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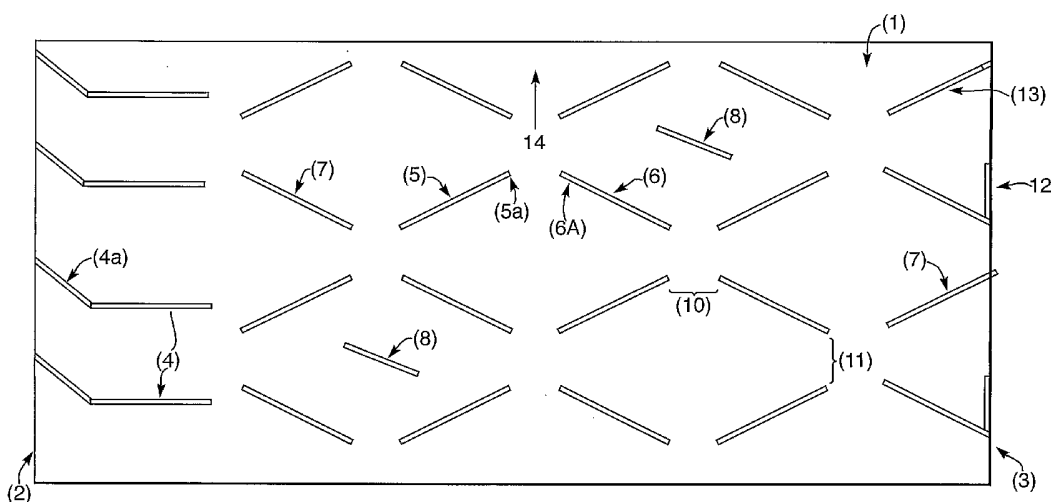
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(54) Title: IMPROVEMENTS RELATING TO MIXERS



(57) Abstract: A mixer comprising of a hollow drum (1) mounted for rotation about its longitudinal axis and having inlet means (2) at one end and outlet means (3) at the other end, and containing at least one row of internal baffle plates arranged in a substantially longitudinal direction and fixed to the interior wall of the cylinder, said row has at least two adjacent baffle plates (5, 6) which are angled relative to the longitudinal axis of the drum in opposite senses, the arrangement being such that one plate directs powder backwards and the other directs powder forwards, CHARACTERISED IN THAT the proximal portions (5a, 6a) of the two plates are further advanced in the direction of drum rotation than the distal portions.



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— *with international search report*

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IMPROVEMENTS RELATING TO MIXERS5 Technical Field:

The present invention concerns continuous mixers used to blend powders or granules.

10

Background to the Invention:

In the manufacture of detergent powders it is common to blend a number of different powder components together. This
15 may be done as a convenient method of formulation control and/or in order to add or post dose ingredients which would not be stable during processes used to form the separate components. In particular ingredients such as perborate or percarbonate bleaches may be post-dosed to dry powders which
20 have been formed by spray drying or granulation/neutralisation processes which involve the ingredients being in slurry, paste or moist powder form. Perfume may also be added in the same manner.

25 A number of powder mixers can be used to carry out this post dosing process. One common mixer type, used for continuous production of powder blends, is a drum mixer. This comprises a rotating cylinder whose longitudinal axis is at a small angle to the horizontal plane. The separate powders
30 to be blended are fed into the raised end of the cylinder

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and, as the cylinder rotates, pass down the cylinder and exit the lower end.

During their passage the powders form a tumbling bed which
5 mixes the ingredients together. In order to promote this tumbling and mixing action the interior of the cylinder is provided with raised baffles which pass through the powder bed as the drum rotates and mix the powder in a radial
direction. Typically, the baffles are arranged
10 substantially parallel to the longitudinal axis of the cylinder. The baffles may be continuous along all or part of the length of the cylinder but usually they comprise a number of separate baffles with gaps between them.

15 It is also known to employ additional angled baffles, arranged in pairs, such that one of each pair of baffles slopes forwards and the other slopes backwards forming a chevron shape, pointing in the direction counter to the direction of rotation and which acts as a funnel during
20 rotation of the mixer.

These design of mixer have problems. They provide almost no back mixing effect. This means that any fluctuation in dosing of a component will still be found at the outlet of
25 the mixer. In routine operation this means that variations in the feed rates of the different components are not ironed out during the mixing process. This leads to variability product composition which is clearly undesirable.

