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

(11) EP 1 160 367 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.12.2001 Bulletin 2001/49

(51) Int Cl.7: **D04H 3/03**, D04H 3/16

(21) Application number: **01201819.8**

(22) Date of filing: **15.05.2001**

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

(30) Priority: **29.05.2000 IT RE000060**

(71) Applicant: **Italdreni S.R.L.**
42020 San Polo d'Enza (Reggio Emilia) (IT)

(72) Inventor: **Siniscalco, Andrea, c/o Italdreni S.R.L.**
I-42020 San Polo d'Enza (Reggio Emilia) (IT)

(74) Representative: **Corradini, Corrado et al**
Studio Ing. C. CORRADINI & C. S.r.l.
4, Via Dante Alighieri
42100 Reggio Emilia (IT)

(54) **Matting of low density thermoplastic material and high voids index, and a device and process for its production**

(57) Matting of interlaced and entangled filaments of low-density thermoplastic material, the matting having a high voids index and comprising a plurality of hollow protuberances arranged in several parallel rows; at least a part of said protuberances presents at least one open portion, defined by non-interlaced filaments, such as to create a chamber for receiving the material with which the matting is intended to be covered; a plant and process for producing said matting.

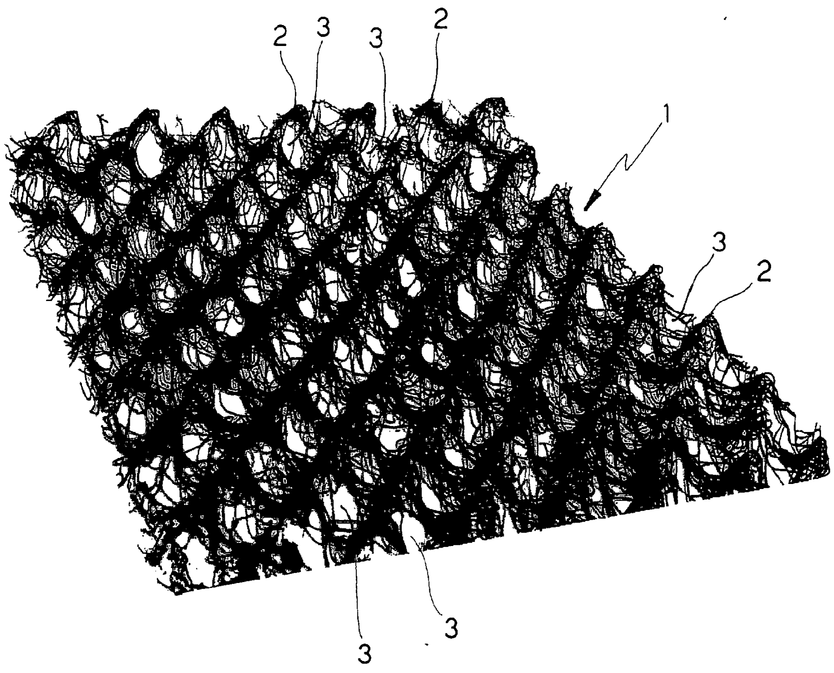

FIG.1

EP 1 160 367 A2

Description

[0001] This invention relates to flexible panels or matting consisting of a plurality of entangled thermoplastic polymer filaments partly bonded together at their points of contact.

[0002] This type of article has been known for some time and has found application in numerous technical sectors, such as soil drainage, protection against erosion, concrete reinforcement, the support and reinforcement of polymer or thermosetting foams, and the reinforcement of resins, mixes and conglomerates.

[0003] Such matting can be produced by two different processes, namely a so- called wet process and a so-called dry process, which give rise to products of different geometry and different mechanical characteristics.

[0004] These known processes are described in Italian Patents 883371, 1061875 and 1257665, to which reference should be made for further information.

[0005] With the wet process, non-stretched monofilament matting is obtained of virtually parallelepiped shape with flat sides, whereas with the so-called dry process the matting can present at least one profiled surface, for example with protuberances.

[0006] The surface profiling is obtained by dropping the filaments onto a surface provided with projections, for example a rotating cylindrical surface, or a translating web presenting a plurality of geometrical projections.

