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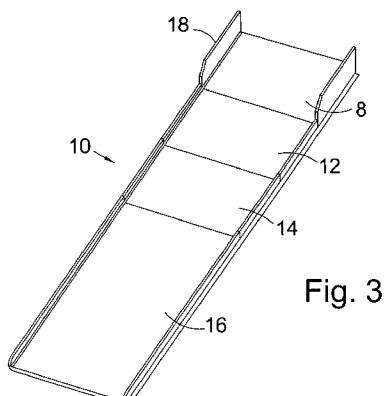
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(54) Title: CHUTES FOR SORTING AND INSPECTION APPARATUS



(57) Abstract: A chute for inspection and sorting apparatus has first and second flat (8,12) sections, with the lower end of the first section (8) being disposed over the second section (12) to form a step from which product falls onto the second section. Additional sections may be included.

Chutes for Sorting and Inspection Apparatus

5        This invention relates to chutes for use in inspection and sorting apparatus, particularly to such apparatus in which products are fed to a chute which delivers it to a sorting or inspection station. Sorting apparatus of this type is described in US Patent Nos. 4,513,868; 4,630,736; and 5,628,411, the disclosures whereof are hereby incorporated by reference. Inspection apparatus can use similar techniques but for the  
10      purpose of gathering data, rather than ejecting unacceptable pieces from the product stream.

15      For some products, grooved or channelled chutes are used to orient and position the product pieces when they leave the lower end of the chute. This facilitates the sorting or inspection process, and in sorting apparatus can help to ensure that devices and mechanisms used to eject pieces from the product stream operate only on the properly selected pieces.

20      In the sorting or inspection station in apparatus of the kind to which the invention relates, product is normally delivered from a supply hopper onto a vibratory feeder which discharges it to form a stream on a chute for delivery to a sorting or inspection station. At that station the apparatus will typically use an optical system to differentiate between product pieces of different quality, and ideally each product piece in the product stream is separate from all adjacent pieces so that individuals can be readily identified and as appropriate, ejected. At the same time it is of course desirable to have as many pieces as possible in the product stream. As the product flows off the  
25      vibrator it is moving relatively slowly. In some known apparatus, where the product feeds straight off a feeder tray onto a channelled chute, the product is fed straight into the channels. If two or more grains enter a channel at the same time they will travel side by side in the channel, a little slower than individual grains, that will catch up with them and then form bunches. Once in the channel there is a tendency for these  
30      bunches of product to travel at the same velocity and not separate out on the chute, thus passing the inspection station as bunches rather than individual spaced product pieces. This reduces the efficiency of the inspection and in sorting apparatus can cause more than one grain to be ejected if a defect is detected. To avoid this it is necessary to limit the rate of flow of product into the chute and the capacity of the

apparatus is reduced. This problem is addressed in International Patent Publication No: WO 2006/010 873, the disclosure whereof is hereby incorporated by reference. That publication discloses a chute having a first smooth section and a second grooved section receiving product from the first section and from which the product is eventually discharged.

We have found that the flow pattern of product down a chute in sorting or inspection apparatus of the kind referred to above can be improved by using a chute having stepped smooth sections. While the use of grooves or channels to align product pieces can be beneficial, they are not essential to achieve satisfactory separation. In other words, successive smooth sections in which the end of the earlier section forms a step from which product falls onto the later section, itself serves to separate product pieces from each other, facilitating differentiation between product pieces at the sorting or inspection station. It is believed that as product pieces tumble from one section to the next, bunched or attached product pieces are separated.

According to the invention, a chute for use in sorting or inspection apparatus has an upper and a lower end, with a first section at the upper end, and a second section for receiving product from the lower end of the first section. Both sections have a substantially even surface. Product is delivered, for example from a hopper over a vibrator, to the upper end of the first chute section, and discharged from the lower end of the second section. The lower end of the first section is disposed over the second section to form a step from which product falls onto the second section. The size or depth of the step will be set relative to the dimensions of the product being sorted or inspected. For example, for rice it will typically be equal to or greater than the mean length of the rice grains. In this respect, it will be appreciated that the depth of the step will normally be measured perpendicular to the surface of the later chute section, although the vertical length of the step will of course be dependent upon the inclination of the respective chute section surface. Typically this is 20° to 40° from the vertical.

