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(54) **Polishing machine with rotating head carrying a plurality of polishing sectors having a segmented and resilient structure**

(57) A polishing machine comprises at least a rotating head (1), connected through a flange (2) to the end of a drive shaft, the working face of the rotating head carrying a plurality of grinding sectors (3), held in hinged brackets (4), connected to the rotating head (1) at uniformly spaced angular positions, each grinding sector (3) being of an aggregate of abrasive particles and of a bonding resin having a cylindrical working face whose geometric axis lies on a plane normal to the axis of rotation of the head (1) and a shank portion shaped

to fit into a receiving slot of the holding bracket (4). Each grinding sectors (3) has a laminated structure including a shaped shank (5) of a rigid material and mechanically resistant to fit in the receiving slot, at least a resilient pad, at least partly of elastomer (6, 8) interposed between a face of said shank (5) and an aggregate abrasive body (9, 10) having said cylindrical working face defined by a plurality of end faces of as many protrusions (9) of aggregate, rising from a relatively thin or flexible base layer (10) of said aggregate, incorporating reinforcing fibers.

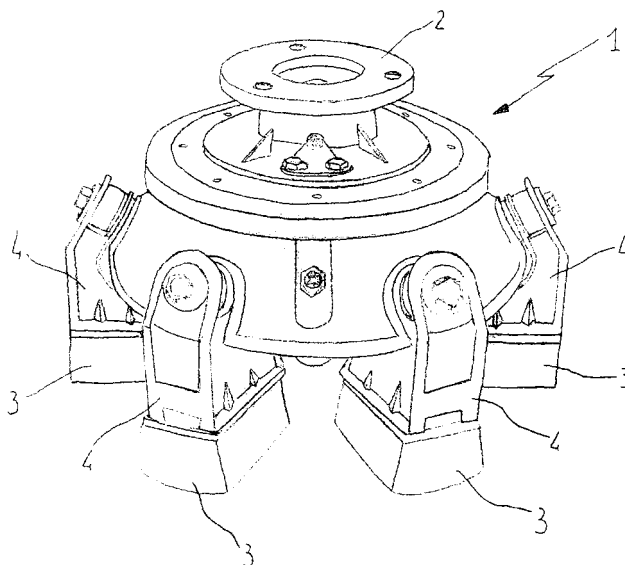


FIG. 1

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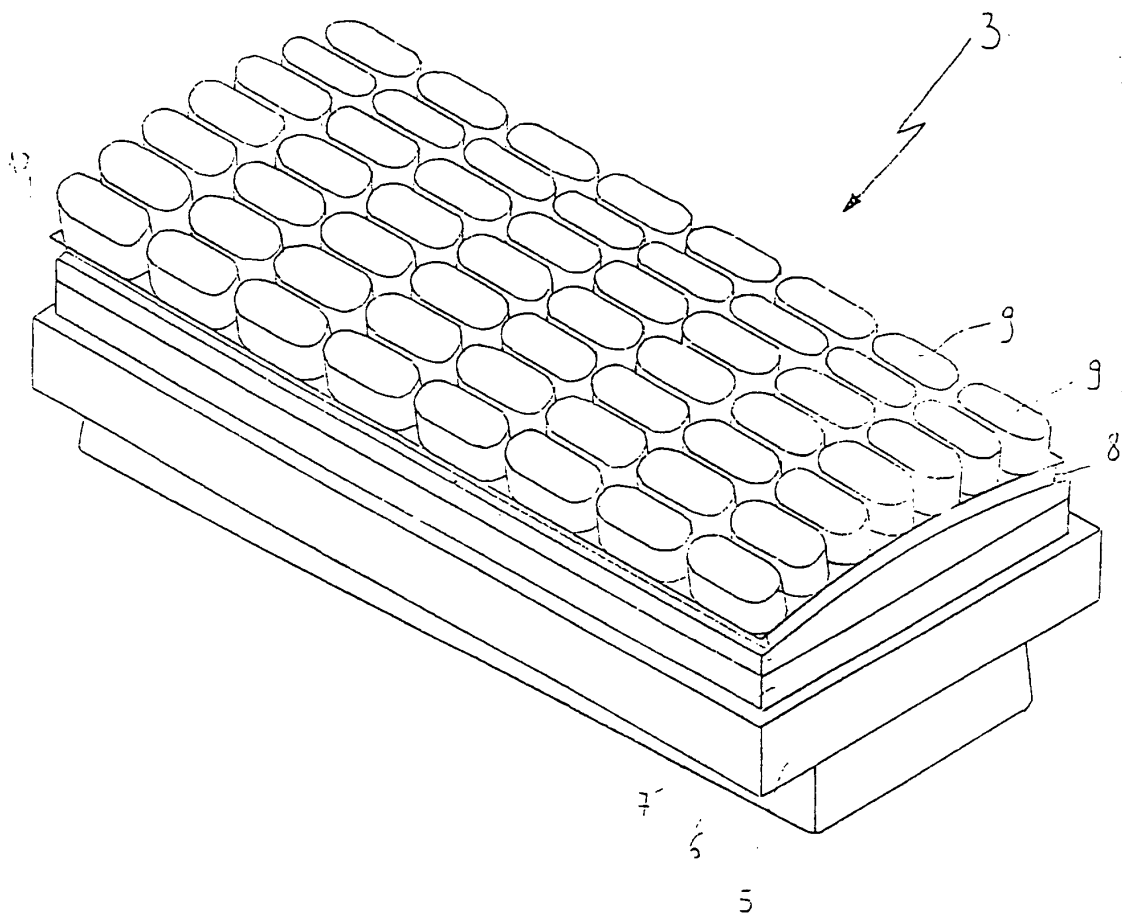