30 A similar problem arises when it is desired to change the product being mixed. In order to minimise the production of

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product contaminated with the previous product it is common practice to operate the mixer with no feed for a time to allow as much as possible of the previous product to be removed. In practice, unless the mixer is swept out, it is not possible to completely empty it and the new product is used to flush out the remains of the old product. This leads to product variability also results in this process being longer than desired and hence to the production of large quantities of unwanted mixed product.

10

Brief Description of the Invention:

It has been found that these disadvantages can be overcome by modifying the baffle design in the mixer to provide longitudinal flow of the contents in both directions over a significant portion of the mixer.

The mixer consists of a hollow cylinder having inlet means at one end and outlet means at the other end, and containing at least one row of internal baffle plates arranged in a substantially longitudinal direction and fixed to the interior wall of the cylinder, said row having at least two adjacent baffle plates which are angled relative to the longitudinal direction in opposite senses, the arrangement being such that one plate directs powder backwards and the other directs powder forwards, and the proximal portions of the two plates being further advanced in the direction of rotation than the distal portions.

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In this description the forward direction is taken as the direction of flow of the powder through the mixer from the raised end to the lower end.

- 5 Typically, the longitudinal extent of each angled baffle plate is greater than the circumferential extent of the baffle plates by a factor of at least 1.2, preferably greater than 1.5.
- 10 Preferably, the angled baffle plates extend, in total, over at least 50% of the length of the mixer.

It is preferred that the angle of the baffle plate to the longitudinal axis of the mixer be such that the angle of the
15 baffle plate to the top of the powder bed when the mixer is operating is greater than the angle of repose of the powder. In order to compensate for the inclination of the mixer the baffle plates deflecting powder backwards may need to be set at a slightly greater angle than those deflecting powder
20 forwards. The magnitude of this angle is therefore such that the powder flows along the baffle plate as it moves through the powder, in order to promote flow in the longitudinal direction rather than turbulence in the radial direction.

25

The baffle plates should not be set at too great an angle to the longitudinal axis of the mixer, otherwise they will be ineffective in mixing the powder. Preferably the angle should be no more than 2 times the angle of repose.

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It is preferred to have more than two baffle plates in each row. The optimum number will be influenced by the length of the mixer cylinder. In general it is preferred that each row comprise at least 4 baffles. Preferably the number of
5 baffles will not exceed 24 baffles, more preferably it will not exceed 16 baffles.

Preferably more than one row of baffles will be arranged radially around the inside of the cylinder, preferably in a
10 symmetrical manner. The number of rows will to some extent depend on the internal diameter of the mixer cylinder. The rows may be arranged in pairs such that for each pair one row is arranged as described as above with the first baffle directing powder forward and the second baffle directing
15 powder backward and the complementary row is arranged to have the opposite orientation, with the first baffle directing powder backwards and the second directing powder forwards.

20 Preferably, the number of rows will be at least 2, more preferably at least 6. Preferably, the number of rows will not exceed 20, more preferably it will not exceed 16. Generally, the optimum number of rows is around 6-12.

25 It is advantageous if the baffle pattern described above does not start until at about 10% of the length of the cylinder from the entrance. In this region baffles which are parallel to the longitudinal axis of the drum may be provided, optionally with an initial section which directs
30 powder into the cylinder. This design facilitates entry of the powders to be mixed to the mixer.

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It is preferred that the rows of baffles extend to the exit of the mixer cylinder. In this case it is preferred that at least the final baffles set to direct powder backwards have a slot at the base parallel to the cylinder wall which will
5 allow some of the powder to flow under the baffle. At low bed depths all of the powder may flow under the baffle via this slot. This feature aids in emptying of the mixer. The depth of the slot is typically between 5 and 50% of the baffle depth.

10

In one particularly preferred arrangement, the baffles comprises circumferential rings of baffles which form a diamond pattern with longitudinal and radial gaps at each vertex of the diamond. It is beneficial to place further
15 baffles in the centre of some of these diamonds, the extra baffles being angled to move powder in the forward direction. This prevents powder simply flowing down the rotating wall of the mixer without being urged in a longitudinal direction.

20

This arrangement of baffles provides a number of advantages. The back mixing caused by the alternating forwards and backwards facing baffles promotes flow through the mixer in a plug flow fashion. It also promotes flow in a more uniform
25 fashion. Any component which tends to flow more quickly is back-mixed by the backward facing baffles into the section of the powder from which it came.

Emptying of the mixer is also made more rapid and complete.