[0007] It has been observed that by using the dry process, matting is obtained with mechanical characteristics substantially better than those of matting obtained by the wet process, and moreover the presence of said protuberances in the final product is useful in all those applications in which the purpose of the matting is substantially to retain a material, such as soil or polymer foam, which lies above it or is partially embedded in it.

[0008] For these reasons, in the environmental field, matting obtained by the dry process is currently used presenting at least one profiled surface, it being generally positioned on inclined ground and then covered with soil.

[0009] To improve soil consolidation it is current practice to cover this with a grass layer, so that the grass roots act as a further soil retention element.

[0010] Such matting has however shown various drawbacks in this application.

[0011] A first drawback lies in the fact that the known products have a poor capacity for copenetration by cultivatable soil, because of the fact that said projections are partially impermeable to soil passage.

[0012] Hence after installation, the product presents practically empty spaces below each protuberance. In this manner air cells are created within said spaces which are deleterious to the development of the root system of the grass layer, the roots of which become dry and die on contact with the air.

[0013] In addition, depending on the inclination of the slope on which the matting is used, it can happen that one side of said projections lies in a horizontal position, or even inclined downwards, hence compromising the soil retention capacity of the product, which is its basic requirement.

[0014] An object of the present patent is to overcome the said drawbacks within the framework of a reliable low-cost solution.

[0015] This and further objects are attained according to the invention by a flexible matting of low density and high voids index, the surface of which comprises a plurality of close-apart protuberances, said protuberances being hollow and provided with at least one open side in such a manner as to define a pocket or chamber to receive the material, such as soil, with which the matting is covered when installed.

[0016] Said matting is obtained by a dry process of the aforesaid type, using as the filament reception surface a translating surface provided with projections.

[0017] According to the invention, said projections present at least one portion inclined to the direction of movement of the surface at the moment of impact by the filament.

[0018] Said inclined portion is preferably flat, its inclination to the direction of movement being defined by the angle α subtended between the surface and the direction perpendicular to the direction of movement.

[0019] In the case of a non-flat portion the angle α is that subtended between the tangential plane at the point considered and said perpendicular direction.

[0020] The translating surface carrying the projections is preferably a rotating cylindrical surface.

[0021] In this case an angle β is defined subtended in the anticlockwise direction between the diametrical horizontal plane of the cylinder and the diametrical plane passing through the point of impact of the filaments.

[0022] In the case of a horizontal flat translating surface the angle β is obviously zero.

[0023] The filament falling velocity is indicated by V_C and the translation velocity of the surface and relative projections is indicated by V_P.

[0024] These velocities are always considered as vectors.

[0025] For the required result to be achieved, the vectorial difference between V_C and V_P must be represented by a resultant vector

$$V_R = V_C - V_P$$

which is directed in such a manner as not to intersect at least an inclined portion of the translating surface.

[0026] In other words the vector V_R which expresses the relative velocity of the vertically falling filament to said inclined portion must be directed against said inclined portion with a positive angle of incidence close to zero or with a negative angle of incidence.

[0027] In this respect, if the angle of incidence is zero, the filaments slide parallel to the inclined portion and lie without entanglement, this also happening for very small angles of incidence, i.e. close to zero.

[0028] The constructional and operational characteristics of the invention will be apparent from the ensuing description of a preferred embodiment thereof given by way of non-limiting example and illustrated in the accompanying drawings.

[0029] The described embodiment relates to a cylindrical translating surface provided with square-based pyramidal projections the walls of which constitute inclined portions of the translating surface, but is also suitable for a flat translating surface for which the angle β is considered equal to zero.

Figure 1 is a perspective view of a first embodiment of the product of the invention.

Figure 2 is a schematic perspective view of the production plant of the invention.

Figure 3 shows a first schematic configuration of the plant of the invention.

Figure 4 shows a second possible configuration of the production plant of the invention.

Figure 5 is an enlarged view of diagrams showing the velocities of the filaments and of the translating surface of Figure 3 and Figure 4 for various values of the angle β.

Figure 6 shows a further possible configuration of the plant of the invention.

