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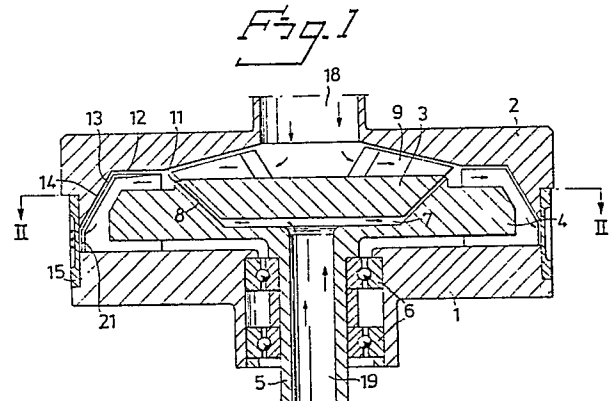
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54 **An apparatus for producing a mixture from liquid and powder ingredients, and kneading and extruding the mixture.**

57 An apparatus for continuously producing from liquid and powder ingredients a substantially homogenous mixture and kneading the mixture to form a compact, plastic mass, and for extruding this mass into elongated extrusions. The mixer comprises a mixer housing (1) and mutually separate liquid and powder delivery conduits (18, 19) and a mixture outlet. A wheel assembly (3, 4) is arranged for rotation in the housing (1) on a shaft (5). The liquid delivery conduit (9) opens into a cavity (7) located in the wheel assembly, whereas the powder delivery conduit (18) opens into powder spaces (10) provided in the upper part (3) of the wheel assembly. The cavity (7) communicates with the upper side of the wheel assembly via a circumferentially extending slot or gap (8) which opens out adjacent an edge (11) which extends circumferentially around the slot or gap on the peripheral side thereof. The slot has a substantially frusto-conical configuration with the apex of the cone facing downwards. Extending around the periphery of the mixer housing is a cylindrical shell (15) which is perforated with holes (16) in that part thereof which extends over the housing outlet, the axes of this shell being coaxial with the axes (5) of the mixer wheel. Blades (12) are arranged in the chordal direction in the mixer housing between the circumferentially extending edge (11) and the cylindrical shell (15). The edges (13) of the blades (12) lie immediately adjacent the inner conical

surface (14) of the mixer housing and knead and tear the mixture in co-action with the surface, while the outer ends (21) of the blades lie against the inner surface (22) of the shell (15) and are operative in forcing the resultant plastic mass through holes (16) to produce elongated extrusions.



Description

An apparatus for producing a mixture from liquid and powder ingredients, and kneading and extruding the mixture.

The present invention relates to an apparatus which combines the steps of continuously mixing together powder and liquid ingredients, kneading the resultant mixture to form a compact plastic mass or dough and extruding said plastic mass to form elongated extrusions. The apparatus includes a mixer, a mixer housing, individual liquid and powder delivery conduits, and a mixture outlet. The mixing housing has arranged therein a horizontal wheel which is rotatable together with a vertically extending shaft in the mixer housing, and the liquid delivery conduit opens into a cavity located in the wheel, whereas the powder delivery conduit opens into a powder chamber located in the upper part of the horizontal wheel. The cavity communicates with the upper side of the wheel through a circumferentially extending slot or gap, which opens out adjacent a circumferentially extending edge located on the side of the slot or gap nearest the periphery of said wheel, said slot having substantially a frusto-conical configuration, with the apex of the cone facing downwards.

Various kinds of pellets are produced by first mixing a dry material with a binder dissolved in water or some other solvent, which will often be highly volatile, whereafter the resultant mixture is transferred to an extruder, in which the mixture is pressed, in various ways, through extrusion dies or orifices of different shapes and sizes.

Apparatus for continuously mixing liquid and powder material together so as to form a substantially homogenous mixture is previously known from Swedish Published Patent Specification 421 047. An apparatus for kneading a mixture and subsequent extrusion of the resultant plastic mass, a so-called extruder, is described and illustrated in EPC-application 85850119.0. When using these two known apparatus, the step of transferring the mixture to the extruder is always encumbered with handling problems, particularly when volatile solvents are used. In addition to engendering losses and creating problems environmentally, vaporization of the solvent present results in partial drying of the mixture, with subsequent disturbances in production, which results in extrusions of uneven quality.

