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(72) Inventors:
• **Boers, Paul Aris**
6842 BX Arnhem (NL)
• **de Haas, Jan Hendrik**
4051 CR Ochten (NL)

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(74) Representative:
Van Reet, Joseph et al
Gevers Patents S.A.,
Brussels Airport Business Park,
Holidaystraat 5
1831 Diegem (BE)

(71) Applicant:
Recticel Nederland B.V.
4041 CL Kesteren (NL)

(54) **Method and apparatus for cutting recesses in foam objects.**

(57) A method for cutting a recess (13) in foam material (8), wherein by means of a first and a second knife (2,3) two cuts are provided in a surface of a foam-made block (8) or like object through a relative, linear movement of the object relative to the knives, wherein the first and the second knife (2,3) include an angle relative to each other and wherein, during use, the material located between the cuts and the contour of the object is removed for forming the or each recess (13), wherein at least the or each second knife (3) is substantially circular, is mounted on a central axis of rotation (15) and, during use, is driven in a rotational sense, wherein during use, the axis of rotation (15) is at least partly located within the contour of the object (8), in such a manner that during cutting, the relevant knife (3) extends within the contours of the object (8).

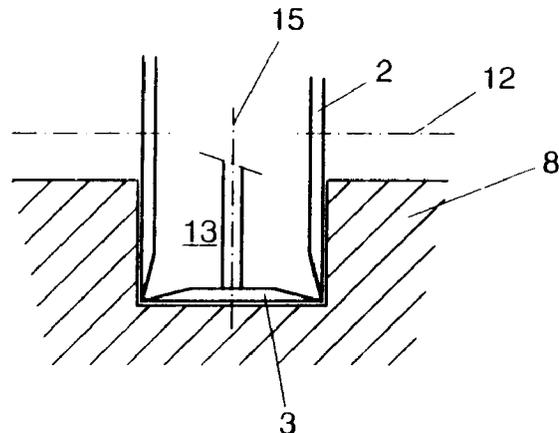


FIG. 6A

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Description

The invention relates to a method for cutting recesses in foam material according to the preamble of the main claim. Such method is known from practice.

In this known method, two cuts are made in a surface of a foam block by means of two circular knives, which cuts touch each other adjacent the lower side to form a triangular slot in the surface, filled by a cut-loose filling piece of the same shape. This filling piece can readily be removed, so that an open slot is obtained.

This known method has the drawback that it is only applicable for the formation of slots having a triangular section, which means that the application of this method considerably limits the freedom of design. A further drawback of this known method is that the possible depth of the slots is limited, because the axes of rotation always extend above the plane of the foam block.

There is further known a method for cutting duct-shaped slots in a foam block utilizing a belt knife, which has a slight height and minimum thickness. It is moved vertically in the surface of a foam block to about the desired slot depth. Next, it is tilted over 90° and moved in a horizontal direction, approximately over the desired width of the slot, after which it is again tilted over an angle of 90° and moved back to the surface of the foam block.

This method offers the possibility of providing slots in a surface of a foam block, which slots have for instance a rectangular section, i.e. a flat bottom and two vertical walls. Hence, this method provides relatively much freedom of design as far as the section of the slots is concerned.

This known method has the drawback that only slots continuing to both sides of the foam block can be provided, which slots always have the same section throughout their lengths. Further, the application of this method requires relatively much production time, which renders it costly. This can be understood as follows. During the vertical up and down movement of the knife, the foam block should be stationary relative to the knife, while during the horizontal movement, the foam block should be moved relative to the knife in a direction at right angles to the longitudinal direction of the knife. This means that for making the slot, the foam block should be alternately accelerated and stopped, or the knife-carrying device should be accelerated and delayed, while, moreover, provisions should be made for tilting the knife. As a result, this known method is time-consuming. A further drawback of this known method is that the guide means for the knife and the tilting device therefor are complicated and hence costly. Moreover, the tilting of the knife during the cutting of the slot results in the formation of a relatively small radius at the transition between the walls and the bottom of the slot.

There is further known a method wherein, by means of a milling or scouring technique, a slot having

a rectangular section is provided in a foam block. Such a method has the advantage that through a suitable selection of the tools, in particular the scouring or milling head, slots of many different sections can be provided, which, moreover, may be of continuous as well as blind design. However, a major drawback of these known methods is that they involve stock removal, which means that a great amount of cuttings, dust and other small particles and gases are released, which is undesirable in particular for reasons of health and hygiene and because of the labor conditions. Moreover, the slots thereby acquire a rougher surface.

The object of the invention is to provide a method of the type described in the preamble of the main claim, wherein the aforesaid drawbacks of the known methods are avoided and the advantages thereof are retained. To that end, a method according to the invention is characterized by the features of the characterizing part of claim 1.

Surprisingly, it has been found that the foam cut loose by the or each first knife is easily pushed aside by the axis of rotation of the second knife, at least by the or each axis of rotation which, during cutting, extends entirely or partly within the original contours of the object, while, after passing the or each relevant axis of rotation, it entirely or partly rebounds into substantially the original shape. By moving, during use, at least one of the axes of rotation at least partly within the contours of the object, i.e. within the space enclosed by the cuts and the or each original outside surface in which the cuts in question have been made, various shapes can be provided in a foam-formed object such as a foam block by means of rotating knives. The or each slot can be continuous as well as blind and can be open towards one or two sides at right angles to the longitudinal direction. The transition between the cut made by the or each first knife and the or each adjoining cut made by a second knife is sharp, i.e. linear and without radius. This creates a pleasant outward appearance of the slot, with a functional form. By using the rotating knives, slots of all types of desired sectional profiles and having flat, relatively smooth walls can be made in a product in a rapid and particularly effective manner.

