, and in which the housing tapers to the closable outlet opening.

The invention will now be described further, by way of example only, with reference to the drawings in which:—

Fig. 1 shows a section through a first form of mixing apparatus constructed in accordance with the invention;

Fig. 2 shows a section on line II-II of Fig. 1;

Fig. 3 shows a section through a further form of mixing apparatus constructed in accordance with the invention;

Fig. 4 shows a section through a third form of mixing apparatus constructed in accordance with the invention; and

Fig. 5 is a block diagram of an installation for mixing three different materials using mixing apparatus according to Fig. 4.

The mixing apparatus 1 illustrated in section in Fig. 1 has a housing 2 the upper side of which is closed by a lid 3 to form a mixing chamber 10. The housing 2 has a closable outlet opening 4 provided with a closable flap 5. The flap 5 is hingedly connected to a lug 6 fixed to a surface 7. The surface 7 may be defined by the outside of the housing 2. The housing tapers symmetrically to the opening 4 in the region of the lower free end of a rotary mixing tool 14. The opening 4 is centered substantially on the axis of rotation of the tool 14.

A delivery apparatus 8 is mounted on the lid 3, the mouth 9 of such apparatus extending into the mixing chamber 10. The apparatus 8 serves to deliver, for example, a first material, for example, plastics granulate and granulated regenerated plastics, in a certain weight or volume ratio of, for example, 10 : 1 to the mixing chamber 10 in the direction of the arrow 12. A further inlet opening 11 is provided in the lid 3 adjacent to that inlet opening through which the apparatus 8 extends, and through which a second material, for example, paint, powder, is introduced into the mixing chamber 10 in the direction of the arrow 13.

The mixing tool 14 is provided within the mixing chamber 10, the longitudinal axis of such tool 14 being inclined with respect to the horizontal. Preferably the longitudinal axis of the mixing tool 14 lies in parallel, spaced-apart disposition relative to an inclined wall 20 of the housing 2. The mixing tool 14 conveniently comprises a

worm wheel having a ratio of cross-sectional surface F_1 of the worm core 15 to outer cross-section surface F_2 (sum of the cross-section surfaces of a worm wheel and of the worm core) of at least 1 : 2 (Fig. 2). The mixing tool 14 rotates with its free end in adjacent opposed disposition relative to the flap 5, whilst the opposite end of the mixing tool 14 passes through the lid 3 and is drivingly connected to a driving apparatus 16 fixed on the lid 3.

The mixing tool 14 is surrounded over a part of its length by a hollow cylindrical member 17 which is mounted, via spaced supports 18, 19, on the inner face of the inclined side wall 20. The longitudinal axis of member 17 is also parallel to the wall 20 and a gap 21 exists between the inner face of the member 17 and the periphery of the mixing tool 14 (Fig. 2), the width B of such gap being so selected that upon rotation of the mixing tool 14 the material in the mixing chamber 10 is conveyed along the gap 21 in the direction of the arrow 22, that is, upwardly against the force of gravity. The width of the gap B lies, for example, within the range of 0.5 to 3mm. In the region of the lid 3 the direction 22 of flow of material being mixed reverses, the material now moving towards the flap 5 on the outer face of the hollow cylindrical member 17. So long as the flap 5 is closed the material lying in front of the flap 5 is again acted on by the mixing tool 14 and is conveyed upwards in the direction of the arrow 22 so that, due to a secondary movement, an intimate mixing is initiated in the gap 21. In this way, a turbulent flow of material is produced in the mixing chamber 10 so that the substances deposited via the apparatus 8 and the inlet opening 11 are intimately mixed.

It is preferable that the materials introduced into the mixing chamber 10 in the direction of the arrows 12, 13 fall, first of all, onto the outer surface of the hollow cylindrical member 17, and, due to the inclined disposition of such member 17, slide downwardly towards the flap 5. Thus, the mouth 9 of the apparatus 8 is so positioned that the axis thereof is vertical and passes between the opposed ends 23, 24 of the hollow cylindrical member 17.

In the second embodiment of the invention as illustrated in Fig. 3, like reference numerals to those of Figs. 1 and 2 are used for the same or similar parts. One difference in the embodiment of Fig. 3 in relation to that shown in Fig. 1 lies in the absence of any hollow cylindrical member about the mixing tool, the mixing tool being mounted in spaced disposition relative to the inclined side wall 20 of the housing 2, the gap 21 being formed between the mixing tool and the side wall. Another difference is that the housing taper to the opening 4 is non-symmetrical.

The mixing tool 14 conveys material to be mixed upwardly through the gap 21 in the direction of the arrow 22, whilst at that side of the tool 14 opposite to gap 21 material being mixed flows downwards towards the flap 5. In this way a turbulent flow of the material within the mixing chamber 10, and thus a satisfactory mixing, is ensured. However, to achieve a uniform degree of mixing the embodiment according to Fig. 3 requires operating for a somewhat longer time than does the embodiment of Fig. 1. For achieving uniform circulation, the mixing tool is better suited than is the embodiment shown in Fig. 1. For a given duty, the dimensions of the apparatus shown in Fig. 3 may be less than the dimensions of the apparatus shown in Fig. 1.