The object of the present invention is to overcome this problem, by enabling the steps of mixing together the mixture ingredients and of kneading and extruding the resultant mixture to be carried out in one and the same apparatus, thereby obviating the need of using two separate apparatus, as required by the prior art techniques. The inventive apparatus is based on the apparatus described and illustrated in the prior published Swedish Specification No. 421 047, this known apparatus being modified in accordance with the inventive concept to include compacting, kneading and extruding facilities.

The inventive apparatus is characterized by a cylindrical shell which surrounds the outer peripheral surface of the mixing housing and which is

perforated with holes over that part of its periphery which lies across the mixer housing outlet and the axis of which is coaxial with the axis of the mixer wheel; and by blades which are disposed between the circumferentially extending edge and the cylindrical shell in the chord direction of the mixer housing and the outer ends of which blades lie against the inner surface of said shell.

The invention will now be described in more detail with reference to an exemplifying embodiment thereof illustrated schematically in the accompanying drawings, in which Figure 1 is a vertical sectional view of the apparatus according to the invention; Figure 2 is a section taken on the line II-II in Figure 1; Figure 3 shows part of the section of Figure 2 in larger scale; and Figure 4 shows part of the section of Figure 1 in larger scale.

The illustrated apparatus includes a mixer housing 1 provided with a cover member 2. Arranged within the housing 1 is a wheel assembly which comprises an upper wheel 3 and a lower wheel 4, said wheels extending in the horizontal plane and said lower wheel including a hollow shaft 5 which is journaled in bearing 6 for rotation in the housing 1. Located between the upper and lower wheels 3 and 4 is a cavity 7 which communicates with the upper side of the upper wheel 3 through a circumferentially extending slot 8 which has a frusto-conical configuration, with the cone apex facing downwards. Blades 9 are mounted on the upper wheel 3. The blades 9 define therebetween spaces 10 which are intended to receive the powder ingredient of the mixture. Located on the lower wheel 4, adjacent the orifice of the slot 8, is a circumferentially extending chopper edge 11, and the lower wheel 4 carries on its peripheral surface blades or "baffles" 12, the outer edges 13 of which run adjacent to a conical surface 14 on the cover member 2. Extending circumferentially around the mixer housing is a recess which accommodates a perforated shell 15. The holes 16 of the shell 15 are of cylindrical configuration and the axes of respective holes form an angle β with the radius of the mixer housing, which lies between 0 and 90° and is, for instance 60°. The angle α between the axes of the holes and the plane 17 of the orifices thereof is preferably about 90°. The powder ingredient is delivered to the mixer housing through a conduit 18 and the liquid ingredient is delivered through the cavity or hollow 19 in the hollow shaft 9.

In the preparation of a mixture, the wheel assembly 3, 4 rotates in the housing 1 at a speed of from 1000 to 5000 rpm. The liquid ingredient, or wet phase, is therewith delivered to the cavity 7 between said upper and lower wheels through the hollow tubular shaft 5. The liquid is thrown outwardly by the centrifugal force generated and passes through the slot 8, to form a liquid film or skin which expands constantly outwards while becoming thinner in the process. When the liquid film leaves the slot 8 it strikes the chopper edge 11 and is therewith

disintegrated into microscopic droplets, so as to form a mist curtain. The powder ingredient is passed through the conduit 18 to the spaces 10 defined between mutually adjacent blades 9 at the same time as the liquid ingredient is delivered to the cavity 7, this powder ingredient being thrown outwardly by centrifugal force and the blades 9, towards the periphery of the upper wheel 3 while simultaneously being whipped-up and impinging with the mist curtain at the chopper edge 11. The two ingredients, or phases, are now slung outwardly together and collide against the conical surface 14 on the cover member 2, where they are instantaneously mixed together. The resultant mixture is immediately caught by the blades 12, the edges 13 of which pass immediately adjacent the conical surface 14 and knead and tear the mixture against said surface, in a process similar to that of kneading and rolling-out pastry dough. The mixture is kneaded and rolled or spread down towards the perforated shell 15 while being formed into a compact, plastic mass. This plastic mass is subsequently pressed through the cylindrical holes 16 by the outer, leading edge 21 of the blades 12, these edges passing contiguously with the inner surface 22 of the shell 15, to form homogenous, compact elongated, cylindrical extrusions 20.