In an advantageous embodiment, a method according to the invention is characterized by the features of claim 2.

The first knives and the or each second knife extending therebetween at least in elevation, which knives are arranged relative to one another in such a manner that of each first knife and a second knife, the cuts in the foam-like product touch each other, offer the advantage that slots having a box-shaped section can thereby be provided in the product. In this context, 'box-shaped' means that at least one face of the slot, a bottom face, does not extend to the face in which the slot is made. The cutting operation ensures that a minimum amount of dust or like particles is released, if any. Moreover, with this method, one or more slots can be pro-

vided in a particularly rapid manner, for instance 10-15 times more rapidly than with the known method utilizing a belt knife. In fact, the slot may have many sectional profiles, including for instance rectangular, outwardly diverging or undercut profiles.

Advantageous further embodiments of a method according to the invention are given in subclaims 3-5.

The invention further relates to an apparatus for cutting at least one slotted recess in foamy material according to the preamble of claim 6. According to the invention, such apparatus is characterized by the features of the characterizing part of claim 6.

The use of at least two first knives and a second knife, arranged so that they together define a channel-shaped profile, offers the possibility of readily providing continuous or non-continuous slots in a surface of a foam-like product without involving undesired dust production, cuttings or like particles. Through variation of the positions of the knives relative to each other and of the object, different profiles can be obtained. Moreover, through the use of several second knives, a bottom profile other than flat can be obtained. As the cutting edges of the first and second knives at least touch each other at least in elevation, sharp transitions are obtained between the different slot-defining cuts. In this context, 'sharp' should be understood to mean linear, without rounding as occurs in the known method where a tiltable belt knife is employed.

In an advantageous embodiment, an apparatus according to the invention is further characterized by the features of claim 7.

The circular knives drivable in a rotational sense offer the advantage that they cut through the foam-like material in a particularly simple manner, in the case of both relatively soft and slightly firmer foam.

By way of illustration, with a method according to the invention, recesses can be provided in foam blocks and the like having a density of preferably 10-250 kg/m³. However, these limits should not be construed as being limitative.

In further elaboration, an apparatus according to the invention is further characterized by the features of claim 8.

With such apparatus, a series of slots can be provided side by side over a length that is in principle infinite, in one processing operation, i.e. by passing the object along or through such apparatus a single time.

In a particularly advantageous embodiment, an apparatus according to the invention is characterized by the features of claim 10.

By positioning series of knives in opposite positions, series of slots can simultaneously be provided on either side of an object.

In a particularly advantageous further embodiment, an apparatus according to the invention is further characterized by the features of claim 11.

The removing means offer the advantage that the cut-loose material is discharged from the or each slot-

ted recess directly, so that after the cutting operation the object is directly ready for further processing, while the environment of the apparatus and the object are kept clean, at least free from scrap, in a simple manner.

Further advantageous embodiments of an apparatus according to the invention are given in the further subclaims.

The invention further relates to an object that can be manufactured with a method and/or apparatus according to the invention.

Methods and apparatus according to the invention are in particular suitable for providing slotted, straight recesses in surfaces of foam-made materials, but may also be used for other types of recesses, for instance circumferential, sinusoidal or otherwise meandering slots. Preferably, the slots always have the same sectional profiles, but they may also have a changing profile, for instance through variation of the positions of the knives during processing.

It is observed that DE-A-24 29 815 shows, in Fig. 6 thereof, an arrangement of circular cutting knives which at first resembles the proposal according to the invention, but is not related thereto after all. In the proposal described in the German publication, the knives engage the product to be cut only partly. At any rate, it is never the case that one of the knives extends entirely within the contours of the object. Moreover, also in the proposal of Fig. 6, only two knives are in cutting engagement with the object each time; one vertical knife operates in a first working direction and the other vertical knife operates in a second, opposite working direction. Accordingly, with the known proposal no slots are formed, but strands of material are removed from an object.

To specify the invention, exemplary embodiments of a method, apparatus and product will hereinafter be described with reference to the accompanying drawings. In these drawings:

Fig. 1 is a top plan view of an apparatus according to the invention;

Fig. 2 shows an apparatus according to Fig. 1 with a partially machined block, manufactured from foam, disposed thereon;

Fig. 3 is an enlarged top plan view of a portion of a slot, with second knife;

Fig. 4 is a sectional side elevation of an apparatus according to Fig. 2 taken on the line IV-IV in Fig. 5; Fig. 5 is a sectional front view of a block in an apparatus taken on the line V-V in Fig. 4; and

Fig. 6 shows a number of possible profiles of slots, with the first and second knives.

In this description of the drawings, methods and the apparatus required therefor are described for manufacturing mattresses. However, it will be understood that these and comparable methods and apparatus can also be used for manufacturing other products, such as

seats, fillings, couplings between foam blocks, decorative objects and the like.

Fig. 1 shows an apparatus according to the invention, adapted to provide a series of slots 13 in two opposite faces of a foam block 8 intended for manufacturing a mattress. The apparatus comprises a block-feeding device 1, two series of first knives 2 and two series of second knives 3 (Figs. 4 and 5), a block-discharge device 4 and scrap-discharge means 5. Further, guide means 6 are arranged on either side of the apparatus 1, in the form of two rows of guide rollers 7 flanking the path of travel of the foam blocks 8 as shown in Figs. 2-5.

The block-feeding device 2 comprises a belt conveyor 9 having a relatively rough surface and conveying foam blocks 8 sitting on the conveyor in the direction of the arrow P towards the two series of first knives 2. Adjacent the knives 2, 3, the belt conveyor 9 connects to a series of conveyor rollers 10 which elongate the conveyor face and extend between the first 2 and second knives 3.