[0030] Figures 1 to 4 show the matting 1, the surface of which consists of a plurality of protuberances 2, aligned along several parallel rows and inclined at an angle of between 30° and 45° to the sides of the matting. Specifically, said protuberances 2 are hollow and present an open side defining a chamber 3 for receiving the material with which the matting is generally covered when installed.

[0031] The matting 1 is produced by the plant 4 shown in Figure 2, comprising a die 5 provided with a plurality of holes aligned along several parallel rows, through which the filaments of thermoplastic material are extruded. The thermoplastic material is fed to the die via a usual extruder, not shown, at a temperature of between 160°C and 270°C.

[0032] Said extruder is fed in its turn by a usual hopper, not shown as it is of known type.

[0033] The theoretical filament extrusion velocity is between 10 and 15 m/min, and preferably about 12 m/min.

[0034] However the actual falling velocity V_C of the filament is from 1 to 1.5 times greater because of the stretching of the filament and the consequent reduction in its cross-section.

[0035] Below the die 5 there is provided a rotating cylinder 8 having its axis parallel to the rows of holes in the die, and presenting on its outer surface a plurality of square-based right pyramids 9 of height preferably between 20 and 50 mm.

[0036] As can be seen from the figure, the pyramids are disposed in mutually aligned rows in the manner of a helix of predetermined inclination, preferably of between 30° and 45° to the horizontal axis of the cylinder 8.

[0037] To obtain the matting 1 with at least one open side for passage of the material, the vertical falling velocity V_C of the filaments must be regulated, relative to the translation velocity V_P of the inclined wall of the pyramids, such that the vectorial difference between the two is a vector V_R having a direction and sense such as not to encounter the wall.

[0038] Figure 5 shows the velocity diagrams for the two cases of β = 90° and β = 120° in a roller of diameter 200 mm provided with pyramidal cusps with a square base of side 15 mm and having a height of 25 mm, with an angle at their vertex of 40° and an angle α of 20°.

[0039] The actual falling velocity V_C of the filament has been assumed to be 20 m/min, and the modulus of the velocity V_P to be 4 m/min.

[0040] From the graphical calculation it can be seen that with β = 120°, the resultant V_R is substantially parallel to the front face of the pyramid in the direction of motion, which means that said face does not encounter the falling filaments, and is hence substantially open.

[0041] If the filament falling velocity V_C is decreased, or the modulus of the pyramid wall translation velocity V_P is increased, the resultant V_R becomes directed towards the wall, which is hence closed.

[0042] With β = 90°, the graphic calculation shows that V_R cuts both the front wall and the rear wall of the pyramid, which are hence closed.

[0043] In order for one of these walls, and in this case the rear wall, to be open, V_C must be decreased or V_P increased; the graph shows with dashed lines that vector V'_R starting from which the wall begins to remain open. For this, the value of V_P is 6 m/min.

[0044] Figure 4 shows the particular case in which β = 0°. In this case, as V_C is perpendicular to V_P, the relationship between the modules which has to be respected is the following:

$$V_C \leq V_P[\cos\alpha/\sin\alpha]$$

i.e.

$$V_C \leq V_P.\text{cotan}\alpha$$

[0045] Figure 6 shows the limiting case in which β = 180°. In this case, as in the case in which β = 0°, the front and rear walls in the direction of movement are always empty.

[0046] Those inclined portions of the projections from which

$$V_R = V_C - V_P$$

is distanced are not struck by the filaments, which hence deposit in a non-interlaced condition, and leave said portions substantially permeable to the passage of the material.

[0047] In contrast, on those portions of the projections opposite the preceding, a thickened structure of interlaced filaments is created which is impermeable to passage of the material. In this manner a chamber open on one side is defined, in the manner of a pocket, for receiving the material with which the matting 1 is covered.

[0048] It should be noted that the matting 1 of the invention can also be obtained by replacing the cylinder 8 with a translating surface on which there are disposed a plurality of pyramids 9, or projections of any type provided they are suitable for the purpose.

[0049] The velocity diagram appropriate for this configuration is that of Figure 4 referred to $\beta = 0°$.

[0050] In this latter case said translating surface is preferably inclined to the horizontal plane by an angle of between 0° and $\alpha°$, to facilitate the phenomenon.

