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(54) Apparatus and method to screen materials having different sizes and/or density

(57) Apparatus to screen materials (11) having different sizes and/or density, comprising a plurality of screening rollers (16) arranged parallel to each other and each having the outer surface shaped in such a manner as to define a plurality of protruding elements (22) alternated to corresponding grooves (24). The screening rollers (16) are arranged in such a manner that the protruding elements (22) of each roller are inserted, more or less deeply, into the grooves (24) of an adjacent roller. The screening rollers (16) define a screening plane which is divided into one or more fractions (F1, F2, F3), one adjacent to the other, in each of which the relative screening rollers (16) are separated from each other so as to define a gap (25) of a determinate value, different from that of the other fractions. In the field of each of the fractions (F1, F2, F3) at least one screening roller (16a) has the protruding elements (22) reduced, beveled or rounded so as to obtain zones (30) with a section of passage which is locally greater, without varying the interaxis between the screening rollers (16a) and hence the gap (25).

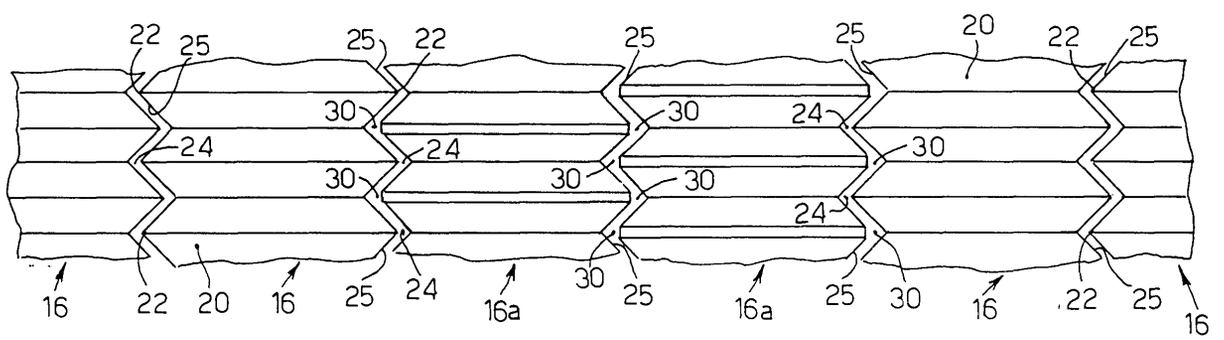

fig. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns an apparatus and a method to screen and separate materials with different sizes and/or density, such as for example pieces, chips or shavings of wood, and at the same time to eliminate, or discard, the impurities which have a greater density than that of the materials to be accepted, such as for example metal pieces or stones of a greater or smaller size. The apparatus comprises a plurality of screening rollers, each one having its outer surface shaped in such a manner as to define a plurality of protruding elements (22) alternated to corresponding grooves. The screening rollers are parallel to each other and arranged so that their cusps are inserted, more or less deeply, into the grooves of an adjacent roller. The rollers all together define a screening plane which is divided into two or more fractions, one adjacent to the other, in each of which the screening rollers are separated from each other so as to define a gap of a determinate value, different from that of the other fractions. In the field of each fraction at least one screening roller has the protruding elements reduced, beveled or rounded so as to obtain sections of passage which are locally greater, without varying the gap between the screening rollers.

BACKGROUND OF THE INVENTION

[0002] In order to screen elements or materials of different sizes, especially those of vegetable origin, such as wood or similar, the state of the art includes various devices, including that described in the Italian patent IT-A-1.290.736 which belongs to the same Applicant. This known device comprises a plurality of rollers, all rotating in the same direction, which face each other so that the cusps of each roller are inserted into the corresponding V-shaped grooves of the adjacent rollers, thus defining a zigzag discharge profile. The rollers are also separated laterally so as to define between them adjustable gaps, through which only the pieces of a size equal to or less than the gaps themselves can pass.