The first knives 2 are circular or curved, a so-called multiple-curve knife with changing radius, which may be advantageous in terms of cutting, as the foam block is thereby slightly compressed intermittently, have a cutting longitudinal edge 11 and are arranged in pairs. The first series of first knives 2A are mounted on a common first axis 12A extending above the conveyor face T of the block-feeding device and block-discharge device, parallel thereto and at right angles to the feed-through direction P outside the contours 18 of the foam block 8. The bottom sides of the vertically disposed knives 2A are located at some distance H1 above the conveyor face in question. The second series of first knives 2B are identical to the first series of first knives 2A, yet the second axis 12B is arranged slightly below the conveyor face T, parallel to and directly opposite the first axis 12A, in such a manner that the top sides of the first knives 2B mounted on the second axis 12B extend at a slight distance H2 above the conveyor face T. The distance D in between each pair of first knives 2A, 2B, measured horizontally and at right angles to the feed-through direction P, is equal to the width of the desired slot 13 in the foam block 8 that is to be cut by means of the relevant knives.

Viewed in feeding direction P, a second knife 3A, 3B is in each case disposed at some distance aft of each pair of first knives 2A, 2B. Each second knife 3A, 3B is circular, has a diameter at least corresponding to the mutual distance D of the adjacent pair of first knives 2A, 2B, has a cutting longitudinal edge 14 and is mounted on a vertical axis 15A, 15B. Of each second knife 3A in the upper series, the cutting edge 14 is provided at least at the same level as the bottom point of the cutting edges 11 of the relevant upper first knives 2A, of each second knife 3B in the lower series, the cutting edge 14 is provided at the same level as the top point of the cutting edges 11 of the relevant first knives 2B. Hence, in front view, as shown in Fig. 5, the cutting edges 11 of a

pair of first knives 2 and the cutting edge 14 of an associated second knife 3 approximately form a U-shape. The distance between the cutting edges of the opposite second knives 3A, 3B determines the distance between the bottoms 16 of opposite slots 13.

In an embodiment not shown, one or more first knives have their cutting edges extending beyond the cutting edge of the adjacent second knife, in such a manner that after removal of the strip 25 from the slot, one or more cuts 23 extend beyond the bottom 16 of the slot 13 in the foam block 8. Thus, the advantage is achieved that simultaneously with the cutting of the slot, a local increase of the flexibility of the block 8 is obtained, a so-called internal hinge. Such hinge is for instance used in mattresses that have to be slightly flexible so that they can be used with for instance adjustable bed bottoms. Such continued cuts may also be advantageous in other applications. As a matter of fact, the cuts of the or each second knife can of course also be continued beyond the first cut or cuts in a comparable manner.

Disposed at some distance aft of each second knife 3 is a scrap-discharge means 5, comprising a run-on face 17 whose free end 18 facing the second knives 3 is approximately level with the bottom 16 of the relevant slot 13 and which extends in the direction away from the bottom to a position outside the contours 19 of the foam block 8. Connecting to the second end opposite the first end 18 is a discharge tube 20 in which a sucking reduced pressure can be maintained so that the foam cut loose from the relevant slot 13 is sucked away continuously and discharged to a suitable scrap apparatus, processing apparatus or the like. In a particularly advantageous embodiment, each scrap-discharge means 5 comprises cutting means or like means dividing the strip 25 into relatively small parts. These means preferably connect to the run-on face 17. During use, the strip 25 is cut into relatively small, for instance bar-shaped parts by the cutting means, so that they can be used as filling means, for instance for cushions and the like, or for instance as packing material for packing articles so as to be impact-resistant. As cutting means, rotating knives, knives on a rotating drum, chopping, falling or hinged knives can for instance be used. Also, tearing means can be used. The small parts can easily be discharged through the discharge tube. This reuse of material is of course environmentally advantageous.

Referring in particular to Figs. 2-5, an apparatus according to the invention can be used as follows.

A foam block 8 of a rectangular cross section is fed by the feeding device 1 to the series of first knives 2A, 2B, guided by the guide means 6. Upon further feed-through of the foam block 8, a series (four in the embodiment shown) of pairs of parallel cuts 23 are simultaneously provided in the top face 21 and the bottom face 22 by the first knives, to form the longitudinal walls of the slot 13 in question. Then, each second knife 3A, 3B, disposed downstream of a pair of first knives 2A, 2B,

makes a horizontal second cut 24 connecting the longitudinal edges of the first cuts 23 which edges point away from the relevant top face 21 and bottom face 22 respectively, to form the bottom 16 of the relevant slot 13, while the strip-shaped foam part 25 located in the slot 13 is cut loose completely. This part 25 is then discharged by the discharge means 5, to release the slot 13.

During the linear movement of the foam block 8 relative to at least the second knives 3, each axis of rotation 15A, 15B extends partly within the contours 18 of the foam block, within the space that is filled with the partly cut-loose strip 25. Surprisingly, it has been found that the foam material of the strip 25 is temporarily pushed aside by this axis of rotation 15A, 15B and thus slightly compressed, while this strip, after passing the relevant axis of rotation 15, resumes its original form. This position is shown clearly in Fig. 2. This enables the axis of rotation 15, and accordingly the second knife 3, to be fed through the foam block 8 in a nevertheless simple manner, at least where the first knives 2 have already been passed, for cutting loose the strip 25. This creates the possibility of providing the or each second cut 24, which extends at least transversely to the feed-through direction P of the foam block 8 entirely within the contours 18, i.e. within the foam block 8. This involves at least the part of each second knife 3 that faces the first knives 2 being included in the foam, which means that at least about 50% of the cutting edge 14 is located below the strip 25 that is or is to be cut loose, at least in the slot 13.