30

In the prior art arrangement it is only the slope of the mixer which promotes powder flow. Powder tends to build up

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behind the baffle plates and move only slowly down the mixer when input to the mixer is stopped. Thus emptying completely takes a long time. In the present arrangement of baffles such build up is impossible since the baffles are at
5 an angle to the powder greater than its angle of repose.

Another important advantage of the present arrangement is that the slots are provided under certain of the baffles allow powder at low levels, typical of levels present at the
10 emptying of the mixer, to leave the mixer without being directed backwards, and hence more quickly.

In order that the present invention may be further understood it will be described hereafter by way of a non-
15 limiting example and with reference to the accompanying figures wherein:

- Figure 1 shows an 'unwrapped' view of the mixer in schematic form.

20

- Figure 2 is a graph showing the results of trials with a mixer according to the present invention as opposed to a known mixer.

25 Turning to Figure 1: the mixer comprises an outer shell (1) having an inlet end (2) and an outlet end (3). The inlet end is provided with baffles (4) which are disposed essentially longitudinally of the mixer cylinder. These have an outer end (4a) which is swept upwards at the inlet
30 end in the direction of rotation so as to assist in the charging of the mixer. The region of the mixer at the inlet

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end may be provided with means (not shown) to add powders (such as bleach containing materials) or to spray on liquid components such as perfumes.

- 5 The central portion of the mixer and the outlet end are provided with rows of baffles (5, 6) which are generally arranged in pairs, although an odd baffle (7a, 7b) may be found at the end or beginning of some rows. The pairs are disposed such that the proximal ends (5a, 6a) are advanced
10 in the direction of rotation (14), which causes both backward and forward flow of the contentions of the mixer when the shell and baffles rotate. A gap (10) is found between the proximal ends of the baffles.
- 15 The gap (10) is narrower than the spacing between baffles in adjacent rows (11) so that at least a proportion powder flowing along a baffle tends to fall onto the following baffle in the row below.
- 20 The angled baffle plates form a generally diamond-like pattern. Additional baffles (8) are located at the centres of some of the diamonds.
- Weirs (12) retain material within the mixer during the
25 mixing progress. The final row of baffles (13) do not fully meet with the internal wall of the mixer, but have slots under them to allow material to flow from the mixer when it is being emptied.
- 30 Turning to Figure 2, there is shown a graph illustrating the benefit of the baffle design of the invention. In each case

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a drum mixer is operated continuously until it is operating at a steady state. A small quantity of a fluorescent tracer powder is added to the feed and the output monitored for its presence. The concentration of the tracer at the outlet of
5 the drum over time is measured to give a pulse response.

From the shape of this curve the average residence time and the spread of residence time in the mixer can be calculated.

A drum which is equipped with the baffles as described herein has a lower peak and broader distribution of this
10 curve than a drum with horizontal baffles. Thus, the initial tracer has been distributed longitudinally showing that in normal operation minor fluctuations in feed composition will be ironed out.