[0003] This known apparatus, although it is very efficacious in separating and dividing relatively small pieces, that is, which have a size of a few millimeters, is not able to separate, in the best possible way, pieces of material with a higher density, like pieces of metal or stone, from the rest of the materials with a lower density, such as wood or similar.

[0004] The state of the art also includes an apparatus wherein the screening rollers are divided into two fractions having different gaps and wherein, in order to divide the higher density materials from the lower density materials, at the end of each fraction the screening rollers are separated from each other by a wider gap than that of the same fraction. To provide a wider gap at the end of every fraction and for the whole length of the rollers, however, entails the following disadvantages: if there is a limited quantity of higher density materials, lower density materials can also pass through the wider gap, even though this is not desired, and can be discarded, although they should be accepted; vice versa, when there is a considerable quantity of higher density materials, there is a risk that not all these materials are expelled through the only wider gap located downstream of the fraction of rollers with a constant and more limited gap.

[0005] The present Applicant has devised the method and embodied the apparatus according to this invention in order to overcome these shortcomings of the state of the art, and to obtain further advantages, which are set out hereafter.

SUMMARY OF THE INVENTION

[0006] The present invention is set forth and characterized in the main claims, while the dependent claims describe other characteristic features of the present invention.

[0007] The purpose of the invention is to achieve an apparatus and perfect a method to screen and separate materials having different sizes, particularly but not exclusively pieces, chips or shavings of wood, and the same time eliminate or discard the impurities or improper materials with a greater density than that of the materials to be accepted, such as for example pieces of metal or stone.

[0008] In accordance with this purpose, the apparatus according to the invention comprises a plurality of screening rollers, each one having the outer surface shaped in such a manner as to define a plurality of protruding elements, constituted by teeth, cusps, or similar elements. The screening rollers are parallel to each other and arranged so that their protruding elements are inserted, more or less deeply, into corresponding grooves of an adjacent roller. All the screening rollers together define a screening plane which is divided into one or more fractions, one adjacent to the other, in each of which the screening rollers are separated from each other so as to define a gap of a determinate value, different from that of the other fractions. In the field of each fraction at least one screening roller has the protruding elements reduced, beveled or rounded, so as to obtain zones of passage which are locally greater, without varying the interaxis between the screening rollers and hence the gap.

[0009] Advantageously, within the field of each fraction, the gap between the screening rollers is constant. Moreover the zones of greater section, as mentioned above, made in correspondence with the protruding elements, even if reduced, beveled or rounded, at intervals with lateral zones with a constant gap, have the advantage that they prevent an excessive quantity of material which should be accepted from being discarded

together with the improper material which is in fact to be discarded.

[0010] The position and number of the screening rollers with the protruding elements reduced, beveled or rounded can vary within the field of each fraction of the screening plane, so that the apparatus according to the invention is very versatile and the layout can easily be varied.

[0011] Below each discharge zone of the higher density materials there are conveyor means, comprising for example a horizontal screw.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] These and other characteristics of the present invention will be apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a lateral and schematic view of an apparatus according to the invention;
- fig. 2 is a section from II to II of fig. 1;
- fig. 3 is an enlarged view from above of a first detail of the apparatus in fig. 1;
- fig. 4 is an enlarged view from above of a variant of fig. 3;
- fig. 5 is an enlarged detail of fig. 3;
- fig. 6 is a variant of fig. 5.

DETAILED DESCRIPTION OF A PREFERENTIAL EMBODIMENT

[0013] With reference to figs. 1 and 2, an apparatus 10 according to the invention, to separate materials 11 having different sizes and/or density, comprises a metal bearing structure 12, substantially shaped like a parallelepiped and able to define a separation chamber 13, open downwards, on one side of which, through a hopper type mouth 15, an incoherent mass of material 11 is able to be introduced. The latter can consist of pieces of woody material, mixed with impurities of other material with a higher density, for example iron or stone material.