Fig. 6 shows a series of examples of possible profiles of slots as can be made by means of an apparatus and method according to the invention. First and second knives are shown schematically. These examples only serve as an illustration and should by no means be construed as being limitative.

Fig. 6A shows a rectangular, U-shaped section as described hereinabove, together with the knives required therefor. Fig. 6B shows an edge profile of a foam block, wherein the second knife 2 offers the advantage that it does not project from the side contour of the foam block 8, so that the guide means 6 can continue along the entire side of the foam block 8. Fig. 6C shows an undercut slot, Fig. 6D shows an outwardly diverging slot and Fig. 6E show a slot with one inclined and one vertical sidewall. Fig. 6F shows a slot having two-faced bottom parts 16A, 16B, including an angle relative to each other.

As is clearly demonstrated in, in particular, Figs. 5 and 6, the transition 28 between each cut is sharp, i.e. without radius, which provides a pleasant outward appearance. In the embodiment shown, in particular each second knife 3 is slightly frusto-conical, tapering in the direction of the axis of rotation 14. This offers the advantage that the knife 3 is relatively stiff, that the axis of rotation 14 extends only on the side which, during use, faces away from the bottom 16 of the relevant slot

13, so that a flat bottom is obtained and maintained, and the conical outer surface 27 of the knife 3 moreover offers the advantage that the foam of the strip 25 is already pressed away slightly upwards and aside as soon as the knife 3 enters the foam block 8, so that the axis of rotation 15 can easily be introduced into the slot 13 without upsetting the strip 25. As a matter of fact, the first knives 2, too, may have such shape and, moreover, other suitable outer shapes may be selected for both the first and the second knives, including flat knives. Also in the case of flat knives, the strip 25 is pushed aside properly.

The invention is by no means limited to the embodiments described and shown as examples in the specification and the Figures. Many variations thereto are possible.

For instance, other numbers of first 2 and second knives 3 may be provided, while other, for instance asymmetrical, arrangements of the knives may also be chosen. The knives may arranged other than opposite each other, while, moreover, a series of first and second knives may also be arranged on one side only. Also, in a similar manner, slots may be provided in the side faces of the foam blocks. Of course, it is possible to move the knives relative to the foam block. Through movement of the knives in one or more directions at right angles to the (relative) feed-through direction of the foam block, wavy slots extending in a flowing line in one or more direction may be provided, while at the same time, slots of different profiles may also be cut. Moreover, by rotating the foam block and the knives relative to each other, curved and for instance circular slots may be provided. Further, all types of driving means for the knives may be used, and different knives may be drivable individually and/or in combination, while in particular the first knives may or may not be fixedly disposed, i.e. nonrotating, knives. By through-feeding the same foam block repeatedly and in different positions, slots may be provided in different directions.

These and comparable embodiments are understood to fall within the framework of the invention.

Claims

1. A method for cutting a recess in foam material, wherein by means of a first and a second knife two cuts are provided in a surface of a foam-made block or like object through a relative, linear movement of the object relative to the knives, wherein the first and the second knife include an angle relative to each other and wherein, during use, the material located between the cuts and the contour of the object is removed for forming the or each recess, **characterized in that** at least the or each second knife (3) is substantially circular, is mounted on a central axis of rotation (15) and, during use, is driven in a rotational sense, wherein during use, the axis of rotation (15) is at least partly located within

- the contour (18) of the object (8), wherein, during cutting, the relevant knife (3) extends entirely within the contours (18) of the object (8), and wherein the material part to be removed for forming the recess is deformed, enabling the central axis of rotation (15) to pass said material part. 5
2. A method according to claim 1, characterized in that by means of at least two first circular or curved, rotating knives (2), two first cuts (23) are made in the object (8), said first cuts extending at a distance (D) from each other from an outside surface (21, 22) of the object (8) at such an angle and to such a depth that said first cuts (23) do not intersect or touch each other, wherein by means of at least one second knife (3) a second cut (24) is provided connecting the first cuts (23) so that the part (25) of the object located between the first cuts (23), the or each second cut (24) and the outside contour (18) of the object (8) is at least substantially freely removable. 10 15 20
 3. A method according to claim 2, characterized in that the or each recess (13) is of duct-shaped design, wherein at least two first knives (2) and one second knife (3) are used, wherein the axis of rotation (15) of the or each second knife (3) extends approximately at right angles to the relative feed-through direction (P) of the object (8) in which the or each recess (13) is provided and the or each second cut (24) extends entirely within the object (8) in a direction at right angles to the feed-through direction (P). 25 30
 4. A method according to claim 2 or 3, characterized in that the first knives (2) extend approximately parallel to each other, wherein the or each second knife (3) extends approximately at right angles to the first knives (2), wherein in the or each object (8), at least one duct-shaped recess (13) is provided having a substantially flat bottom (16) and walls extending approximately at right angles to the bottom. 35 40
 5. A method according to claim 2 or 3, characterized in that the first knives (2) include an angle relative to each other, wherein in the or each object, at least one duct-shaped recess (13) having inclined walls is provided. 45
 6. An apparatus for cutting at least one slotted recess in foam-like material, in particular for using a method according to any one of the preceding claims, comprising a first and a second knife, wherein the faces determined by the cutting edges of the knives include an angle relative to each other, further comprising means for moving a foam-like object relative to the knives, characterized in that at least two first knives (2) are provided whose cutting edges (11), viewed at right angles to the feed-through direction (P) of the object (8), are spaced apart by a distance (D), wherein the cutting edge (14) of the or each second knife (3), viewed at right angles to the feed-through direction (P) of the object (8), at least substantially touches the cutting edge (11) of at least one and preferably each first knife (2), in such a manner that the cutting edges of the first (2) and second knives (3) define a slightly channel-shaped contour of the cross section of the or each slotted recess (13) to be formed, while during use, at least the entire cutting face (14) of the or each second knife (3) extends within the object (8). 7. An apparatus according to claim 6, characterized in that two first circular knives (2), drivable in a rotational sense, are provided, wherein there is provided at least one second circular knife (3), drivable in a rotational sense, whose axis of rotation (15) includes an angle with the axes of rotation (12) of the first knives (2). 8. An apparatus according to claim 6 or 7, characterized in that a series of pairs of first knives (2) is provided, wherein, viewed in front view, a second knife (3) is in each case included between two first knives (2), wherein the knives (2, 3) are jointly drivable. 9. An apparatus according to claim 8, characterized in that the first knives (2) are mounted on a common axis of rotation (12). 10. An apparatus according to any one of claims 6-9, characterized in that two series of knives (2, 3) are arranged opposite each other, wherein, during use, the or each object (8) to be processed is substantially fed between the knives (2, 3). 11. An apparatus according to any one of claims 6-10, characterized in that means (5) are provided for removing the cut-loose material (25) from the or each slotted recess (13). 12. An apparatus according to claim 11, characterized in that the removing means (5) for each slotted recess (13) to be formed comprise a run-on face (17) of which, during use, a free end (18) facing the knives (2, 3) and located, in feed-through direction (P), aft of the knives (2, 3), lies adjacent and preferably against the bottom (16) of the slot (13), on which discharge means (20) for the cut-loose foam material (25) connect to the run-on face. 13. An apparatus according to claim 11 or 12, characterized in that means are provided for dividing the cut-loose material (25) into parts, during use. 50 55