The holes 16 are formed at an angle β relative to the shell radius, which lies as close to a right angle as possible, so that the forces exerted by the blades are active as near as possible in the direction of the axes of said holes 16. This will reduce losses due to friction and also reduce the amount of heat generated during the actual moment of extruding the plastic mass.

The plane of the inlet orifices of respective holes 16 shall form with the axes of said holes an angle α which is as near to a right angle as possible, so as to prevent the extrusions from being deflected against the outer surface of the shell, such deflection resulting in bending of the extrusions such as to form a porous and cracked outer surface which renders further processing of the extrusions difficult.

Claims

1. An apparatus for continuously producing a substantially homogenous mixture from liquid and powder ingredients, kneading such a mixture into a compact, plastic mass, and extruding the plastic mass to form elongated extrusions, said apparatus comprising a mixer, a mixer housing (1), mutually separate liquid delivery and powder delivery conduits (18, 19), a mixture exit, a wheel assembly (3, 4) which is mounted for rotation in the mixer housing on a vertical shaft (5), said liquid delivery conduit (9) opening into a cavity (7) located in the wheel assembly, whereas the powder delivery conduit (8) opens into powder spaces (10) defined by first blades (9) mounted on the upper part (3) of

the wheel assembly, said first blades (9) being operative in forcing the powder ingredient out towards the periphery of the wheel assembly, and in which apparatus the cavity (7) communicates with the upper side of the wheel assembly via a circumferentially extending slot or gap (8) which opens out adjacent a chopper edge (11) which extends circumferentially on the peripheral side of the slot or gap having a substantially frusto-conical configuration with the apex of the cone facing downwards, characterized by a circular, cylindrical shell (15) which extends around the periphery of the mixer housing (1) and which is perforated with holes (16) over that part of its periphery which lies across the mixer housing outlet and the axis of which shell is coaxial with the axis (5) of the mixer wheel assembly; and in that arranged between said chopper edge (11) and the cylindrical shell (15), in a direction of a chord in the mixer housing, are second blades (12) which are connected with the lower wheel part (4) of the wheel assembly, and the outer extremities (21) of which second blades are intended to sweep over the inner surface of the shell (15).

2. Apparatus according to Claim 1, characterized in that the axes of the holes (16) in the shell (15) form an angle $180^\circ - \beta$ with the cylindrical shell radius which lies between 90° and 180° .

3. An apparatus according to Claim 2, characterized in that the orifices of respective holes (16) on the outer surface of the shell are configured so as to form substantially a right angle with the axes of respective holes.

4. Apparatus according to any of Claims 1-3, characterized in that the second blades (12) have a wedge-configuration in a projection on a horizontal plane in the mixer housing with the apex of the wedges facing inwardly in said housing (1).

5. An apparatus according to any of Claims 1-4, characterized in that the upper part of the mixer housing has a frusto-conical configuration, and in that the outer extremities (13) of the blades are contiguous with said conical surface.