Claims

1. Matting of interlaced and entangled filaments of low-density thermoplastic material, the matting having a high voids index and comprising a plurality of hollow protuberances arranged in several parallel rows, **characterised in that** at least a part of said protuberances presents at least one open portion, defined by non- interlaced filaments, such as to create a chamber for receiving the material with which the matting is intended to be covered.

2. Matting as claimed in claim 1, **characterised in that** said protuberances are without their lower base.

3. Matting as claimed in claim 1, **characterised in that** said hollow protuberances are positioned alongside each other in adjacent parallel rows.

4. A device for manufacturing entangled monofilament matting provided with protuberances having at least one portion not occupied by the filaments, comprising a die of vertical axis for extruding parallel alignments of said filaments, a rotating cylinder positioned below said die and having its axis horizontal and parallel to said alignments, and a series of projections regularly distributed on said cylinder and having at least one portion inclined to the direction of movement, **characterised in that** the distance between the cylinder axis and the mean vertical plane in which the filaments fall is chosen such that the vector V_R resulting from the vectorial difference between the vector V_C, namely the velocity of vertical fall of the filament, and the vector V_P, namely the velocity of translation of the inclined portion, cuts the inclined portion at an angle close to zero or at a negative angle.

5. A device as claimed in claim 4, **characterised in that** said projections are arranged in rows mutually aligned in the manner of a helix.

6. A device as claimed in claim 5, **characterised in that** said helix along which the projections are arranged has an inclination of between 30° and 40° to the cylinder axis.

7. A device as claimed in any one of claims 4 to 6, **characterised in that** said projections are right pyramids.

8. A device as claimed in claim 7, **characterised in that** the base of said pyramids is square.

9. A device as claimed in claim 8, **characterised in that** the bases of said pyramids have at least one side in common with the adjacent pyramids.

10. A process for producing matting of interlaced and entangled filaments of low-density thermoplastic material, comprising the steps of extruding a thermoplastic material through a die and collecting the vertically falling extruded filaments on a translating surface provided with a plurality of profiled projections having at least one portion inclined to the direction of movement, **characterised in that** the vector V_R which expresses the relative velocity of the vertically falling filament to said inclined portion is directed against said inclined portion with a positive angle of incidence close to zero or with a negative angle of incidence.

11. A process as claimed in claim 10, **characterised in that** said translating surface is a flat conveyor belt on which a plurality of right pyramidal projections are disposed.

12. A process as claimed in claim 11, **characterised in that** the translation velocity V_P of the belt is related to the vertical falling velocity V_C of the filament by the following relationship:

$$V_C \leq V_P[\cos\alpha/\sin\alpha]$$

where α is the half-angle at the vertex of the pyramids.

13. A process as claimed in claim 12, **characterised in that** said belt is preferably inclined to the horizontal plane by an angle between 0° and α°.

