(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 884 113 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.12.1998 Bulletin 1998/51

(51) Int. Cl.[6]: **B07B 13/065**, A01D 33/08

(21) Application number: **98201924.2**

(22) Date of filing: **09.06.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **10.06.1997 NL 1006272**

(71) Applicant:
van der Poel, Johannes Godefridus Gerardus
2371 AG Roelofarendsveen (NL)

(72) Inventor:
van der Poel, Johannes Godefridus Gerardus
2371 AG Roelofarendsveen (NL)

(74) Representative:
Bakkum, Ruben Joseph
van Exter Polak & Charlouis B.V.,
P.O. Box 3241
2280 GE Rijswijk (NL)

(54) Method and device for sorting objects, in particular fruit and bulbous plants, with regard to their cross-sectional dimension

(57) A description is given of a method and a device for sorting objects, such as fruit and bulbous plants, with regard to their cross-sectional dimension. The objects are placed on at least one pair of cords which are situated next to one another and at a distance apart and diverge from one another in the direction of transport, the cords moving at different velocities from one another and the velocity of at least one of the cords of a pair being varied periodically. As a result, the objects are made to rotate in a varying manner about a characteristic axis of rotation which is defined by the shape of these objects. In this way, the objects are sorted with great accuracy with regard to the largest dimension, as measured substantially perpendicular to the said axis of rotation. A description is also given of a device for carrying out the said method.

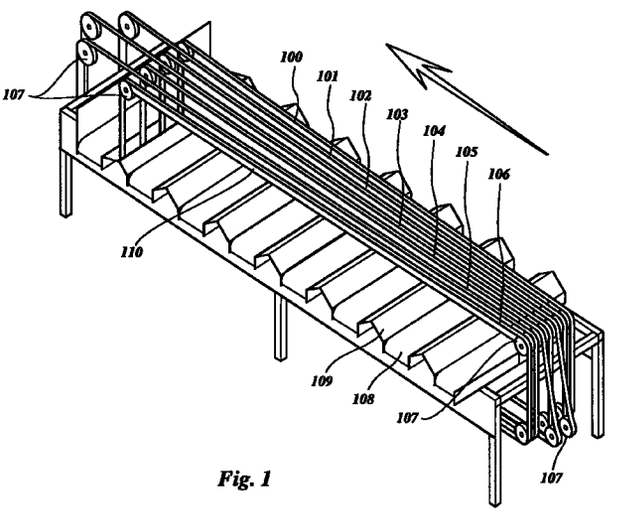

Fig. 1

EP 0 884 113 A1

Description

The invention relates to a method for sorting objects, in particular fruit and bulbous plants, with regard to their cross-sectional dimension, by placing these objects on at least one pair of cords which are situated next to one another and at a distance apart, diverge from one another in the direction of transport.

A method of this kind, in which the objects to be sorted therefore fall through between the diverging cords further downstream as their cross-sectional dimension increases, is e.g. known from German Patent Application DE-A-3,124,446.

The problem with unround objects is that their cross-sectional dimension is not constant. In DE-A-3,124,446, the cords situated next to one another are moved at different, constant velocities with respect to one another, an effect which is achieved by the fact that the cords are driven via pulleys of different diameters on a common drive shaft. The difference in velocity between the cords results in rotation of the objects to be sorted on the cords, leading to a uniform positioning of the objects for sorting, i.e. with their dimension to be sorted transverse to the direction of transport of the cords.

The known method therefore provides better sorting than if cords which move at the same velocity are used. However, despite the difference in velocity between the cords, the velocity ratio of the cords is constant. It may therefor happen that the objects which have been put on the cords do not change position to a desirable extent when being conveyed along the cords, and consequently are sorted with regard to an incorrect dimension.

FR-A-1 076 299 describes a sorting method of the same kind. The ratio of the velocities of two diverging adjacent cords may be chosen from a limited number fixed ratios by a positional change of a drive belt when the sorter is in rest; said ratio is however constant during transport of the objects over the cords.

The object of the present invention is to improve the abovementioned method in such a manner that objects can be sorted with regard to their cross-sectional dimension with increased accuracy, and to this end is characterized in that the ratio of the velocities of the cords of a pair is varied during the transport of the objects over the cords. In this application, a pair of cords means two cords which are positioned next to one another. It will be clear that if three or five cords are used, two or four pairs of cords, respectively, are formed. The said ratio can be defined at the quotient of V_1/V_2, V_1 being the velocity of one cord of the pair, and V_2 being the velocity of the other cord of the pair. Herein, this ratio is also referred to as "velocity ratio". Depending on the objects to be sorted, the velocity ratio may be kept constant during a certain period and may even equal 1; at least once during the transport of each object, a change in velocity ratio should take place.