14. A product manufactured from foam-like material and comprising at least one series of slotted recesses extending approximately parallel to each other in at least one face of the product, wherein the or each recess has at least a bottom face and two sidewalls, wherein the transition between the bottom face and each of the sidewalls is linear so that said transitions do not comprise a radius.

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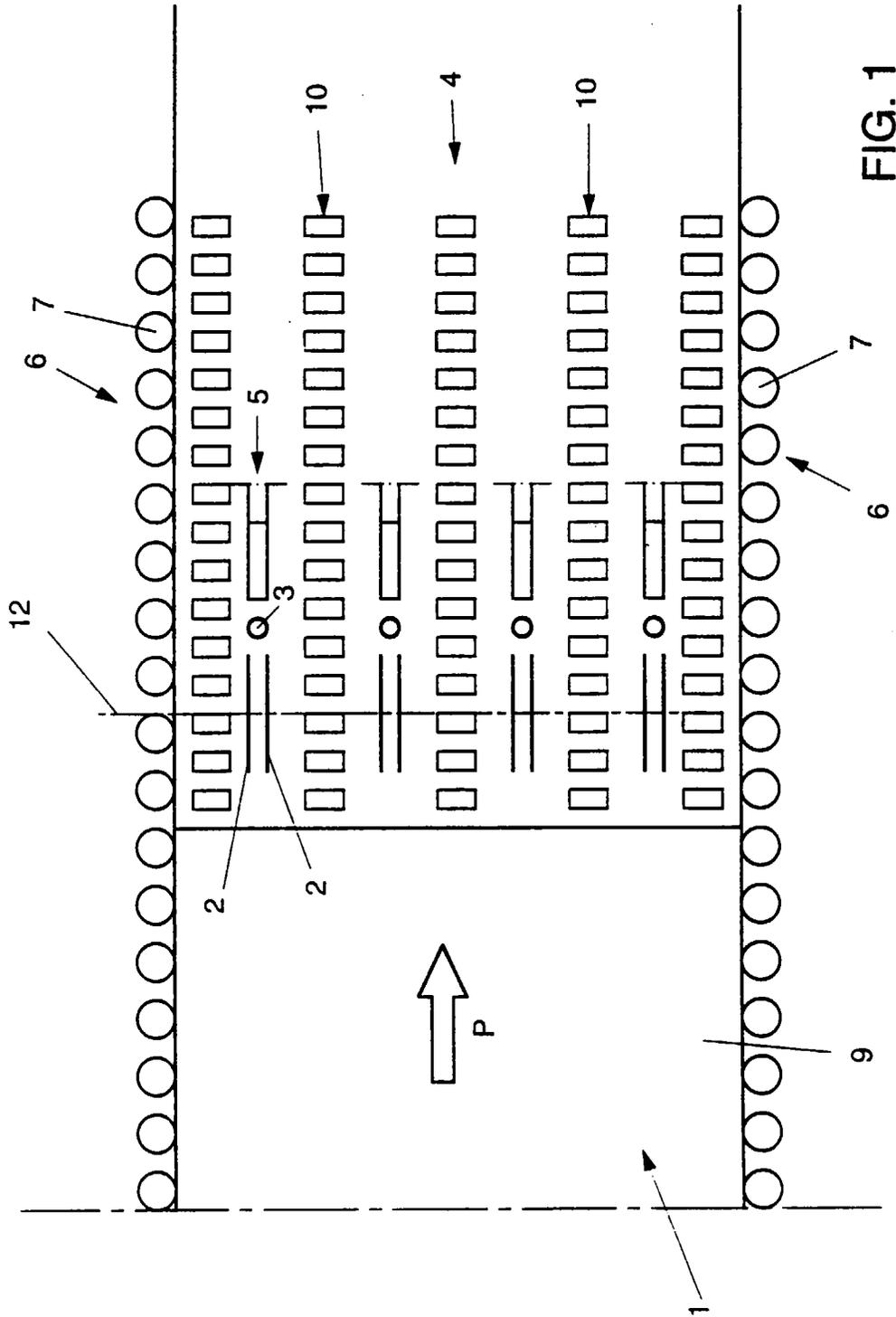