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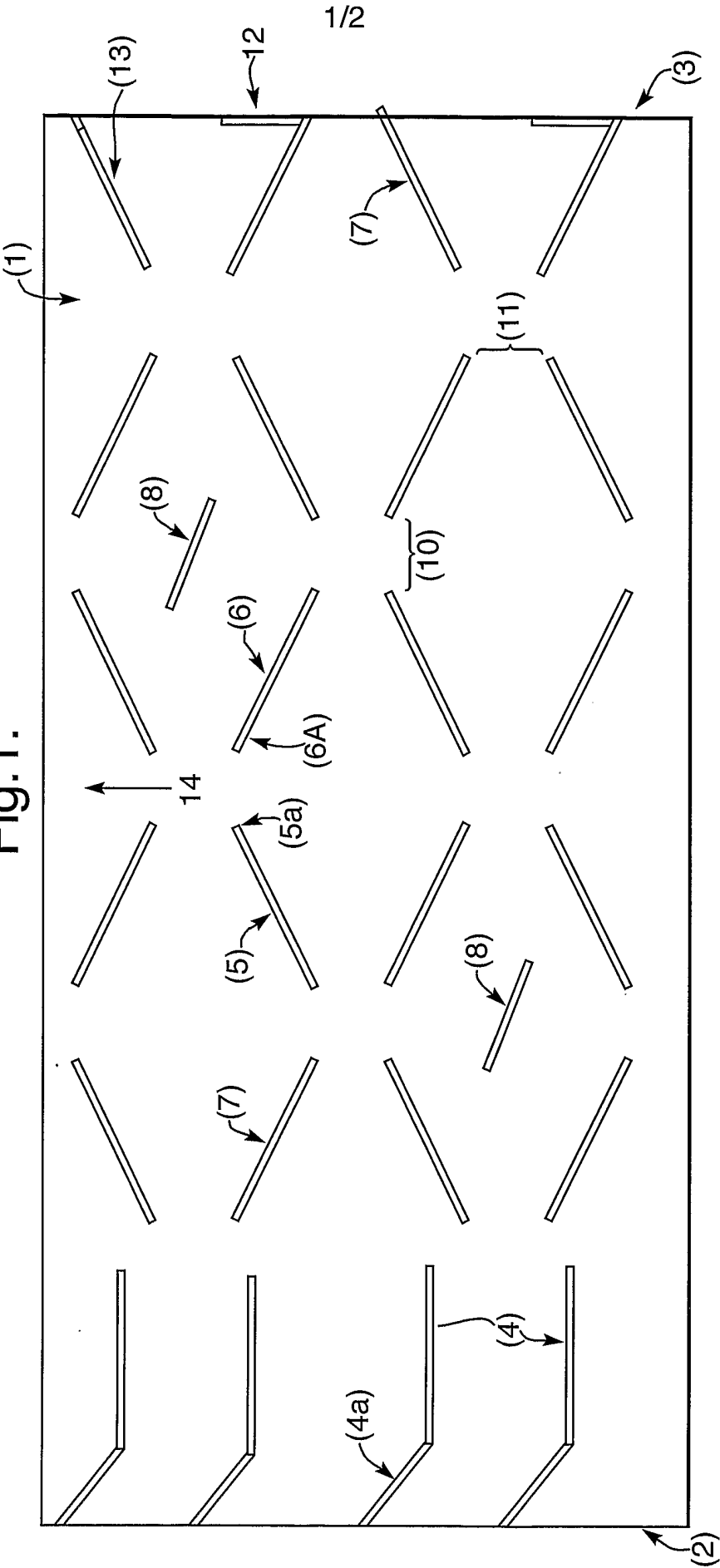
CLAIMS