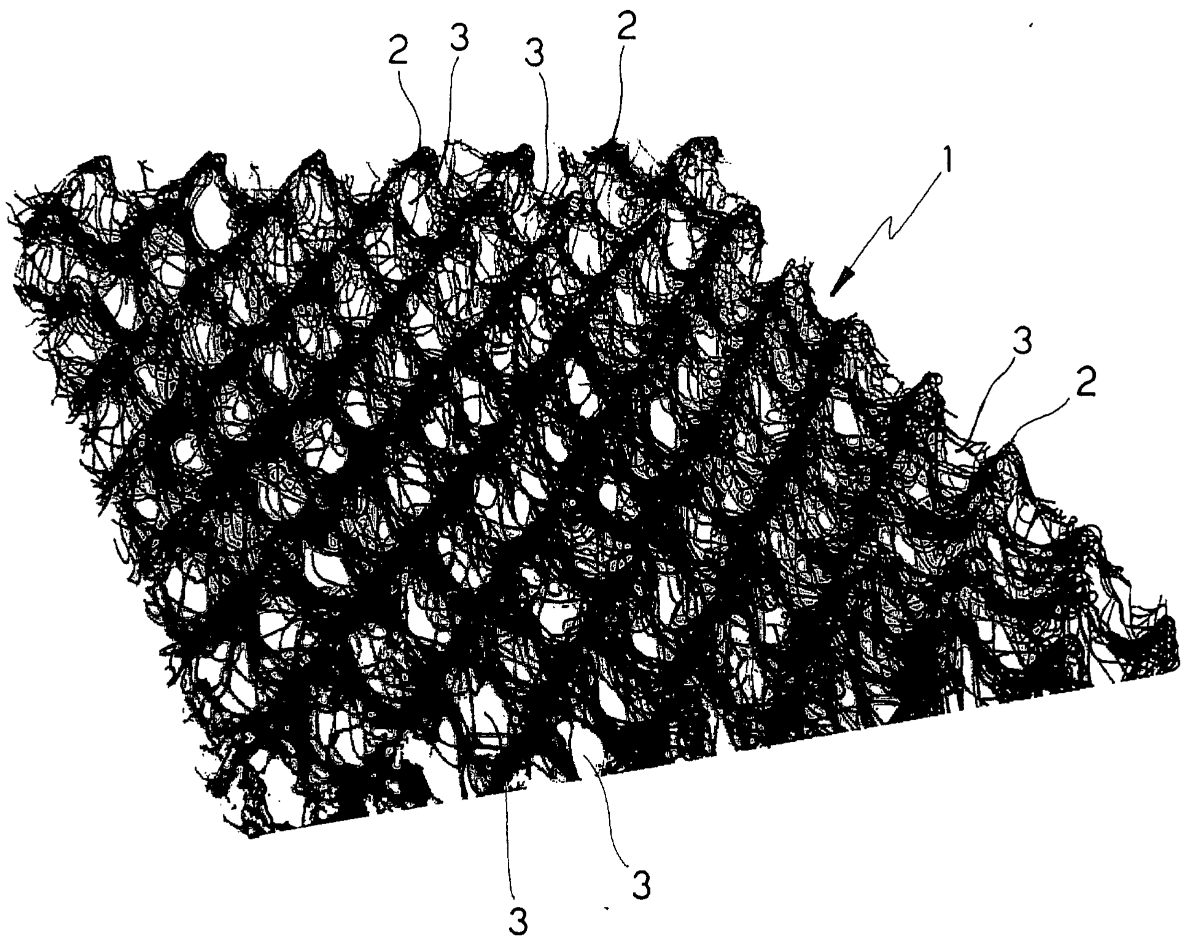

FIG.1

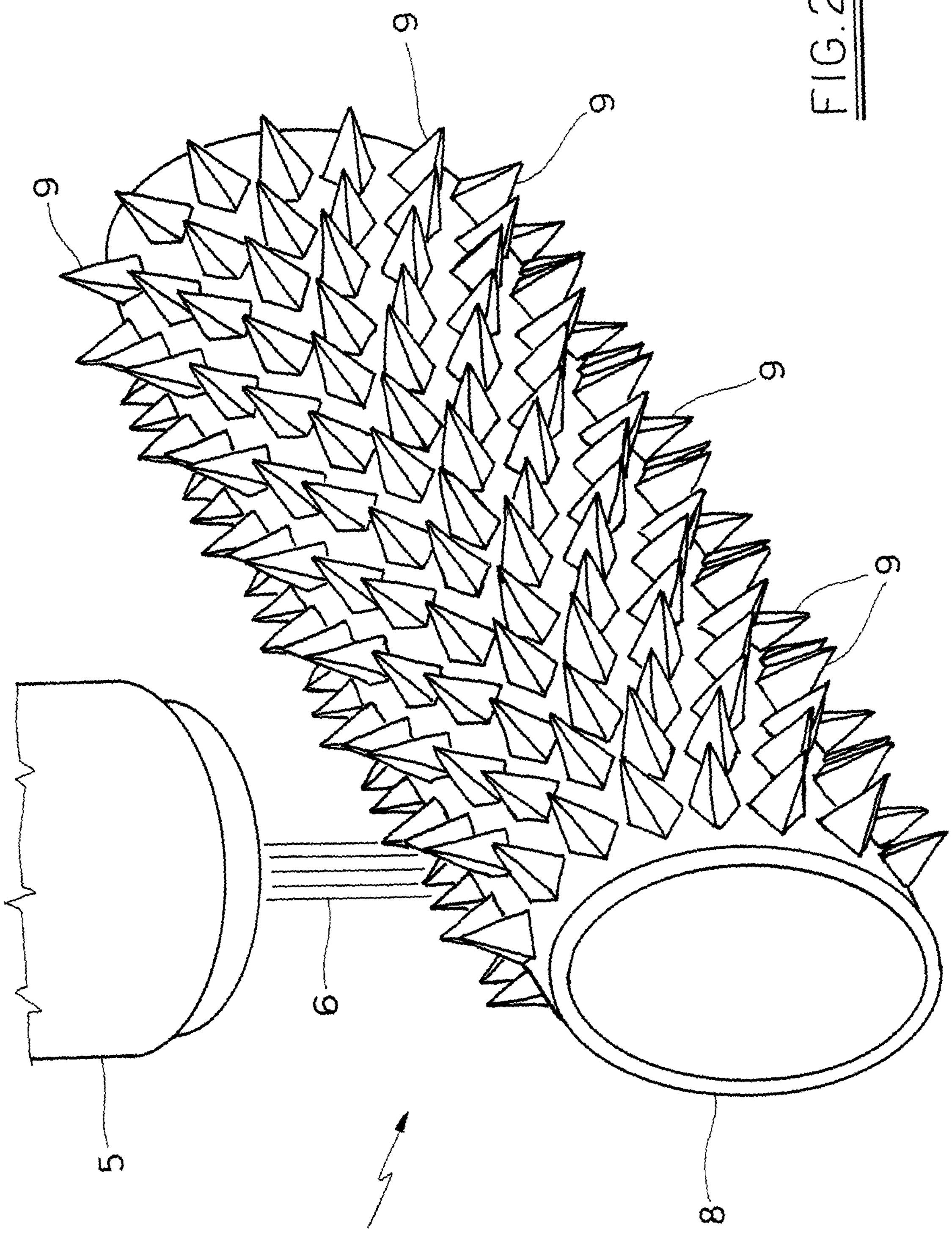