In chutes according to the invention the surfaces of the first and second sections are substantially even, and normally flat and polished. The sections themselves can be formed as an aluminium alloy extrusion. However, the surfaces may themselves differ, such that the first chute section offers greater resistance to flow of product thereon than does the second. The chute section surfaces may have particular coatings to provide the desired resistance, and this also can be dependent

upon the nature of the product to be sorted or inspected. A useful surface coating, particularly for the second or lower chute section, is polytetrafluoroethylene. Alternatively, the chute surface can be treated to create particular surfaces. One such treatment is anodizing.

5 The chute of the invention has been described above as comprising first and second sections. However, three or more sections can be used if required, to progressively separate and organise product pieces before delivery to the sorting or inspection station. If a third or subsequent chute section is used, it may be formed with channels extending to its lower end so that the product pieces are not only separated, 10 but also substantially aligned upon delivery to the sorting or inspection station.

15 The length of each chute section relative to the total length of a multi-section chute of the invention can also be selected with reference to the product being sorted or inspected. With two sections, the length of the first will normally be 20 to 50% of the overall chute length. If three or more chute sections are used, the third or last section, which may be formed with channels or alternatively, shallow grooves. This section will normally be the longest section, and can be equal to or longer than the combined lengths of the earlier sections. This serves to stabilise the flow of product prior to discharge. In a typical chute having three sections, the length of the first section will normally be greater than that of the second section, but less than that of the third.

20 Each section in a chute according to the invention will normally be flat such that the sections define successive linear paths. However, one or more sections can have a curved profile. Particularly, some benefit can be had if the first section, which receives product from a feed station, defines a convex flow path. The last section can be convex or concave to accelerate or slow the acceleration of product just prior to 25 discharge to the sorting or inspection station.

30 Sorting apparatus using a chute according to the invention will as noted above, normally have an optical system at the sorting station. Suitable optical sorting systems are described in the Patents referred to above. At the upper end of the chute a feed station normally comprises a horizontal conveyor 4 carrying product from a hopper or other reservoir to be fed to the chute. Typically, the conveyor is a vibratory feeder providing uniform delivery of the product pieces to the chute.

As noted above, the invention is equally useful in inspection apparatus in which product in the stream leaving a chute is inspected for the purposes of data retrieval rather than sorting. Similar inspection mechanisms can be employed as are used in sorting apparatus of the kind just referred to. Such inspection is useful to gather 5 attributes about the product flowing through the machine such as broken or distorted product pieces.

Chutes of the invention are particularly suited to sorting or inspecting product with a relatively high concentration of defective product. One application of the invention is in "re-sorting" processes which involve two or more stages. In the first 10 stage, only very high quality product is accepted by allowing quite a lot of good to be rejected with the poor quality product. The reject from this first pass, which has a higher concentration of defective product, is then sorted again in a second pass to recover most of the good product. Chutes of the invention may be used in primary, secondary and subsequent sorting stages.

15 Chutes of the present invention are useful in apparatus for sorting and inspecting a wide range of products including for example, coffee beans and rice. Product having a generally elongate shape will of course tend to align themselves naturally in channels or grooves, but the channels and grooves are also effective for controlling the movement of product having widely different shapes.

20 The invention will now be described by way of example and with reference to the accompanying schematic drawing wherein:

Figure 1 illustrates sorting or inspection apparatus using a chute according to the first embodiment of the invention; and

25 Figure 2 illustrates sorting or inspection apparatus using a chute according to a second embodiment of the invention;

Figure 3 is a front perspective view of a chute according to a third embodiment of the invention; and

Figure 4 is a front perspective view of a chute according to a fourth embodiment of the invention.