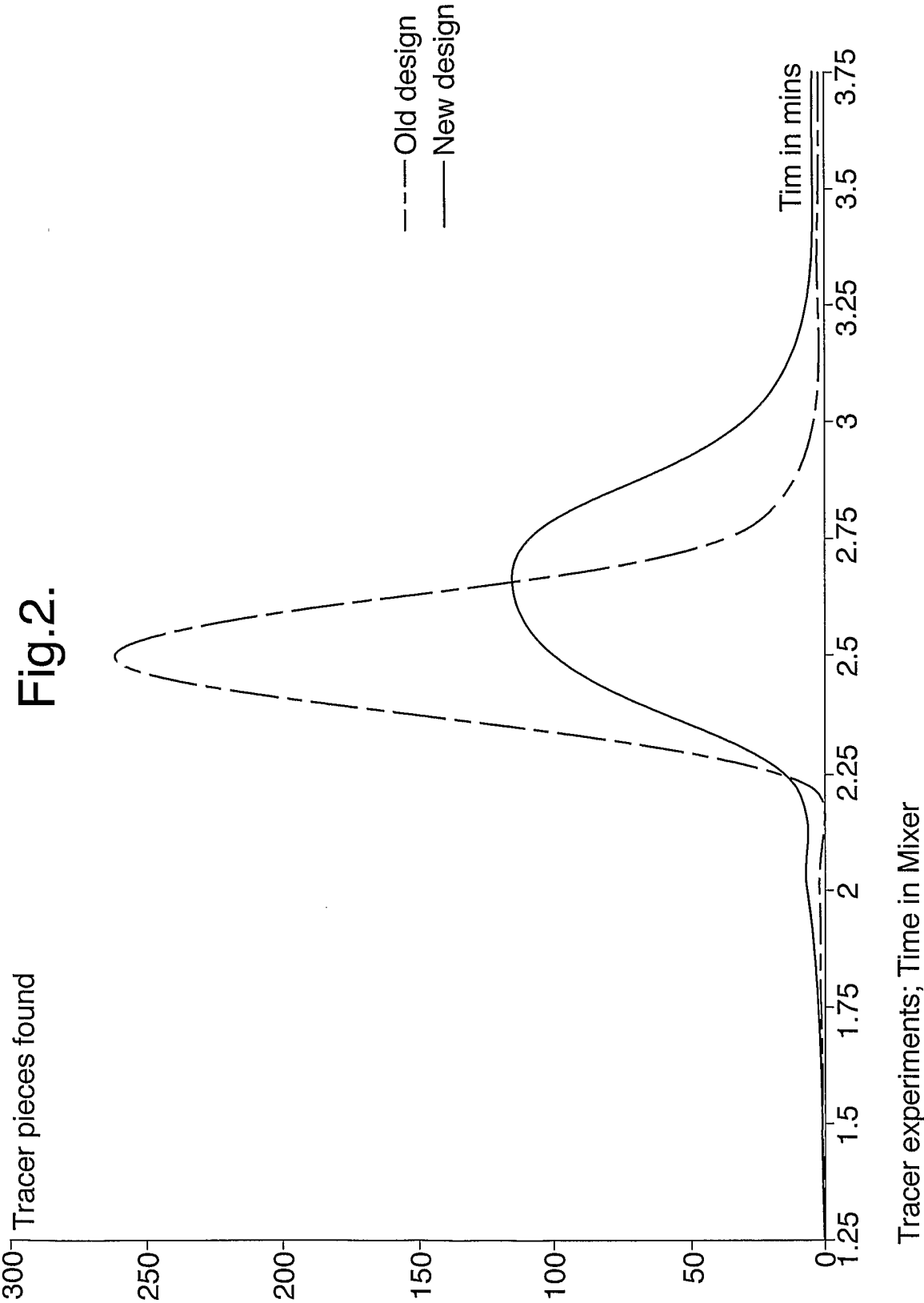
1. A mixer comprising of a hollow drum mounted for rotation
5 about its longitudinal axis and having inlet means at
one end and outlet means at the other end, and
containing at least one row of internal baffle plates
arranged in a substantially longitudinal direction and
fixed to the interior wall of the cylinder, said row has
10 at least two adjacent baffle plates which are angled
relative to the longitudinal axis of the drum in
opposite senses, the arrangement being such that one
plate directs powder backwards and the other directs
powder forwards, CHARACTERISED IN THAT the proximal
15 portions of the two plates are further advanced in the
direction of drum rotation than the distal portions.
2. A mixer according to claim 1 wherein the longitudinal
extent of each angled baffle plate is greater than the
20 circumferential extent of the baffle plates by a factor
of at least 1.2, preferably greater than 1.5.
3. A mixer according to claim 1 wherein the angle of the
baffle plate to the longitudinal axis of the drum is
25 such that the angle of the baffle plate to the top of
the powder bed when the mixer is operating is greater
than the angle of repose of the powder.
4. A mixer according to claim 3 wherein the angle of the
30 baffle plate to the longitudinal axis of the drum is no
more than 2 times the angle of repose of the powder.

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5. A mixer as described in claim 1 having a plurality of rows of baffle plates, arranged in pairs such that for each pair one row is arranged with the first baffle directing powder forward and the second baffle directing powder backward and the complementary row is arranged to have the opposite orientation, with the first baffle directing powder backwards and the second directing powder forwards.
6. A mixer according to claim 1 wherein baffle plates which are parallel to the longitudinal axis of the drum are provided, optionally with an initial section which directs powder into the drum.
7. A mixer according to claim 1 wherein at least the baffles closest to the outlet end and set to direct powder backwards has a slot at the base parallel to the cylinder wall which will allow some of the powder to flow under the baffle.
8. A mixer according to claim 5 wherein the baffles comprises circumferential rings of baffles which form a diamond pattern with longitudinal and radial gaps at each vertex of the diamond.
9. A mixer according to claim 8 wherein further baffles are provided in the centre of some of the diamonds.

Fig.1.





INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B01F B05C B01J B28C A23G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 751 218 A (CHERENSON E) 7 August 1973 (1973-08-07)	1-4
Y	column 3, line 18 - line 37 column 3, line 65 - column 4, line 12 column 5, line 51 - column 6, line 33 column 7, line 13 - line 45	7
A	figures 2,3	5,6,8,9
X	SU 1 006 241 A (GV DOROZHNYJ NII) 23 March 1983 (1983-03-23)	1-6,8
Y	the whole document	7
A	& DATABASE WPI Week 198404 Derwent Publications Ltd., London, GB;page 003, AN 022881 XP002291819 abstract	9
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

International Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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