As a result of the variation in velocity ratio, the objects which are subjected to the sorting method are provided with a varying rotational velocity, resulting in an improved rotation of the objects on the cords and as a result, the objects move more quickly into the desired sorting position.

It is however preferred, that the velocity ratio does not equal 1 and that the ratio is varied a number of times during the transport of the objects. Advantageously, the velocity ratio between the cords of a pair is varied periodically. By varying the velocity of one or both cords of a pair in this way, it is possible to improve the desired effect of varying rotation of the objects, and sorting can be carried out even more efficiently.

It is also possible to vary the velocity of only one of the cords of a pair, and drive the remaining cord with a constant velocity. Advantageously, the velocity of both cords are changed periodically. Very effective rotation of the objects, and consequently improved sorting, are obtained by varying the velocity of each cord (V_1 and V_2 resp.) between a maximum and a minimum value in two respectively alternating periods of substantially identical duration, the periods of the cords belonging to the same pair being staggered by 180° in phase with respect to one another. In this case, one cord of a pair is at its maximum velocity when the adjacent cord/cords is/are at its/their minimum velocity. The latter cords are at their maximum velocity when the former cord is at its minimum velocity.

Most advantageously, the minimum and maximum values of the velocities of all the cords are selected to be identical. In this way, the objects which are to be sorted using the method are rotated alternately to the left and to the right, thus achieving an optimum sorting action. Moreover, objects which are difficult to rotate or are not positioned optimally on the cords are nevertheless rotated very quickly.

Particularly with relatively large objects, it may be advantageous to change the periods, as calculated over the effective sorting length of the cords, a number of times, preferably four to five times.

The invention furthermore relates to a device for sorting objects, in particular fruit and bulbous plants, with regard to their cross-sectional dimension, at least comprising a pair of endless cords which run at a distance from one another over pulleys and diverge with respect to one another, and drive means, which are able to drive the cords at different velocities, as is known from DE-A-3,124,446. The device according to the invention is characterized in that the drive means are designed in such a way that in use, the ratio of velocities of the cords of a pair can be varied during transport of the object over the cords. A device of this kind can be used to sort objects in accordance with the method of the present invention. Hereto, the velocity at least of the cords of a pair can be varied in relation to the other cord of the same pair. E.g. a drive means drives one of the cords of a pair with a constant power, leading to a con-

stant velocity of said cord, whereas another drive means is present driving the other cord of the same pair in a sinusoidal fashion, so that the velocity of said second cord is continuously varied, leading to a varying ratio of the velocities of the cords of the pair during the use of the device.

Advantageously, both cords of a pair can be driven at varying velocities in order, as has already been discussed above, to rotate the objects to be sorted better and more quickly, thus achieving improved sorting.

Advantageously, adjustment means are present for periodically varying the velocity ratio of the cords. Means of this nature are used to make the velocities of the cords, as well as the duration of the periods in which the velocity of each cord is varied, adjustable. In this way, depending on the desired sorting capacity and the objects to be sorted, the device can always provide optimum sorting functions by applying the correct adjustments. It is preferable for these means to be electronic adjustment means, by means of which the drive means are controlled.

In a preferred embodiment, the pulleys which guide the cords are equipped with a circumferential rib, which interacts in a guiding manner with a corresponding guide groove in the internal circumferential face of the cord running over the pulley, and a stationary guide rib is optionally arranged in the path of the active part of each cord, the rib interacting with the guide groove of the corresponding cord, the cords having a substantially roof-shaped cross-section, with the groove arranged in the base thereof.

Devices for sorting objects with regard to their cross-sectional dimension comprising ribs on the pulley and optionally on separate guiding parts are described in US-A-2 776 746. It has been found that during sorting in devices of this nature, transverse forces are often exerted on the cords. Because of the presence of the ribs, the cord cannot run off the pulley, because the presence of the rib ensures that the tilting movement which is required in order to lift the cord over the rib so that it runs off the pulley, cannot take place. Moreover, in the event of a force being exerted on the cords in a direction transverse to the direction of transport, the result is that an increased force is exerted by the cord on the pulley, with the result that they in fact interact with one another even more efficiently.