[0014] Inside the chamber 13 there is a plurality of screening rollers 16, mounted rotary on lateral walls 18 and 19 of the structure 12. The rollers 16 have their axes of rotation parallel to each other and lying substantially on the same plane, so as to form a so-called screening bed; this plane can be horizontal, as shown in fig. 1, or inclined, advantageously upwards. The screening rollers 16 are made to rotate, all in a clockwise direction (fig. 1), by motor means of a conventional type and not shown in the drawings.

[0015] Each roller 16 comprises a plurality of screening elements 20 adjacent to each other; they are advantageously made of metal, rubber or synthetic material, and have cusps 22 (figs. 3 and 4).

[0016] The screening elements 20, adjacent to each other, define a plurality of grooves 24, for example V-shaped grooves, alternating with the corresponding teeth or cusps 22.

[0017] Each screening roller 16 is mounted in such a manner that the cusps 22 of the screening elements 20 of each of them is constantly inserted, more or less deeply, into the corresponding grooves 24 of the adjacent roller 16, so as to define discharge gaps 25 with a zigzag profile.

[0018] The bed of screening rollers 16 is divided into a plurality of fractions, for example three, F1, F2 and F3. In each fraction F1, F2 and F3 the gap 25 between the different screening rollers 16 can be either constant or variable, according to the screening requirements. Moreover, advantageously, the amplitude G2 of the gap 25 of the second fraction F2 is greater than the amplitude G1 of the gap 25 of the first fraction F1 and the amplitude G3 of the gap 25 of the third fraction F3 is greater than the amplitude G2 of the gap 25 of the second fraction F2.

[0019] The sizes of the gaps 25 vary according to the granulometry of the material which is to be screened, that is, to be passed between the rollers 16. For example, G1 can be between 0.3 mm and 1.5 mm, G2 can be between 1 mm and 2.5 mm and G3 can be between 2 mm and 6 mm.

[0020] According to one characteristic of the invention, at least one roller 16a of each fraction F1, F2, F3 has the cusps 22 reduced, beveled or rounded, so as to define, in association with the corresponding groove 24 of the adjacent roller 16, zones 30 having an amplitude greater than that of the corresponding gap 25, whether it be G1, G2 or G3. Fig. 3 shows a solution which provides the presence of two rollers 16a, with reduced, beveled or rounded cusps 22, adjacent to each other, whereas fig. 4 shows a variant which provides the presence of a single roller 16a, with reduced, beveled or rounded cusps 22. In the solution shown in fig. 3, between the two rollers 16a there is a continuity of zones 30 and there are no V-shaped grooves 24.

[0021] In this way, with each of the two solutions, through the zones 30 it is possible to discharge possible extraneous bodies or impurities with a greater density than that of the materials to be accepted, even if they have a bigger size than the relative gap 25, without needing to vary the interaxis between the rollers 16.

[0022] Moreover, as can be seen better in figs. 5 and 6, when the cusps 22 have a reduced, beveled or rounded shape K, with a height substantially equal to the gap 25, we achieve zones 30 which have a transverse section of several times more than that of the corresponding V-shaped grooves 24, as shown by the shaded part of fig. 5.

[0023] The position of the roller(s) 16a in the field of each fraction F1, F2, F3 is chosen according to the screening requirements and the percentage of improper material in the mass 11 to be eliminated.

[0024] Below each roller 16a, or each group of rollers 16a (fig. 1), of each fraction F1, F2, F3, there is a screw 31, connected to an electric motor 32 (fig. 2) and able to remove to the outside the materials discarded mainly through zones 30. Each screw 31 is movable horizontally so as to be correctly positioned in correspondence with the rollers 16a above. Moreover, associated with each screw 31, there is a pair of conveyor walls 33, substantially vertical, which can be suitably inclined.