FIG. 1

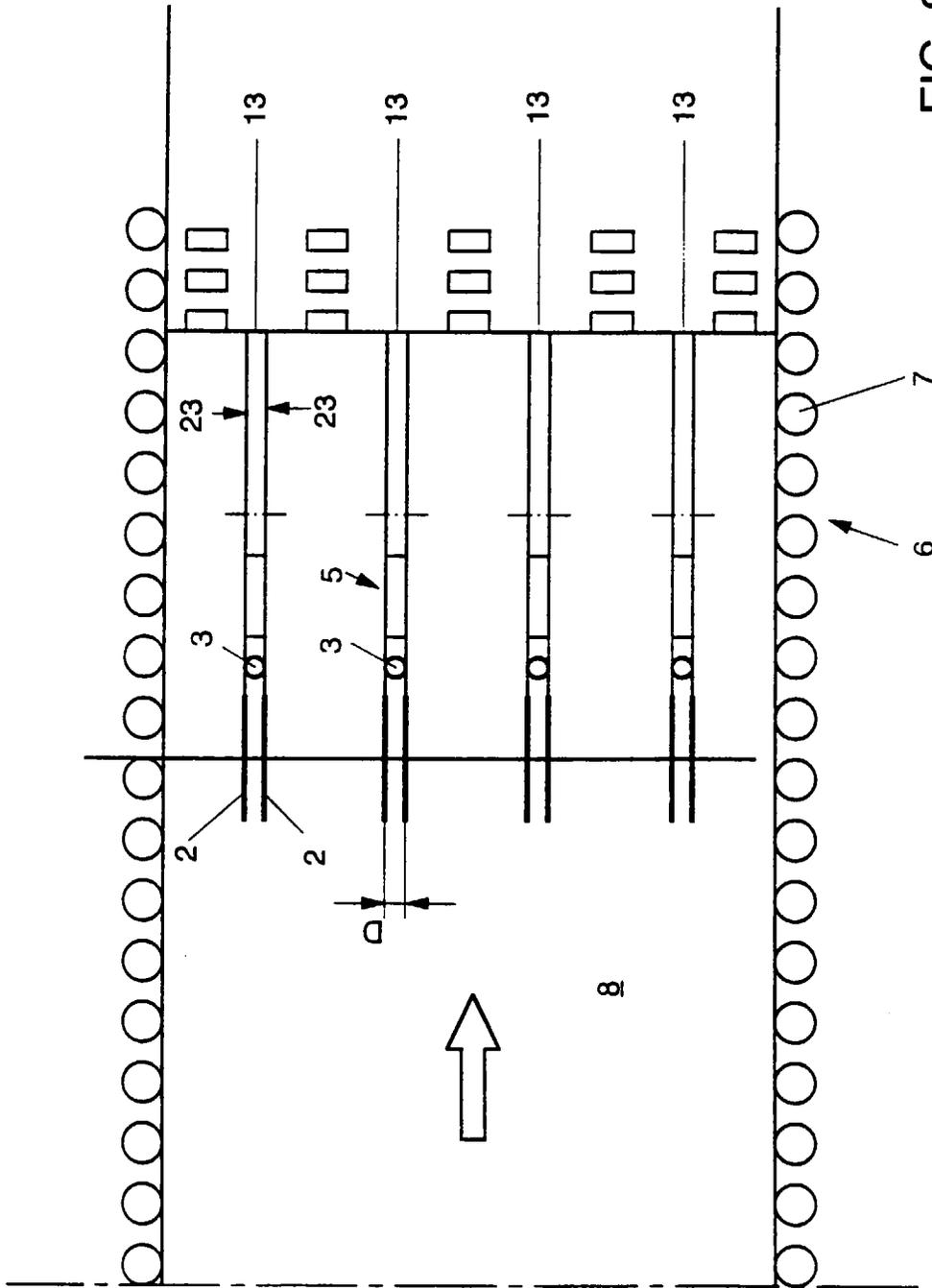


FIG. 2

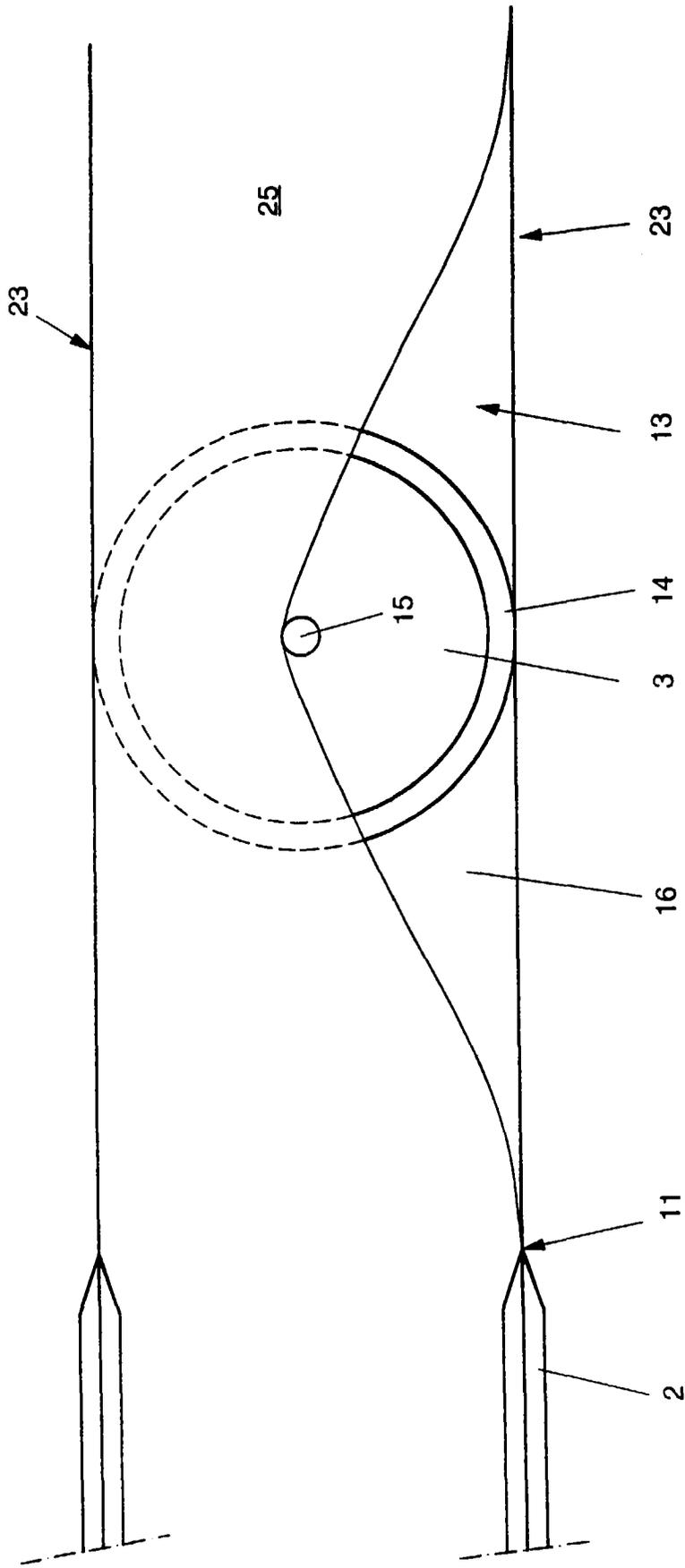


FIG. 3

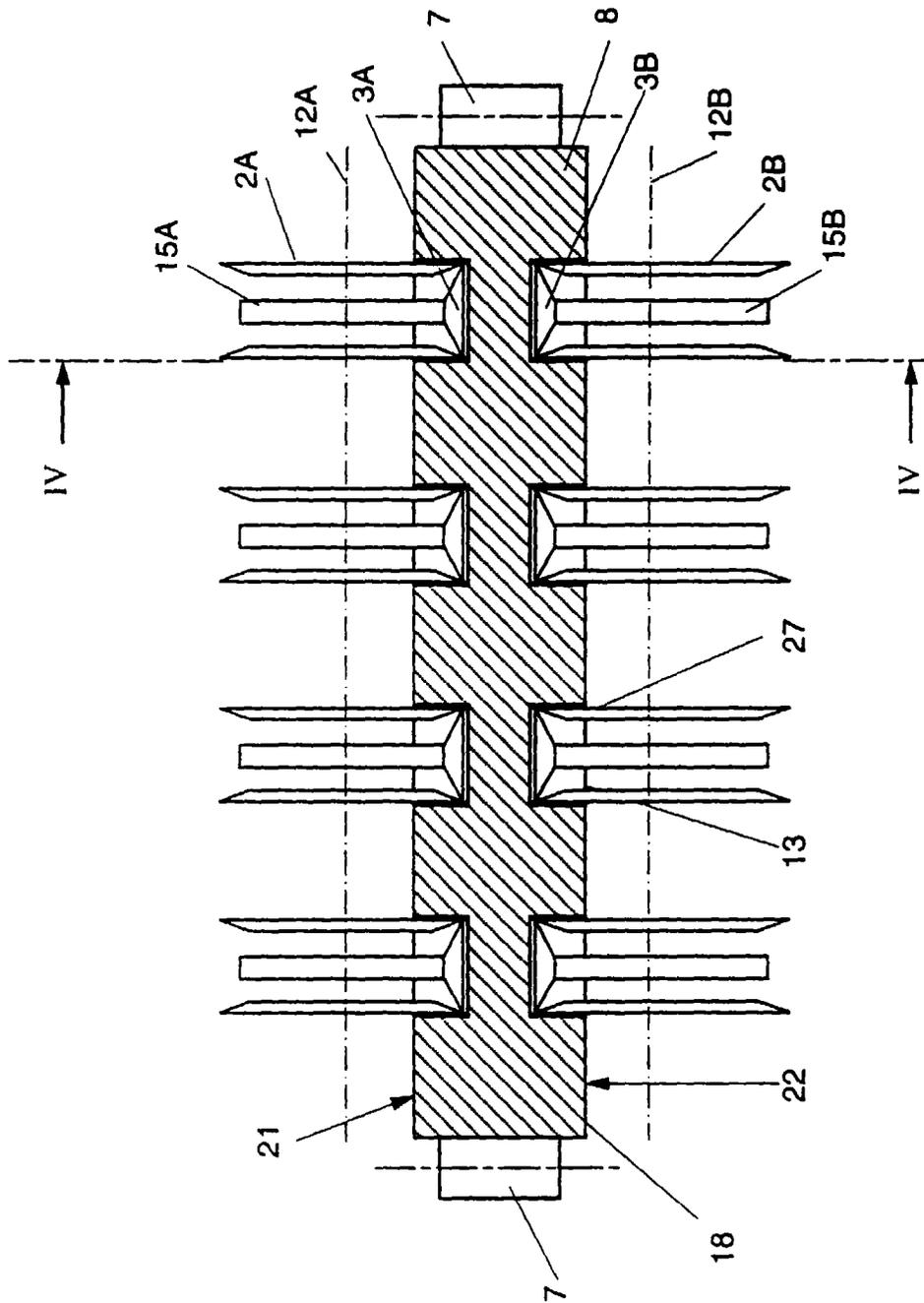


FIG. 5

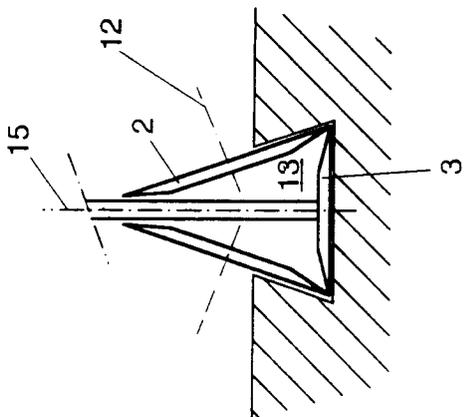


FIG. 6C

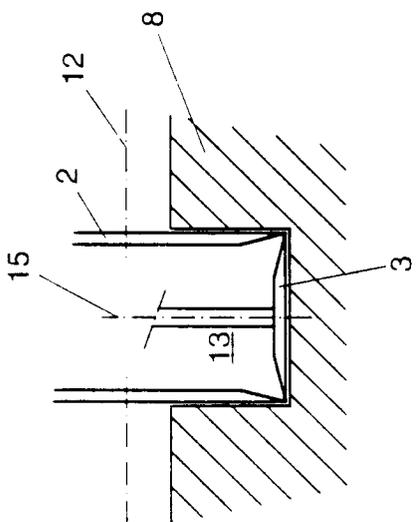


FIG. 6A

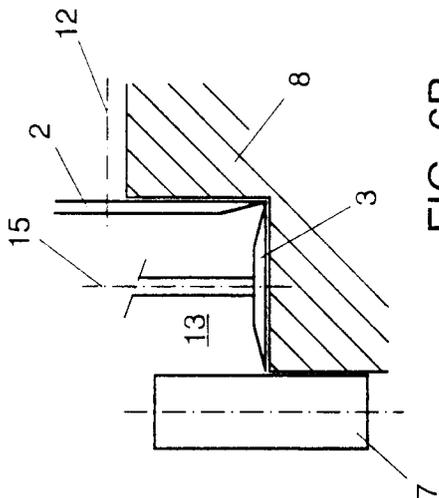


FIG. 6B

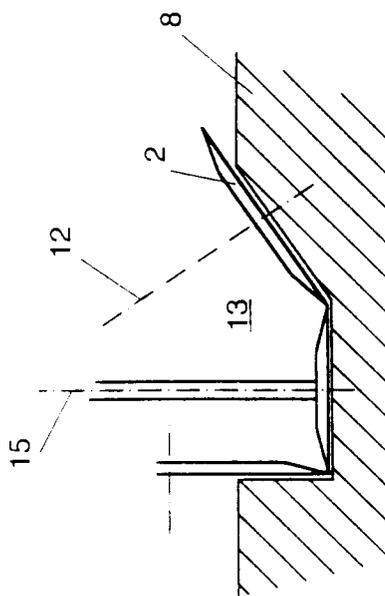


FIG. 6E

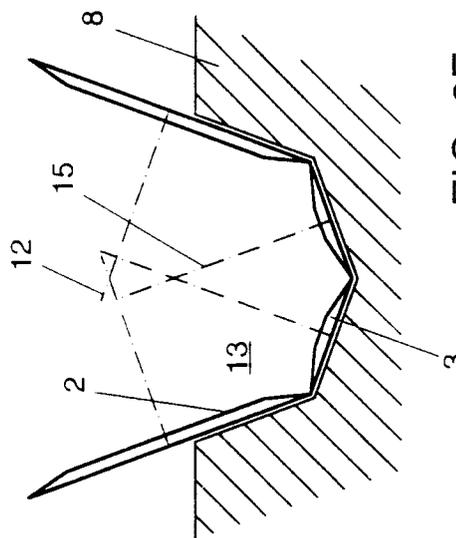


FIG. 6F

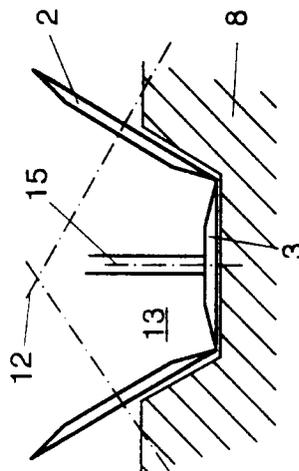


FIG. 6D



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 20 2646

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	FR 81 596 E (GAILLARD) 13 January 1964 * the whole document * ---	1-4,6-9	B26D3/06
X Y	US 4 091 697 A (CAILEY) 30 May 1978 * the whole document * ---	6,11-13 8,10,14	
Y	US 3 924 496 A (W.R. GRACE & CO.) 9 December 1975 * the whole document * ---	1-4,6-8, 11,12,14	
Y	CH 482 528 A (TREUHANDBÜRO A. KÜNZLE) 15 December 1969 * column 3, line 34 - line 56; figures * ---	1-4,6,7, 11,12	
Y	CH 482 529 A (BESSE) 15 December 1969 * figures * ---	10	
A	DE 35 151 C (SCHERBEL ET AL.) 16 October 1885 * the whole document * ---	5	
A	US 3 915 038 A (MALIN) 28 October 1975 * column 2, line 60 - line 11; figures * -----	1-4,6,9, 11,12	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B26D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 1 December 1997	Examiner Vaglianti, G
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			

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