Figure 1 illustrates sorting apparatus of the kind disclosed in International Patent Publication No: WO 2006/010 873, referred to above. It comprises an input hopper 2 which delivers product to be sorted or inspected to a tray 4 mounted on a vibratory feeder 6. Operation of the feeder delivers product to the upper end of the first 5 section 8 of a chute 10. This first section 8 has a highly polished smooth surface, typically of aluminium. Product released onto this first section 8 moves freely laterally and downwardly on the surface and is delivered to the second section 12. The second section 12 also has a highly polished smooth surface along which the product continues to flow. A typical highly polished surface has a roughness average 10 measured in the lateral direction of 0.2 microns. As an alternative to highly polished surfaces, one or both of the first and second sections can be treated or coated to create particular surface characteristics. A typical surface treatment is anodizing. A typical surface coating is polytetrafluoroethylene.

The product pieces fall from the discharge end 20 of the chute into the 15 inspection zone 22. In the inspection zone 22 the product pieces are illuminated and monitored using optical techniques of the kind disclosed in the patents referred to above. If the apparatus is used for inspection only, then the product pieces continue unimpeded into the receptacle 24. If the apparatus is for sorting, then an ejector 26 normally a pneumatic ejector, is included to eject pieces from the product stream in 20 response to signals generated by the inspection devices. Ejected product pieces are deflected from the product stream into a reject receptacle 28.

Figure 2 illustrates apparatus essentially similar to that of Figure 5, but in which the first section 8 of the chute has a curved profile. With this profile, product pieces delivered from the tray 4 accelerate on the section 8 towards the second section 12 a 25 little more slowly, and this can be of assistance where the delivery rate from the tray is relatively slow, and there is a need or desire to slow the rate of delivery of product to the second section. This can improve the lateral separation of product pieces.

A typical chute according to the invention will have a width of around 300 mm, and a length of around 1200 mm. The length of the first section will normally be at 30 least 20%, and preferably no more than 50% of the overall chute length. In the embodiment of Figure 1 it is around 500 mm long; around 40%. The depth of the step, perpendicular to the plane of the chute surface will normally be at least 0.5 mm and

typically 2 to 3 mm, but a particular depth will be selected to suit the product on the chute.

The transition from the first section 8 to the second section 12 is a step whose depth is determined relative to the nature of the product being sorted or inspected. As 5 product falls over the step and tumbles onto the second section 12, bunched or attached product pieces become separated. For many products a single step of this kind will result in the product pieces being sufficiently separated to enable them to be effectively differentiated at the sorting or inspection station, and they can therefore be released directly from the second section to the sorting or inspection station. However, 10 if a single "step" does not achieve sufficient separation, then one or more additional steps can be created by the inclusion of one or more additional chute sections. A chute having four sections is shown in Figure 3. As can be seen, the first, second and third sections 8, 12 and 14 are of substantially equal length. The fourth section 16 has a length substantially equal to the accumulated length of the earlier sections. The 15 chute of Figure 4 has three sections, of which the third has elongate channels in which product released from the second section is aligned before discharge to the sorting or inspection station. As can be seen, in Figure 4 the channelled section 16 is considerably longer than either of the first and second sections, and that the first section is longer than the second. The first section is bounded by wings 18 to reduce 20 product spillage on delivery.

The channels of the third section 16 can have a standard U-shaped or V-shaped cross-section, and described in WO 2006/010 873, referred to above and incorporated by reference. Depending upon the product for which the chute is to be used, each channel may have a cross-sectional area in the range 2 mm<sup>2</sup> to 25 mm<sup>2</sup>. A 25 typical depth of each groove is no more than 3mm. In a particular variant, the channels can take the form of shallow grooves, each having a depth of around 0.5 mm. In cross-section, such a surface appears as corrugated, or a shallow sinusoidal curve, with the pitch of each groove being in the range 2 to 2.5 mm.

As product moves along each section of a chute according to the invention, it is 30 accelerating under gravity. This movement is disrupted at each transition, and the final section is made longer to provide for a longer period of continuous acceleration before discharge to the sorting or inspection station. The rate at which product moves down the chute sections can be controlled by the respective surfaces. These can be created

by particular coatings selected having regard to the product under consideration. Highly polished surfaces provide minimal resistance to dry product. Some plastics coatings, such as polytetrafluoroethylene, are effective with product having some moisture content. If successive chute sections are to offer different resistance to 5 passage of product, then the resistance offered by a chute section should normally be less than that of the section from which it is receiving product. In some embodiments the chute sections can be moved relative to one another to alter their respective lengths. This can be readily accomplished by having the one or each upper section supported in the respective adjacent lower section.