A stationary guide rib of the abovementioned kind prevents the cord in question from deviating laterally and hence prevents an object from passing prematurely through an opening between the cords which is actually too narrow.

A cord having a substantially roof-shaped cross-section prevents the objects to be sorted to lie on the cords, but directs the objects to the space between the cords, preventing incorrect sorting. With this form of cord, exerting a force which is directed laterally with respect to the direction of transport will lead to improved engagement of the cord on the pulley.

Preferably, the cords are of truncated roof-like design. This increases the flexibility of the cords in the radial direction, and also improves the correct guidance of the cord. Other cord forms, for example with planar or convex cross-sections, may also be suitable.

When the cords of a pair of cords, or at least the active parts thereof, in the device run in the same horizontal plane, the lateral forces produced do not have a component directed vertically upwards, which could easily cause the cord to run off one of the pulleys. Moreover, in this way the lateral forces are taken up in an optimum manner by the guide rib in question.

The invention furthermore relates to a device for sorting objects, in particular fruit and bulbous plants, with regard to their cross-sectional dimension, at least comprising a pair of endless cords which run at a distance from one another over pulleys delimiting the active part of the cords, the cords diverge with respect to one another, in which device of each cord at least one pulley is arranged so as to be axially adjustable in relation to the other axially adjustable pulleys, said pulleys delimiting the same side of the active part of the cords.

With a device of this nature, it is possible to adjust the extent of divergence and the distance between the cords. With the same side, one of the common edges of the active part of the cords (i.e. the upstream edge or the downstream edge formed by the total of the cords) is meant. Preferably, both pulleys are axially adjustable at their respective edges. In this way, the device can be used for sorting various objects with regard to their cross-sectional dimension, and the accuracy of sorting can also be adapted.

In the device according to the present invention, each cord may be provided with its own drive shaft and may be connected to its own drive motor. The change in the periods can be effected by actuating the motor by means of frequency regulators and time switches. In that case, a relatively lightweight and low powered drive motor is sufficient for each driven cord. However, it is also possible for the device to comprise, for example, two independent drive shafts, in which case one cord of each pair of cords is connected to one drive shaft and the other cord is connected to the other drive shaft, in such a manner that the cords are alternately driven in each case by the other drive shaft. This has the advantage that only one variable drive is required if only one of the cords of a pair of cords is to be driven at a periodically varying velocity. If both cords of a pair of cords are driven at periodically varying velocities, this case only requires two drive motors, one motor being connected to one drive shaft and the other motor being connected to the other drive shaft. Obviously, in this case the two drive motors are heavier than if each cord is driven by a separate drive motor. In the case of two common motors, problems relating to synchronization of the cords will arise less quickly.

The cords of each pair, or at least the active parts thereof, can also run in a common horizontal plane,

which is not possible with the known devices, in view of the different diameters of the pulleys which are situated on a common shaft. The advantage of this is that the transverse forces which are exerted on the cords by the objects during sorting (see above) do not have a vertical, upwardly directed component, as in the known device. Moreover, the transverse forces are in this way taken up in an optimum manner by the guide rib in question, leading to improved engagement of the cord on the guide rib or pulley.

The invention is described in more detail with reference to the drawing of a number of exemplary embodiments, in which:

Fig. 1 shows a schematic view of a simplified form of the device according to the present invention,
Fig. 2 shows a cross-section through a cord and a pulley or guide rib interacting therewith, and
Fig. 3 shows a schematic end view of the device, depicting the means for axially adjusting the cords.

The device shown in Fig. 1 comprises, by way of example, seven cords 100-106, which together form six pairs of cords (respectively 100-101, 101-102, 102-103, 103-104, 104-105 and 105-106). The cords are disposed so as to diverge in the direction of transport, which is indicated by an arrow. The cords 100-106 are guided over pulleys 107, which are provided with a circumferential guide rib. Further, the active parts of the cords 100-106 are each supported by a guide rib 110. The cords are each connected, via one of their pulleys, to a separate drive means (not shown), and can be driven at a variable rotational velocity, in such a manner that the cords 100, 102, 104 and 106, all at the same velocity, move more quickly than cords 101, 103 and 105, which also all move with a common, albeit lower velocity. With changing periods, however, the cords 100, 102, 104 and 106 will all move more slowly than the cords 101, 103 and 105. Belts 108, which move transversely to the direction of movement of the cords, are situated beneath the active part of the cords in order to collect objects which fall through between the cords during sorting, which moving belts 108 are in each case delimited on either side by partitions 109.