FIG. 2

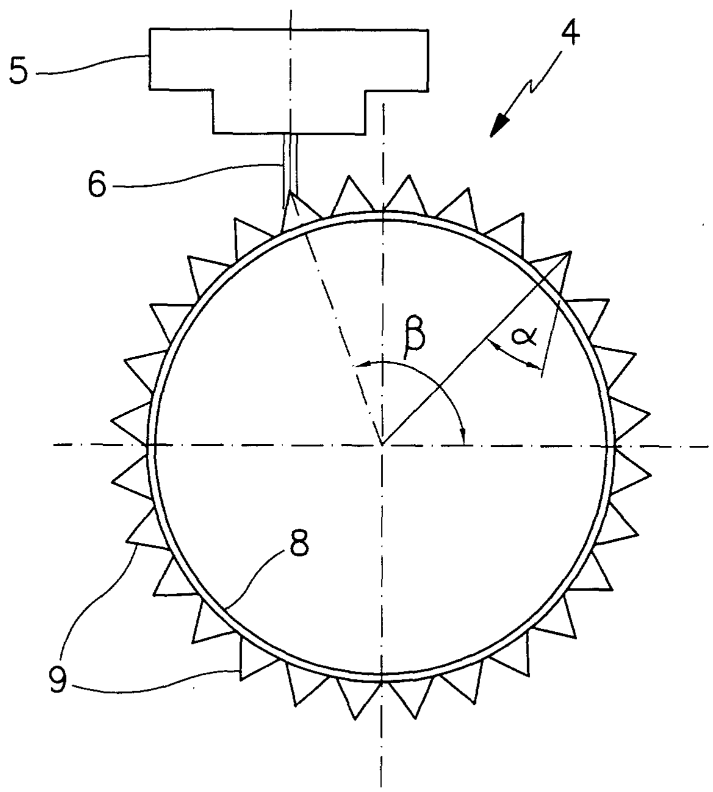

FIG.3