The gap 21, both in the embodiment of Fig. 1 and in that of Fig. 3, may be of constant width or may taper in the direction of the arrow 22. Such a tapering of the gap width has the advantage that the speed of flow in the region of the gap (that is, in the case of the embodiment of Fig. 1, in the region of the upper end 24 of the hollow cylindrical member 17) increases very much, whereby the flow of the material to the mixed in the direction of the arrow 22 is substantially maintained through the gap end.

The lid 3, together with the driving apparatus 16 mounted thereon and the mixing tool 14 connected to such driving apparatus, can be removed from the housing 2, thereby to allow of an easy cleaning of the housing 2 and of the mixing tool 14.

A third, and further simplified, form of mixing apparatus is shown in Fig. 4, parts corresponding to those of the embodiment shown in Fig. 1 again being afforded the same references. In this embodiment there is fixed on the lid 3 of the housing 2 a suction blower 41 which draws air from the mixing chamber 10 through an air filter 42 and produces a reduced pressure within the chamber. A channel 43 (Fig. 5) connects with the mixing chamber 10 via an inlet opening 44, such channel being adapted to be connected, via an adjustable control member 48, for example, a flap with one or more, for example, three containers 45, 46 and 47 (Fig. 5) for different materials, I, II, III. Due to the reduced pressure in the mixing chamber 10, material I, II or III is conveyed from the container 45 and 46 and 47 respectively into the mixing chamber 10, according to the position of member 48. The control member 48 is selectively adjusted by several, for example, three filling level indicators of the mixing apparatus 1 via separate control pipes 49, 50, 51 indicated in broken lines in Fig. 5.

The filling level indicators, of which only the uppermost filling level indicator 53 is shown in Fig. 4, are fixed above one another in the side wall of the housing 2 and are associated with a respective one of the different materials I, II, III. Instead of only one filling level indicator per material, there may be provided, of course, several filling level indicators fixed at the same level.

The mixing apparatus shown in Fig. 4 operates as follows: With the apparatus 1 empty, and with an appropriate setting for the control member 48, the suction blower 41 draws material I from the container 45 until the lowermost filling level indicator associated with the container 45 responds and the suction blower 41 is switched off. The control member 48 is now adjusted so that the container 46 is connected to the channel 43. After adjustment of the control member 48, the conveying of the material II from the container 46 into the mixing chamber 10 is effected until the next filling level indicator responds and the suction blower 41 again switches off. Adjustment of the control member 48 to the channel 43 is effected, and on reactivation of the suction blower 41 material III is fed from container 47 into the mixing chamber 10 until the uppermost filling level indicator 53 responds. Again, a switching off of the suction blower, as well as an adjustment of the adjusting member 48 to its initial position is effected. There then takes place in the manner already described above, the mixing of the three materials; I to III by starting the driving apparatus 16.

WHAT WE CLAIM IS:—

1. An apparatus for mixing granular and/or pulverent materials comprising a housing forming a mixing chamber and a rotary mixing tool, having a peripheral face, a lower free end, and an inclined fixed longitudinal axis, within the mixing chamber, wherein at least a part of the peripheral face of the mixing tool is arranged in spaced disposition relative to a surface to define a gap therewith, the width of the gap being so dimensioned that upon rotation of the mixing tool the material to be mixed is conveyed along the gap against gravitational forces in which the housing defines a closable outlet opening centered substantially on the axis of rotation of said tool and at the said lower free end of the tool, and in which the housing tapers to the closable outlet opening.

2. Apparatus according to claim 1 in which said surface comprises the inner face of a cylindrical member surrounding the mixing tool over at least a part of the length of the tool.

3. Apparatus according to claim 1 in which said surface comprises the inner face of a wall of the housing.

4. Apparatus according to any one of claims 1 to 3 in which the gap is of substantial uniform width.

5. Apparatus according to any one of claims 1 to 3 in which the gap is of reducing width in the direction of intended material flow.

6. Apparatus according to claim 2 in which the longitudinal axis of the mixing tool and the cylindrical member are disposed substantially parallel to an inclined wall of the housing.

7. Apparatus according to any one of claims 1 to 6, in which the mixing tool comprises a worm wheel wherein the ratio between the core cross-sectional surface and the outer cross-section surface is at least 1 : 2.

8. Apparatus according to any one of claims 1 to 7 in which the housing of the apparatus has an inlet opening and at least one delivery apparatus in said opening, the outlet of the delivery apparatus projecting into the mixing chamber.

9. Apparatus according to claim 8, when appendant to claim 2 in which the delivery apparatus is positioned so that a vertical axis through the outlet thereof passes between the opposed ends of the hollow cylindrical member surrounding the mixing tool.

10. Apparatus according to any one of claims 1 to 9, in which the housing has a lid and one or more inlet openings are provided in the lid.