Fig. 1

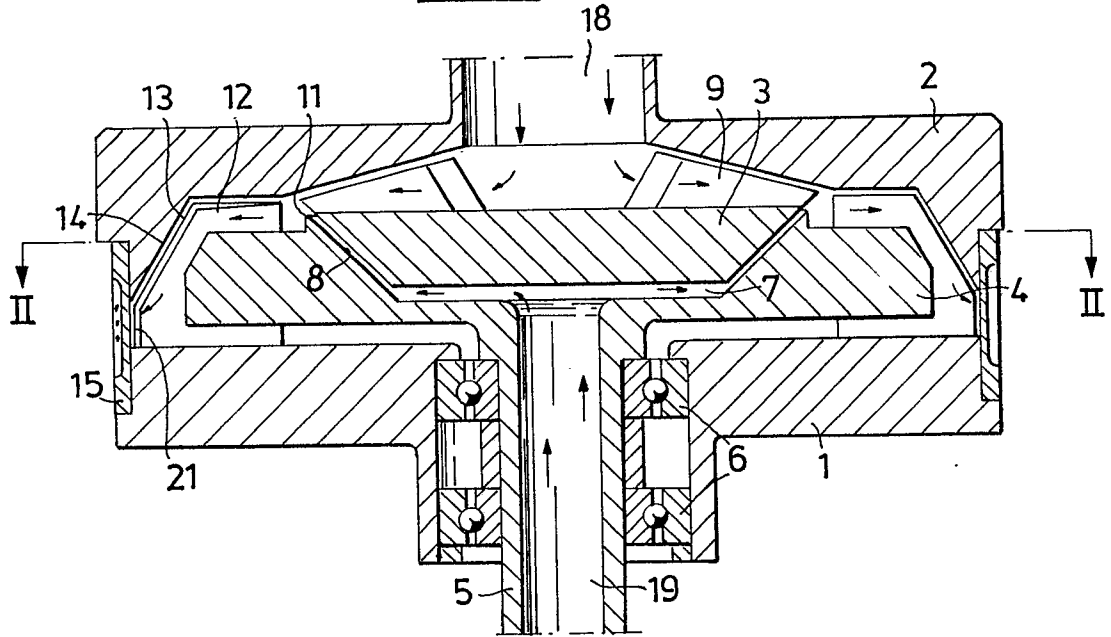


Fig. 2

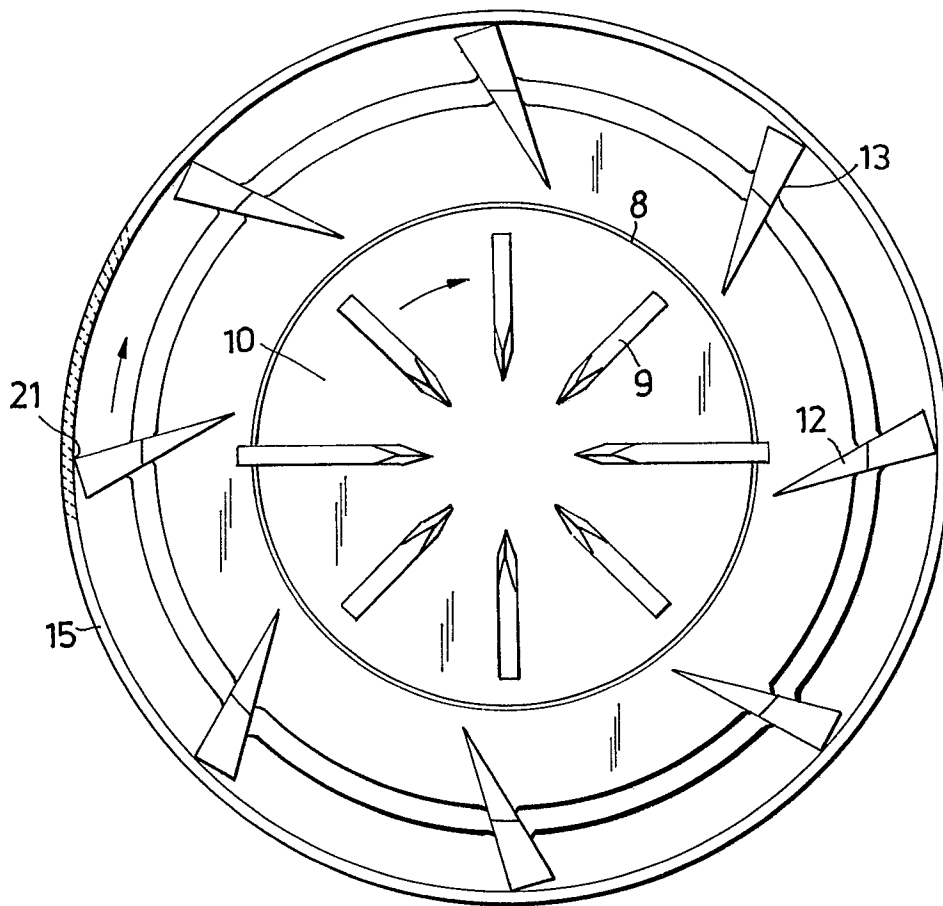


Fig. 3

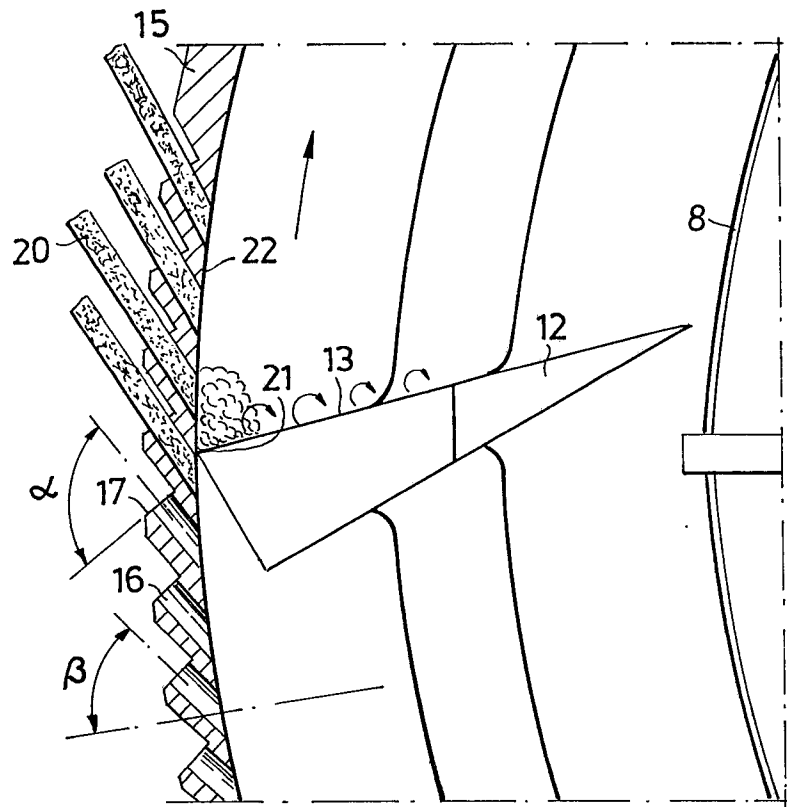
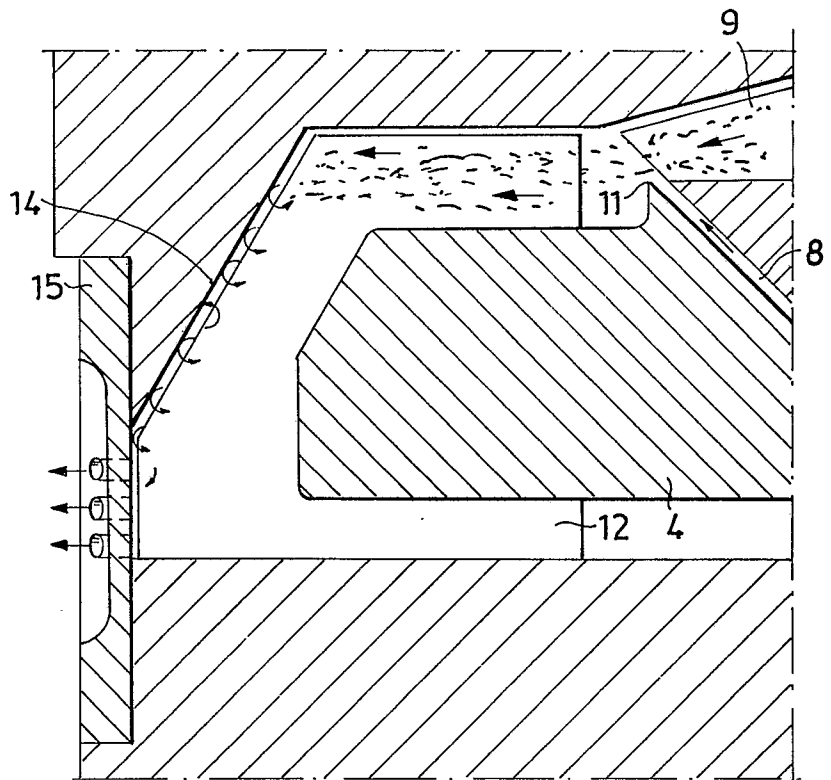


Fig. 4





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	DE-B-1 085 851 (BAYER) * Column 2, line 40 - column 3, line 9; figure * ---	1,4	B 01 F 5/22 B 30 B 11/22
Y,D	EP-A-0 163 619 (LEJUS) * Claims; figures * ---	1,4	
A	GB-A-1 354 167 (FOUCAULT) * Figures * ---	5	
A	US-A-4 511 321 (HOWARD) * Figure 1 * ---	2	
A	GB-A-1 016 232 (MEYER) ---		
A	US-A-3 045 613 (KENNEDY) ---		
A	FR-A-2 119 797 (DEGOUL) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 01 F B 30 B B 29 B B 01 J
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20-03-1989	Examiner PEETERS S.
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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