10 The sections in chutes according to the invention will normally be manufactured separately, and mechanically secured to form a single assembly for installation in sorting or inspection apparatus of the kind described. The sections themselves may be extrusions in an aluminium alloy, and the surfaces adapted for the particular purpose of the apparatus in which the chute is to be installed. The feed surface in each section 15 can be polished or coated to provide the appropriate feed properties and protection against corrosion. The surface in each chute section can as noted above, also be selected to provide the requisite encouragement or resistance to motion of product therealong.

**CLAIMS**

1. A chute for use in sorting or inspection apparatus for delivering product from a feed station in free flight to a sorting or inspection station, which chute has an upper end and a lower end, and comprises a first section at the upper end with a substantially even surface for receiving product from a said feed station; and a second section with a substantially even surface for receiving product from the end of the first section, the end of the first section being disposed over the second section to form a step from which product falls onto the second section.  
5
2. A chute according to Claim 1 wherein the surface of the first chute section provides greater resistance to the flow of product thereon than does the surface of the second chute section.
3. A chute according to Claim 1 wherein the surfaces of the first section and  
15 section chute sections are flat and polished.
4. A chute according to Claim 1 or Claim 2 wherein at least one of the chute section surfaces is coated.
5. A chute according to Claim 5 wherein the surface coating comprises polytetrafluoroethylene.
- 20 6. A chute according to Claim 1 or Claim 2 wherein at least one of the chute sections has been subject to surface treatment.
7. A chute for use in sorting or inspection apparatus for delivering product from a feed station in free flight to a sorting or inspection station, which chute has an upper end and a lower end, and comprises a first section at the upper end with a substantially even surface for receiving product from a said feed station; and a second section with a substantially even surface for receiving product from the end of the first section, the end of the first section being disposed over the second section to form a step from which product falls onto the second section; and a third chute section for receiving product from the end of the second section, the end of the second section being  
25

disposed over the third section to form a step from which product falls onto the third section.

8. A chute according to Claim 7 wherein the surface of the third chute section is formed with channels extending to the lower end of the chute for delivering product to a  
5 said sorting or inspection station.

9. A chute according to Claim 8 wherein the channels are in the form of shallow grooves.

10. A chute according to any of Claims 7 to 9 wherein the length of the first chute section is greater than the length of the second section and less than the length of the  
10 third chute section.

11. A chute according to any of Claims 7 to 10 wherein the length of the chute section from which product is delivered to the sorting or inspection station is greater than the length of any other section.

12. A chute according to any of Claims 7 to 11 comprising a total of four chute  
15 sections.

13. A chute according to any preceding Claim wherein at least the first section has a curved profile.

14. A chute according to any preceding Claim wherein the chute sections can be moved relative to one another to alter their respective lengths.

20 15. Sorting or inspection apparatus including a chute according to any preceding Claim.

25 16. Sorting apparatus comprising a feed station and a sorting station; and a chute for delivering product from the feed station in free flight to the sorting station, which chute has an upper end and a lower end, and comprises a first section at the upper end with a substantially even surface for receiving product from a said feed station; and a second section with a substantially even surface for receiving product from the end of the first section, the end of the first section being disposed over the second section to form a step from which product falls onto the second section.

17. Inspection apparatus comprising a feed station and an inspection station; and a chute for delivering product from the feed station in free flight to the inspection station, which chute has an upper end and a lower end, and comprises a first section at the 5 upper end with a substantially even surface for receiving product from a said feed station; and a second section with a substantially even surface for receiving product from the end of the first section, the end of the first section being disposed over the second section to form a step from which product falls onto the second section.