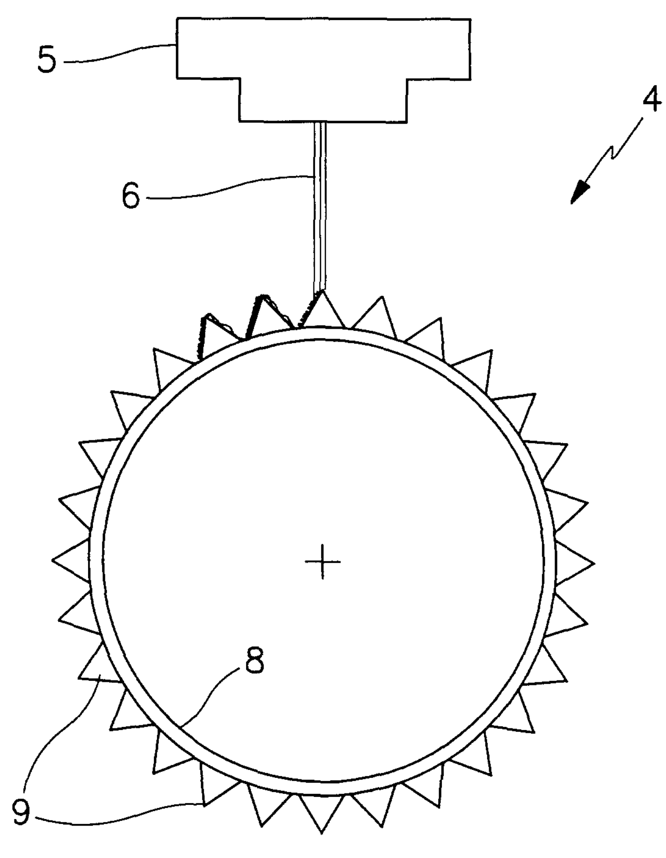

FIG.4

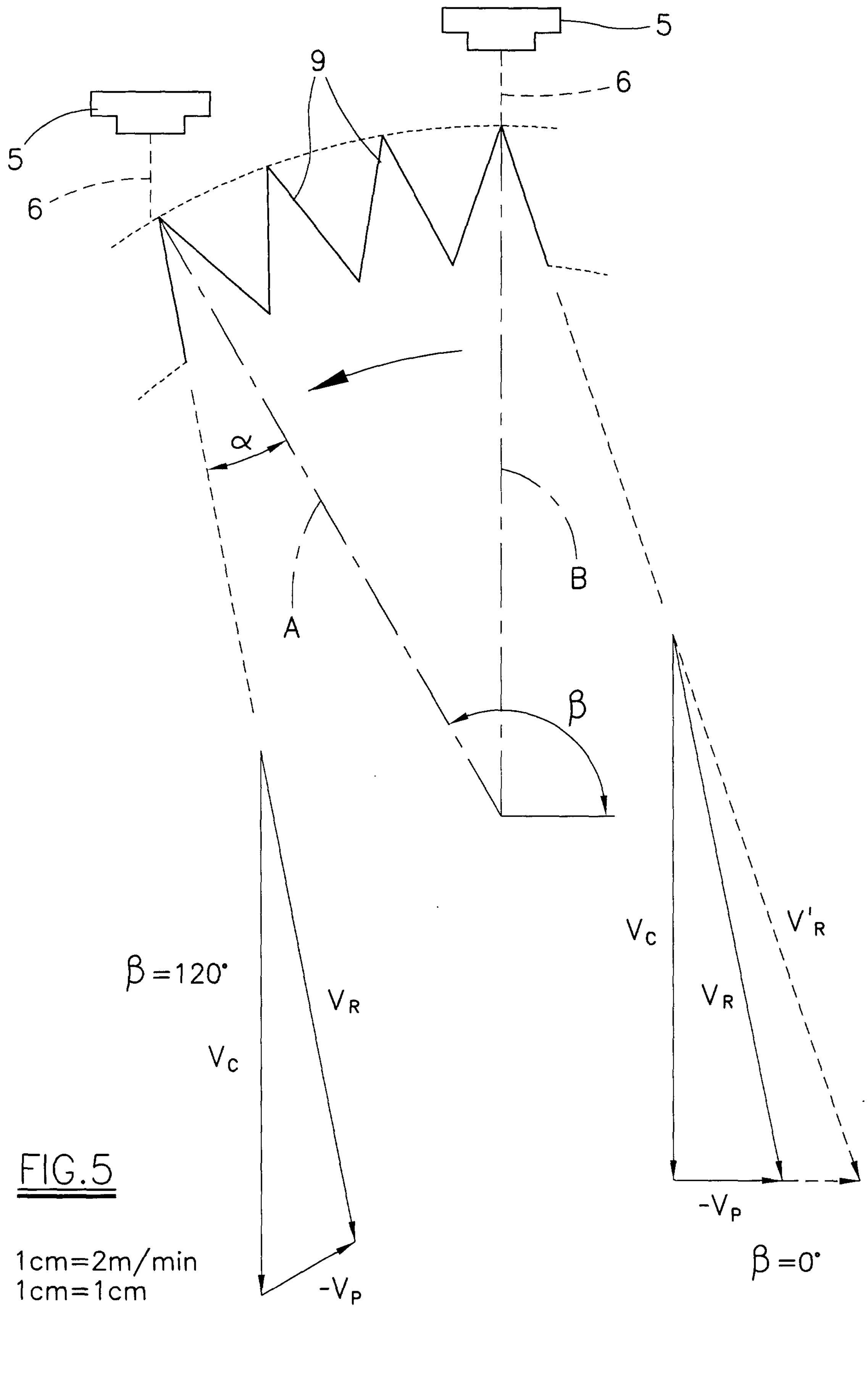