11. Apparatus according to claim 10 having a driving apparatus for the mixing tool on the outside of the lid.

12. Apparatus according to any one of the preceding claims having means for drawing air from the mixing chamber.

13. Apparatus as claimed in claim 12 connected via an inlet opening to a control member for controlling the supply of differing materials to said inlet.

14. Apparatus as claimed in claim 13 in which said apparatus has at least one filling level indicator and said control member is moved to supply a differing material when a previously supplied material reaches the level of said indicator.

15. Apparatus as claimed in claim 14 having a plurality of level indicators disposed above one another and arranged so that the control member is moved to supply a differing material when the level of each indicator is reached.

16. Apparatus for mixing granular and/or pulverent materials substantially as hereinbefore described with reference to Figs. 1 and 2, Fig. 3 or Fig. 4 of the accompanying drawings.

17. An installation including a mixing apparatus as claimed in any one of claims 12 to 14, substantially as hereinbefore described with reference to Figs. 4 and 5 of the accompanying drawings.

Agents for the Applicants:
SYDNEY E. M'CAW & CO.,
Chartered Patent Agents,
Saxone House,
52-56 Market Street,
Manchester M1 1PP.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1980.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1561799 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

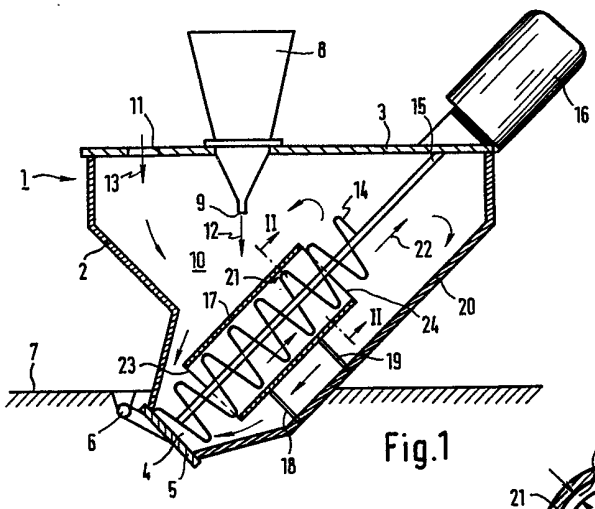

Fig.1

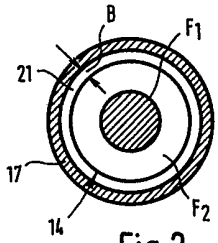

Fig.2

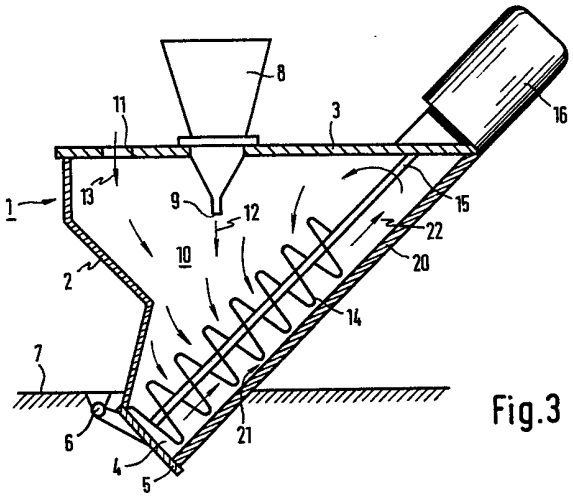

Fig.3

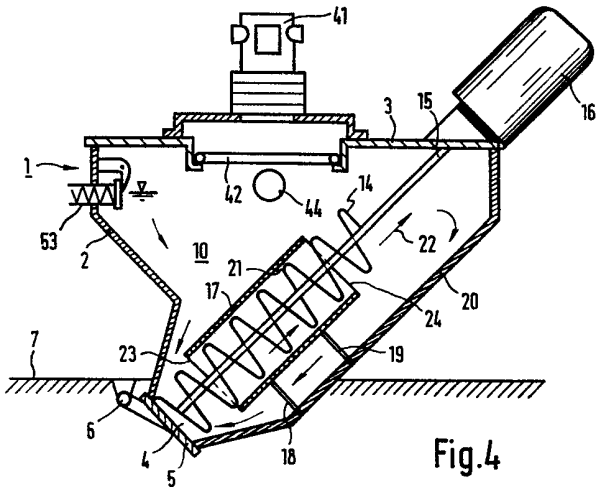
41
3
15
16
1
42
44
14
53
2
10
22
21
17
20
24
7
23
19
6
4
5
18

Fig.4

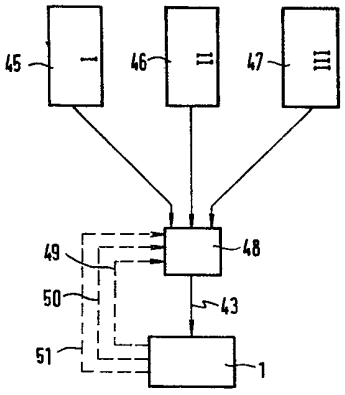
45
I
46
II
47
III
49
48
50
43
51
1

Fig.5