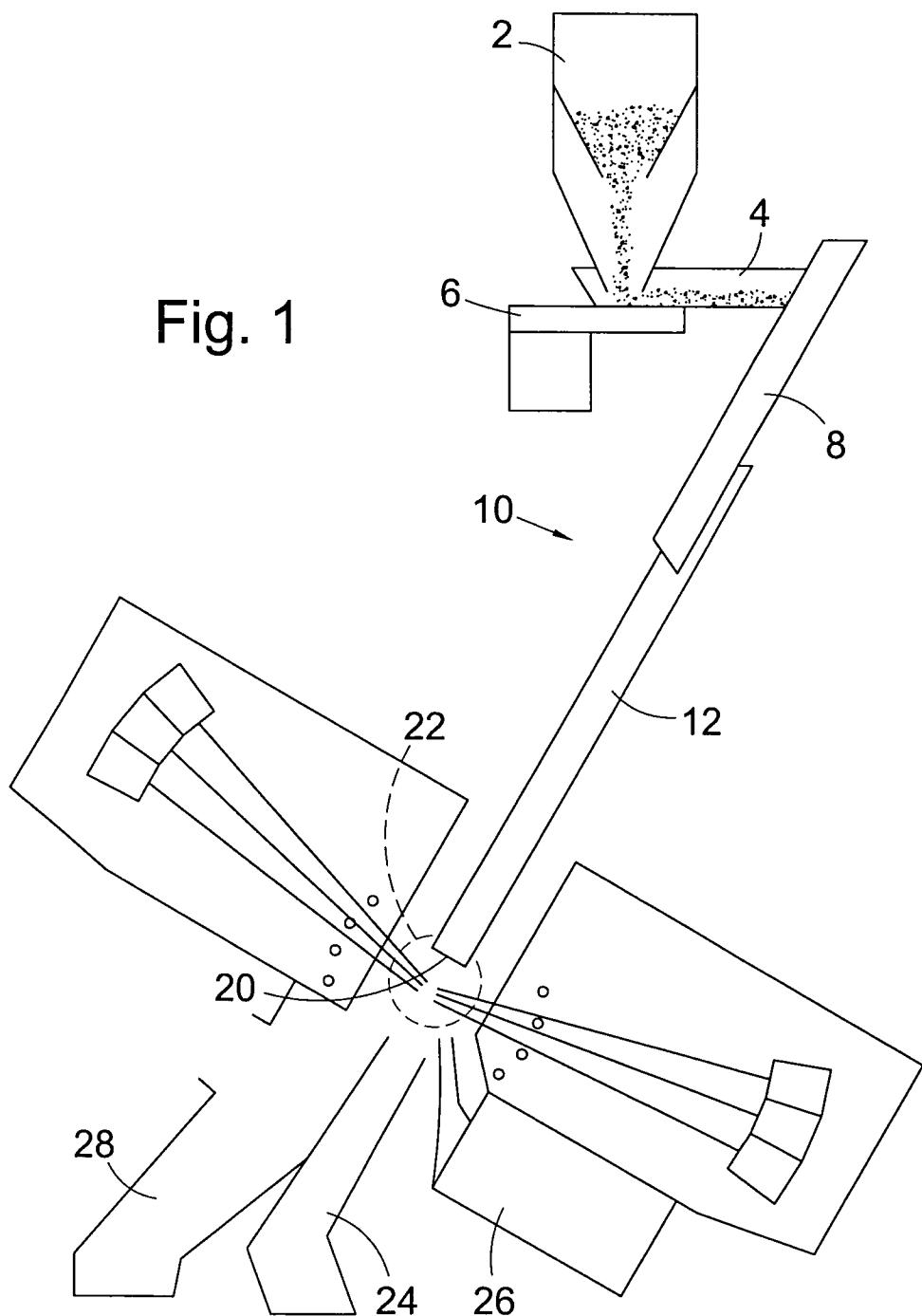
18. Apparatus according to Claim 16 or Claim 17 including a straight chute section 10 inclined to the vertical at an angle in the range 20° to 40°.

19. Apparatus according to Claim 18 wherein the straight section is that from which product is released in free flight.

20. Apparatus according to any of Claims 16 to 19 wherein the chute includes at 15 least a third chute section for receiving product from the end of the second section, the end of the second section being disposed over the third section to form a step from which product falls onto the third section.