FIG.5

1cm=2m/min
1cm=1cm

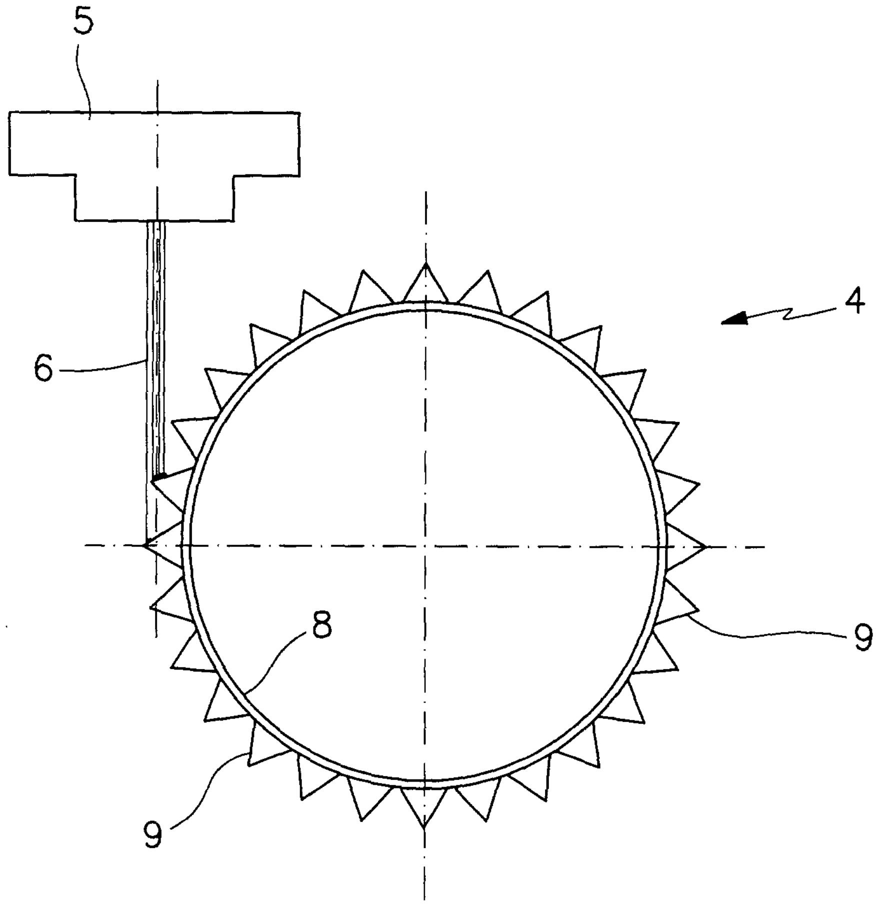

FIG.6