Fig. 2 shows the cross-section through a preferred embodiment of a cord 200 which is in the shape of a truncated roof and the base of which is provided with a groove 201 which interacts with rib 202 of the pulley or guide rib 203. In the event of a horizontal force being exerted on inclined side 204 of the cord, the base of the cord 200 will be pressed against the pulley or guide rib 203.

Fig. 3 diagrammatically depicts a width adjustment device, which is situated in the region of one of the ends of the active part of the cords. The cords 300, 301, 302, 303, 304, 305 and 306, which are guided by pulleys 310, 311, 312, 313, 314, 315 and 316, respectively, are each connected to a frame 320, 321, 322, 323, 324, 325 and 326, respectively. At the underside of each frame, a pulley 330, 331, 332, 333, 334, 335 and 336 is located for guiding back the cords 300, 301, 302, 303, 304, 305 and 306, respectively, Two of the frames, in this case frame 320 and frame 326, are each connected, via an internal screw thread 317 and 318, respectively, to a shaft 307 which is provided with an opposite external screw thread and is mounted fixedly in the axial direction in a bearing 350 in the frame 323. The adjacent frames 321, 325 are connected to the respective frames 320 and 326 by in each case two mutually intersecting arms 340, 341 and 342, 343, respectively. For their part, frames 321 and 325 are connected in the same way to adjacent frames, etc. By rotating shaft 307, depending on the direction of rotation, frames 320 and 326 will be moved towards one another or away from one another, with the result that the other frames 321-325 move towards one another or away from one another in a corresponding manner via the concertina-like arms, with the result that the distance between the cords is varied.

The operation of the device will be explained briefly below.

At the start of the active part, i.e. at the location where the cords are situated closest together, the device is loaded with objects which are to be sorted with regard to their cross-sectional dimension. The objects are moved towards the other end of the active part by means of the moving cords, with the objects each being in contact with both cords of a pair of cords. The velocities of these cords are varied periodically with respect to one another. As a result, the objects are effectively rotated about a characteristic axis of rotation which is defined by the shape of these objects. Due to the fact that the cords diverge in the direction of transport, the aligned objects will fall down between the diverging cords at that location where the distance between the cords first becomes larger than the cross-section of the object, which cross-section is situated substantially perpendicular to the said axis of rotation. Once they have fallen down between the cords, the sorted objects are collected on the moving belts which are situated beneath the cords and convey the objects onwards to, for example, a container or processing device.

Claims

1. Method for sorting objects, in particular fruit and bulbous plants, with regard to their cross-sectional dimension, by placing these objects on at least one pair of cords (100-106) which are situated next to one another and at a distance apart, diverge from one another in the direction of transport, characterized in that the ratio of the velocities of the cords of a pair is varied during transport of the objects over the cords.

2. Method according to claim 1, characterized in that the velocity ratio between the cords of a pair is var-

ied periodically.

3. Method according to claim 2, characterized in that the velocity of both cords of a pair varies between a maximum and a minimum value in two respectively alternating periods of substantially identical duration, the periods of the cords belonging to the same pair being staggered by 180° in phase with respect to one another.

4. Method according to claim 3, characterized in that the minimum and maximum values of the velocities of all the cords are selected to be identical.

5. Device for sorting objects, in particular fruit and bulbous plants, with regard to their cross-sectional dimension, at least comprising a pair of endless cords (100-106) which run at a distance from one another over pulleys (107, 108, 109, 114) and diverge with respect to one another, and drive means, which are able to drive the cords at different velocities, characterized in that the drive means are designed in such a way that in use ratio of the velocities of the cords of a pair can be varied during transport of the objects over the cords.

6. Device according to claim 5, characterized in that both cords of a pair can be driven with varying velocities.

7. Device according to claim 5 or 6, characterized in that adjustment means are present for periodically varying the velocity ratio of the cords.

8. Device according to one or more of claims 5-7, characterized in that the pulleys which guide the cords are equipped with a circumferential rib which interacts in a guiding manner with a corresponding guide groove in the internal circumferential face of the cord running over the pulley, a stationary guide rib (115) optionally being arranged in the path of the active part of each cord, said rib interacting with the guide groove of the corresponding cord, the cords having a substantially roof-shaped cross-section, with the groove arranged in the base thereof.