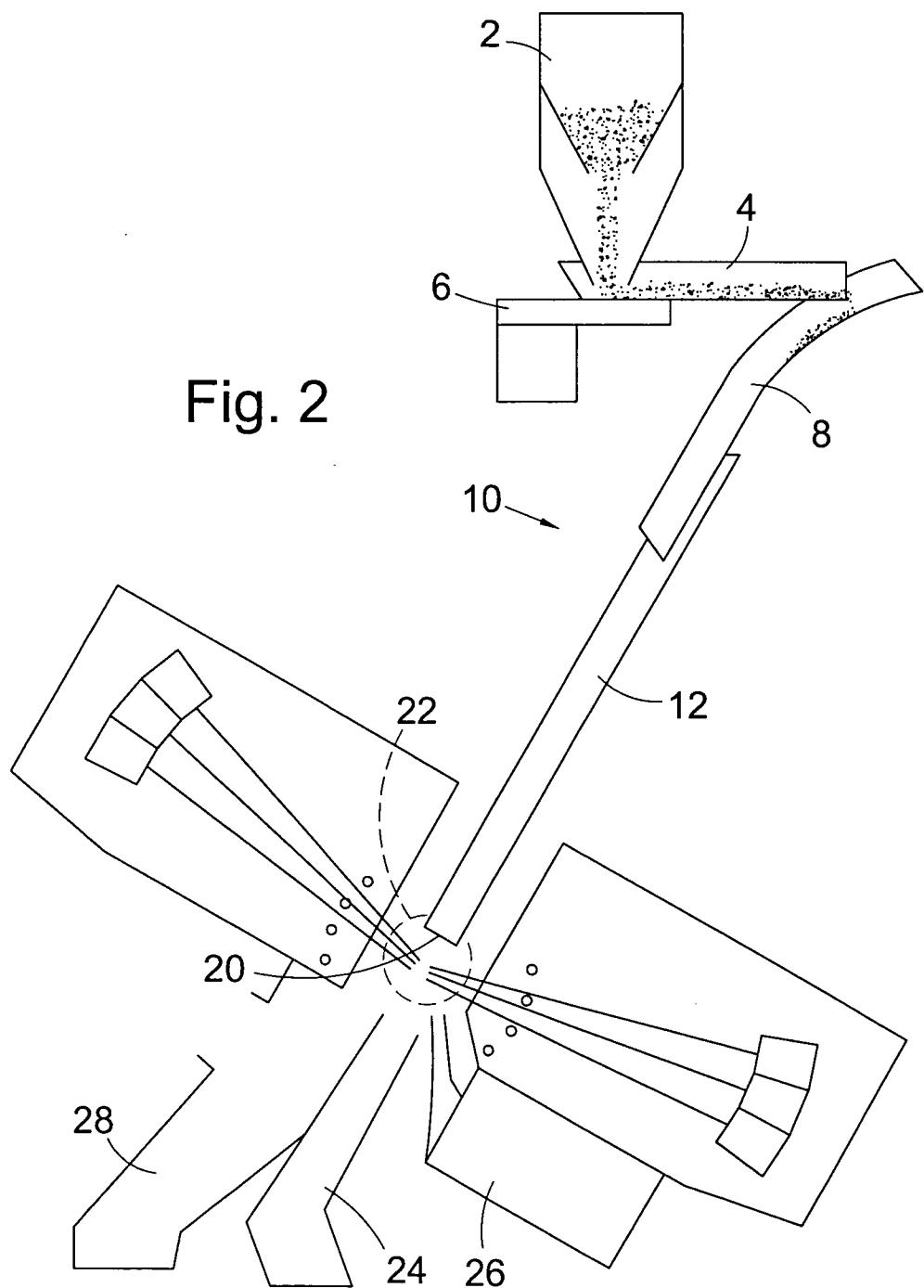
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Fig. 1