[0025] The screening method of the apparatus 10 as described heretofore comprises a step of introducing the materials 11 through the mouth 15 into the bed of screening rollers 16 in such a manner that the latter, rotating, perform a first screening action in the fraction F1 and allow only the fine materials to pass, with a size less than G1. Due to the action of the rollers 16, the higher density materials tend to be arranged towards the bottom so that, when they reach the zones 30, created by each roller 16a, they naturally fall downwards and are discharged by the screw 31 below. The same action is performed in the subsequent fractions F2 and F3.

[0026] It is clear that modifications and additions of parts or steps can be made to the apparatus 10 and method to separate elements or materials 11 having different sizes as described heretofore, without departing from the field and scope of the present invention. For example, instead of the screw 31, any other discharge means of a conventional type can be used.

[0027] It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the field shall certainly be able to achieve many other equivalent forms of embodiment, all of which shall come within the field and scope of the present invention.

Claims

1. Apparatus to screen materials (11) having different sizes and/or density, comprising a plurality of screening rollers (16) arranged parallel to each other and each having the outer surface shaped in such a manner as to define a plurality of protruding elements (22) alternated to corresponding grooves (24), wherein said screening rollers (16) are arranged in such a manner that the protruding elements (22) of each roller are inserted, more or less deeply, into the grooves (24) of an adjacent roller, and wherein said screening rollers (16) define a screening plane which is divided into one or more fractions (F1, F2, F3), one adjacent to the other, in each of which the relative screening rollers (16) are separated from each other so as to define a gap (25) of a determinate value, different from that of the other fractions, **characterized in that** in the field of each of said fractions (F1, F2, F3) at least one screening roller (16a) has the protruding elements (22) reduced, beveled or rounded so as to obtain zones (30) with a section of passage which is locally greater, without varying the interaxis between the screening rollers (16a) and hence the gap (25).

2. Apparatus as in claim 1, **characterized in that** in at least one of said fractions (F1, F2, F3) at least two screening rollers (16a) are provided, adjacent to each other, having the protruding elements (22) reduced, beveled or rounded.

3. Apparatus as in claim 1 or 2, **characterized in that**, in the field of each of said fractions (F1, F2, F3), the gap (25) between the relative screening rollers (16, 16a) is substantially constant and that said zones (30) are at intervals with lateral zones with a constant gap (25).

4. Apparatus as in any claim hereinbefore, **characterized in that** there are at least three fractions (F1, F2, F3), that the amplitude (G2) of the gap (25) of the second of said fractions (F2) is greater than the amplitude (G1) of the gap (25) of the first fraction (F1) and that the amplitude (G3) of the gap (25) of the third fraction (F3) is greater than the amplitude (G2) of the gap (25) of the second fraction (F2).

5. Apparatus as in claim 4, **characterized in that** the amplitude (G1) of the gap (25) of the first fraction (F1) is between 0.3 mm and 1.5 mm, the amplitude (G2) of the gap (25) of the second fraction (F2) is between 1 mm and 2.5 mm, and the amplitude (G3) of the gap (25) of the third fraction (F3) is between 2 mm and 6 mm.

6. Apparatus as in any claim hereinbefore, **characterized in that** below each of said screening rollers (16a) with reduced, beveled or rounded protruding elements (22) of each of said fractions (F1, F2, F3) there are discharge means (31) to discharge the eliminated materials.

7. Apparatus as in claim 6, **characterized in that** said discharge means comprise a screw (31), connected to a motor means (32).

8. Apparatus as in claim 6 or 7, **characterized in that** between said discharge means (31) and said screening rollers (16a) with reduced, beveled or rounded protruding elements (22), there is a pair of conveyor walls (33), substantially vertical, but selectively inclinable.