9. Device according to claim 8, characterized in that the cross-section of the cords is designed in the form of a truncated roof.

10. Device for sorting objects, in particular fruit and bulbous plants, with regard to their cross-sectional dimension, at least comprising a pair of endless cords which run at a distance from one another over pulleys delimiting the active part of the cords, the cords diverge with respect to one another, characterized in that of each cord at least one pulley is arranged so as to be axially adjustable in relation to the other axially adjustable pulleys, said pulleys delimiting the same side of the active part of the cords.

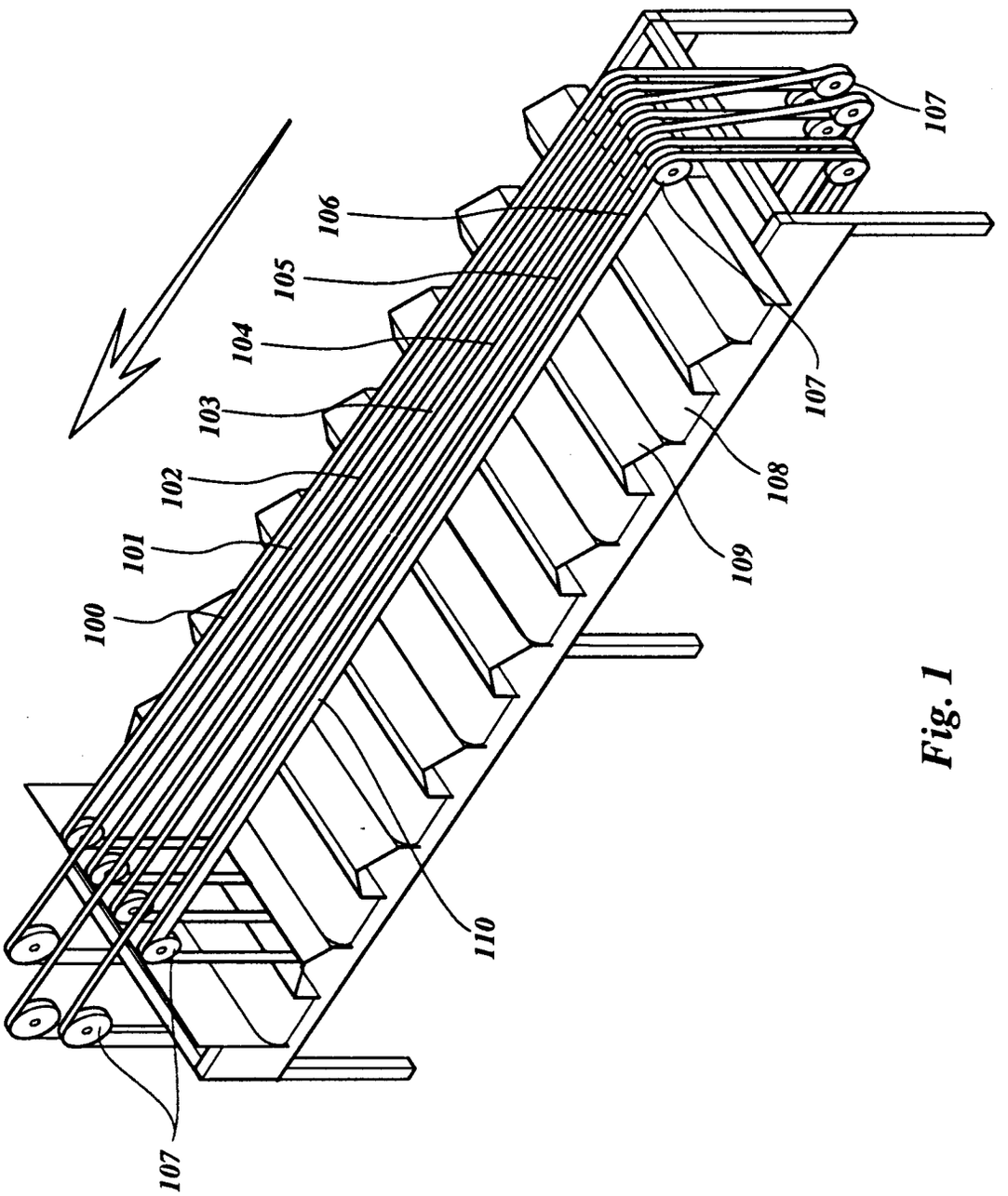

Fig. 1

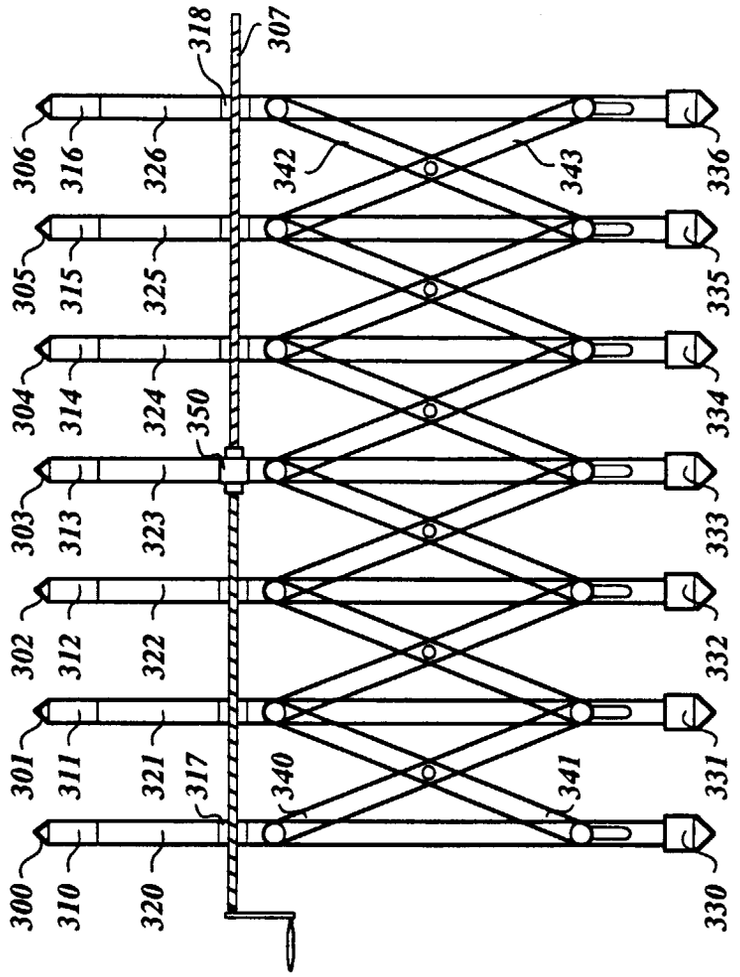
318
307
306
316
326
342
343
336
305
315
325
335
304
314
324
350
334
303
313
323
333
302
312
322
332
301
311
321
317
340
341
331
300
310
320
330

Fig. 3

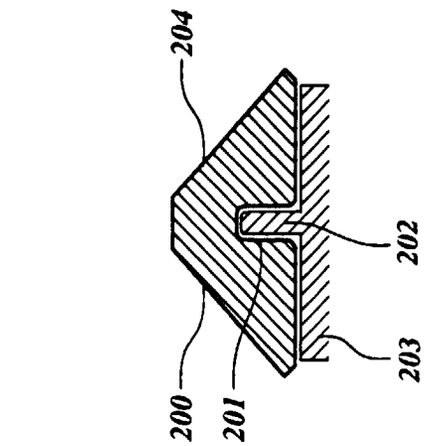
204
202
203
200
201

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 20 1924

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.6)
X,D A	DE 31 24 446 A (F. VOLL) 30 December 1982 * the whole document *	10 1,5,6	B07B13/065 A01D33/08
X	GB 758 347 A (J. CORYN) 3 October 1956 * page 1, line 53 - page 2, line 18 * * figures 1,2 *	10	
A,D	FR 1 076 299 A (G. MARIJON) 25 October 1954 * page 1, right-hand column, line 4 - page 2, left-hand column, line 51 * * figures *	1,5,6	
A	NL 6 511 129 A (J. DE GREEF) 27 February 1967 * page 3, line 5 - page 5, line 24 * * figures 1,2 *	1,5,6	
A,D	US 2 776 746 A (K. ENVOLDSEN) 8 January 1957 * column 2, line 7 - column 3, line 45 * * figures *	8	
A	US 3 587 854 A (S. BROWN) 28 June 1971 * column 2, line 4 - column 3, line 61 * * figures *	10	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B07B
A01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 September 1998	Laval, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

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

EPO FORM 1503 03.82 (P04C01)