2/3

Fig. 2



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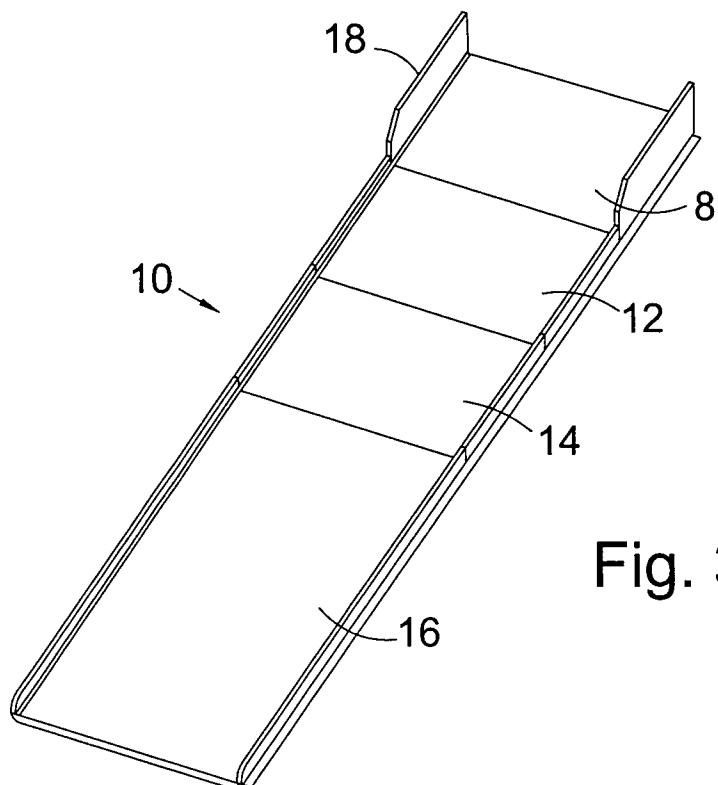


Fig. 3

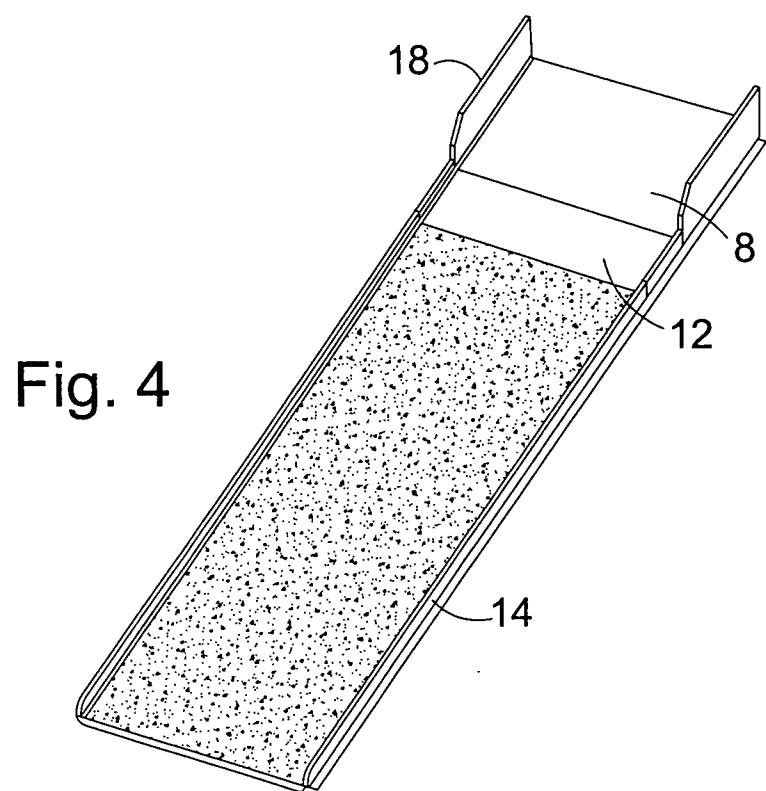


Fig. 4

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2009/002494

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. B65G11/08

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
B65G

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	the whole document	14 3-6,13, 15-20
Y	----- DE 10 2004 050493 A1 (GAEUBODEN KRAEUTER GBR VERTRET [DE]) 20 April 2006 (2006-04-20) paragraph [0027]	3-5
Y	----- GB 1 404 230 A (GUNSONS SORTEX LTD) 28 August 1975 (1975-08-28) page 3, line 31	6
Y	----- US 6 347 696 B1 (ROBINSON JAMES T [US]) 19 February 2002 (2002-02-19) figures 3,10	13
	----- -/-	

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Schneider, Emmanuel

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2009/002494

**C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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# INTERNATIONAL SEARCH REPORT

## Information on patent family members

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