9. Method to screen materials (11) having different sizes and/or density, comprising a step of introducing said materials (11) onto a plurality of screening rollers (16) arranged parallel to each other and each having the outer surface shaped in such a manner as to define a plurality of protruding elements (22)

alternated to corresponding grooves (24), wherein said screening rollers (16) are arranged in such a manner that the protruding elements (22) of each roller are inserted, more or less deeply, into the grooves (24) of an adjacent roller, and wherein said screening rollers (16) define a screening plane which is divided into one or more fractions (F1, F2, F3), one adjacent to the other, in each of which the relative screening rollers (16) are separated from each other so as to define a gap (25) of a determinate value, different from that of the other fractions, **characterized in that** in the field of each of said fractions (F1, F2, F3) said material is made to advance by said screening rollers (16) towards at least one screening roller (16a) having the protruding elements (22) reduced, beveled or rounded and defining zones (30) with a section of passage which is locally greater.

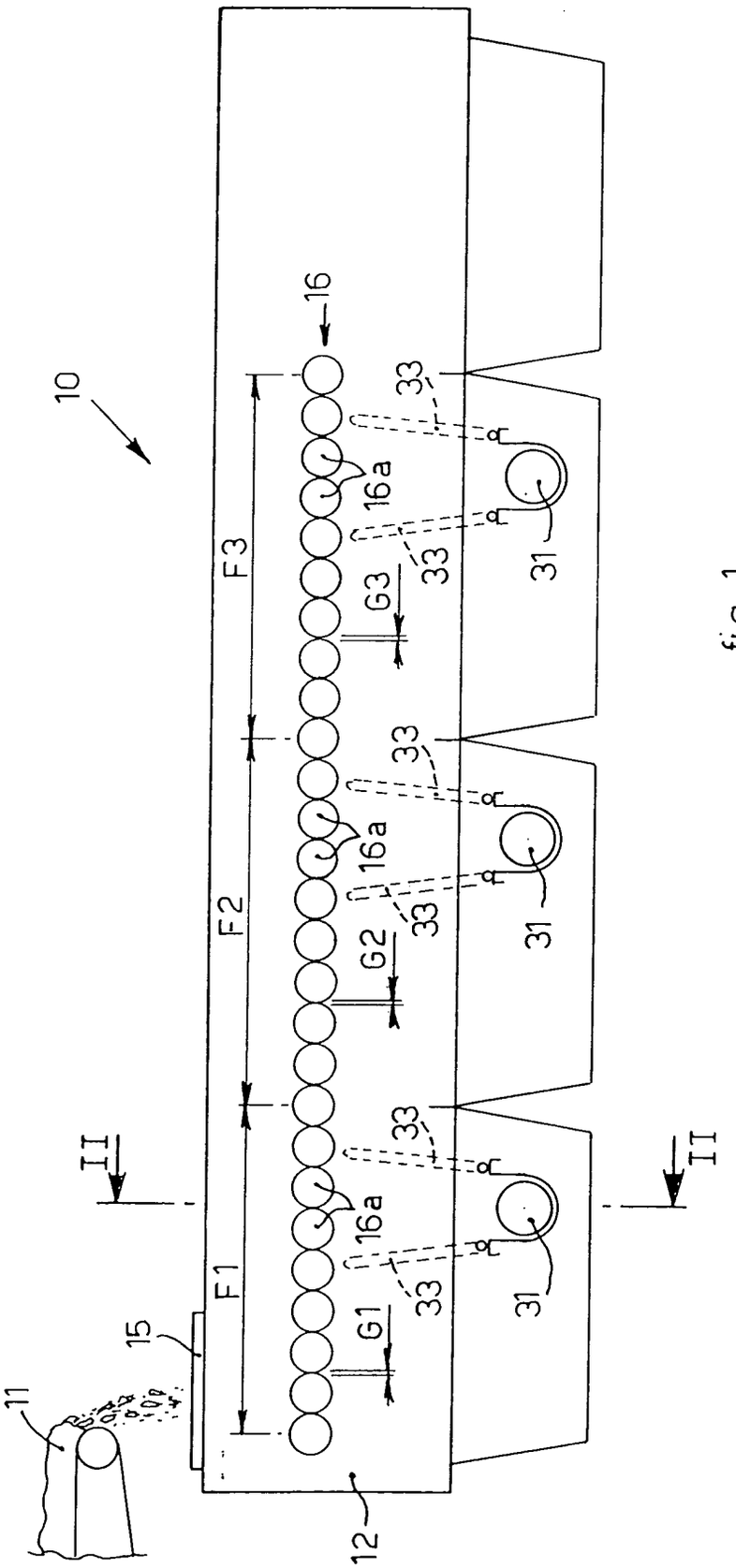

fig. 1

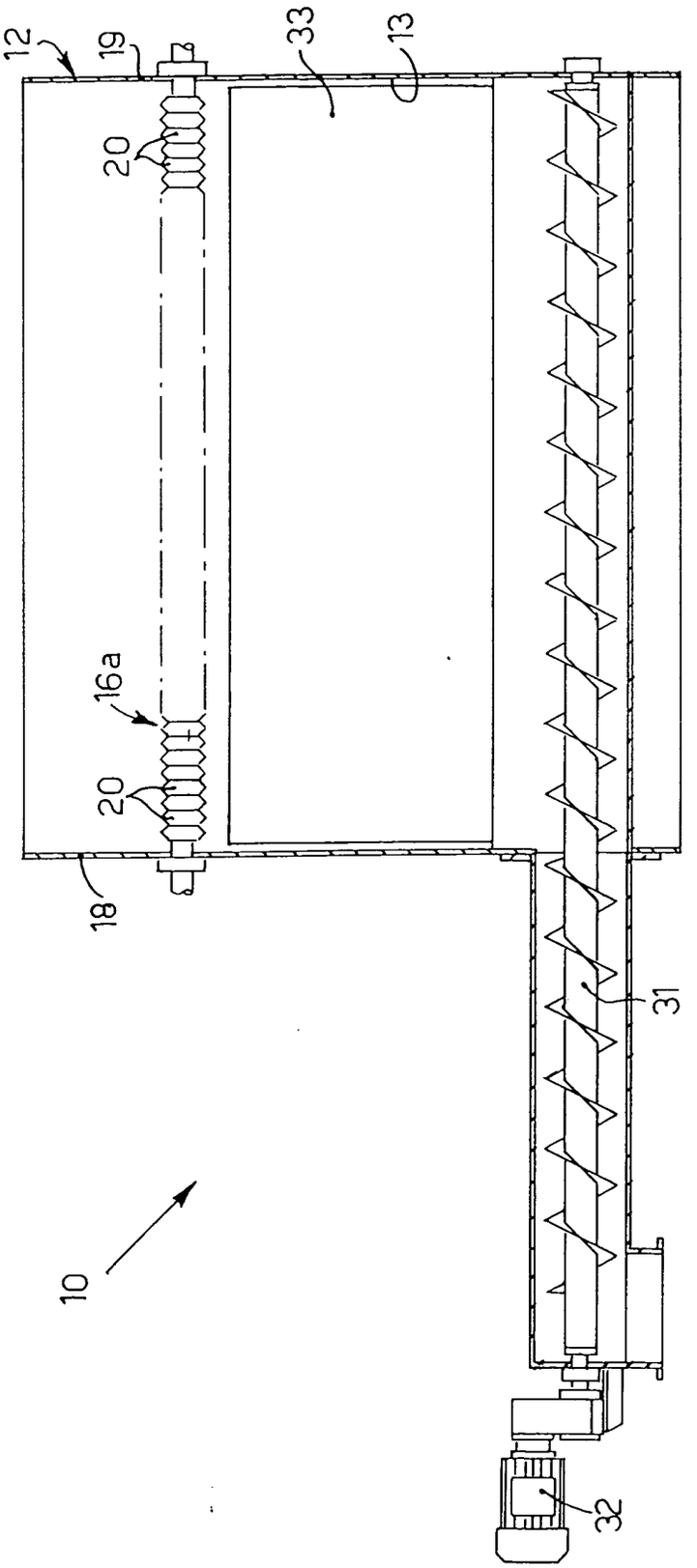

fig. 2

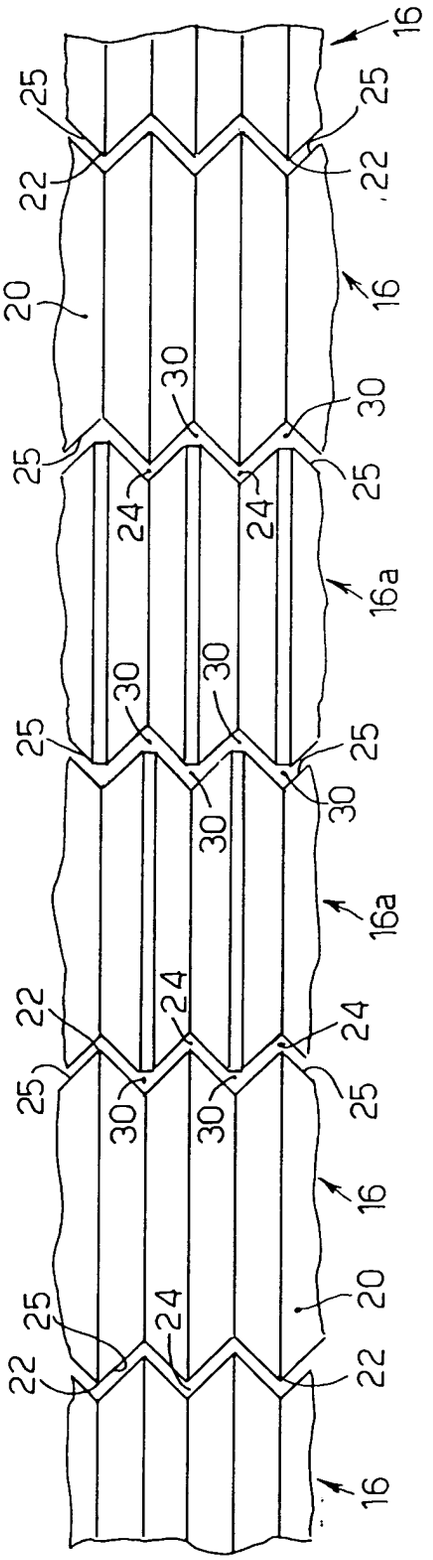

fig. 3

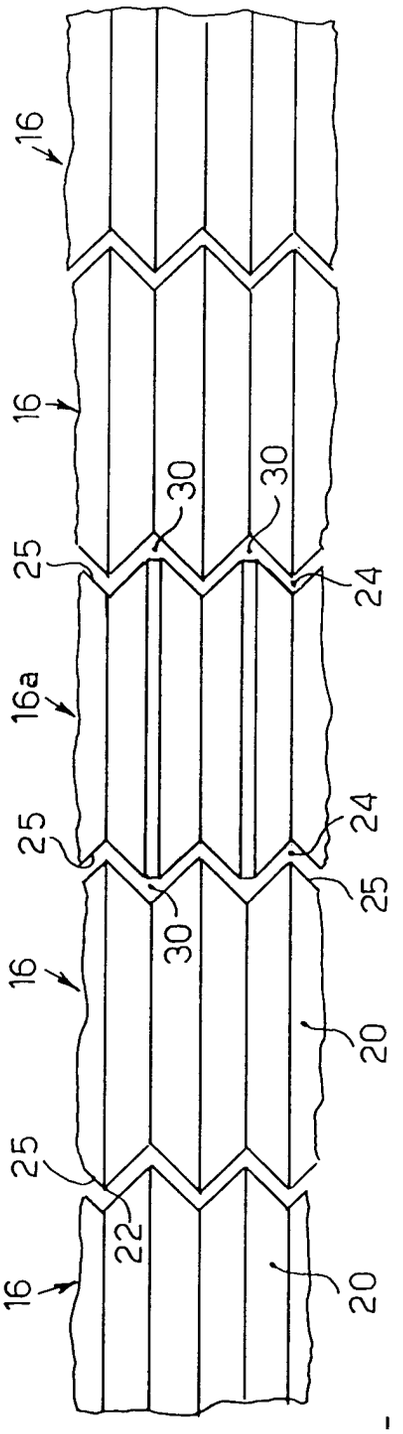

fig. 4

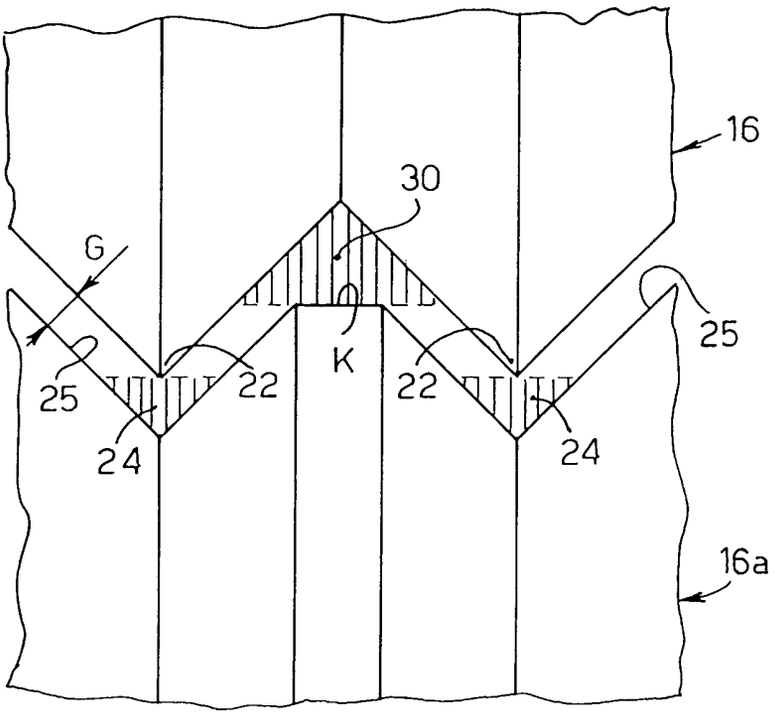

fig. 5

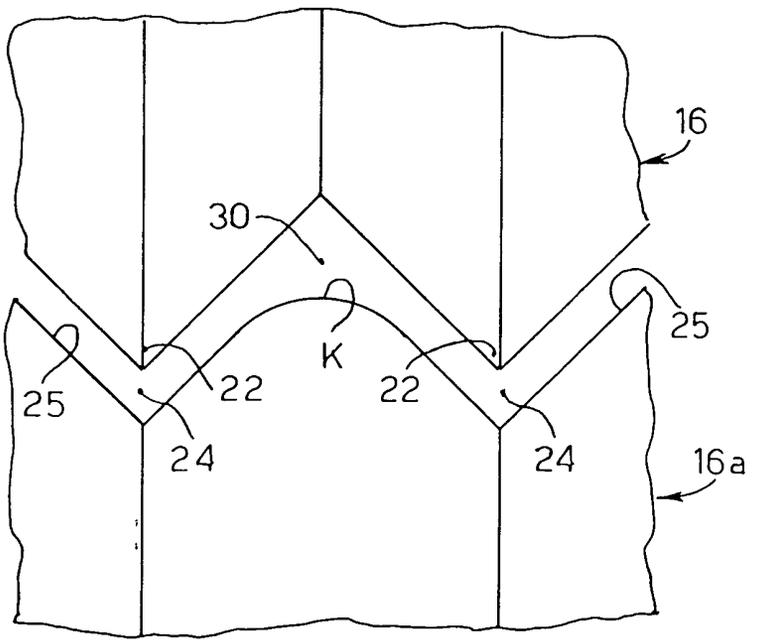

fig. 6

European Patent Office

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Application Number
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B07B D21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31 July 2003	Laval, J

CATEGORY OF CITED DOCUMENTS

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