FIG. 2

Description

[0001] The present invention relates to polishing machines having tools in the form of sectors of abrasive materials mounted on rotating units of the machine, used to polish and grind slabs of natural stones, ceramic floor tiles, porcelain, enameled tiles and similar materials.

[0002] The abrasive sectors are commonly solid bodies of an aggregate of resin loaded with diamond dust, usually of synthetic origin, having a "shank" shaped to fit into a retaining slot of a steel bracket fastened to the rotating head of the machine and a grinding face shaped like a sector of a cylinder whose axis lies on the same plane of the axis of all the grinding sectors of the rotating unit, all intersecting the axis of rotation of the grinding head. The rotating head may comprise three to six or even more grinding sectors, coplanar among each other and radially spaced at regular angular intervals.

[0003] The fastening brackets of the abrasive sectors may be rigidly linked or more preferably hinged to the rotating unit, allowing for a limited angle of oscillation in opposition to the contrasting force of robust springs, in order to reduce vibrations caused by pinnings of a grinding sector against asperities of the surface being ground.

[0004] The rotating unit is mounted on the end flange of a driving shaft. The shaft rotates at a speed of 300 to 700 RPM and is advanced such to force the abrasive sectors against the material being ground.

[0005] The grinding action is typically that of levelling the surface of the worked material and is perfectly suitable to many polishing and grinding treatments of natural stone and ceramic floor tiles.

[0006] By contrast, in case of certain types of floor tiles or of other materials where it is just required to level the crests of decorative enamel smudgings, pittings, crevices, corrugations, and the like, such an intrinsic levelling characteristic may not be ideal. Indeed, if the aim is to give to the material a particular worn aspect, the rigidity of these polishing machines tends to cut the crests leaving unaesthetical sharp edges around the levelled areas.

[0007] In order to attenuate the levelling effect and to produce somewhat blunter edges, machines have been proposed wherein the rotating head assembly is fixed to the drive shaft through springs for attenuating the levelling effect of the grinding process by introducing a certain ability of the rotating head to oscillate.

[0008] Such an approach imposes important mechanical modifications of the design of the machine, and in the majority of cases, it becomes necessary to purchase a new machine equipped with special adjustments.

[0009] It has now been found and is the object of the present invention, a way to provide for a grinding operation without an excessive levelling action on the surface being ground resulting in an appreciable "rounding

off" of the edges of the ground crest areas as well as the perimeter of the tile surface even with a normal polishing machine without any adjusting mechanisms and/or to accentuate the effect of such adjustments on specially designed machines.

[0010] Essentially, a structure has been devised for the individual abrasive sectors, to be mounted on the face of a rotating head, that produces a less accentuated levelling action. The ground crests of corrugations present on the surface of the material to be finished assume a convex shape and/or a blunt edge as desirable in specific applications.

[0011] Essentially, the approach of the present invention is to confer intrinsically to each of the tools or abrasive sectors installed on the operating unit a certain resilience such to make the working face of the grinding sectors substantially flexible, that is, capable of slightly deflecting upon increasing the load.

[0012] This effective result is attained by realizing each abrasive tool or sector in a composite or stratified manner, typically including at least a layer or pad of elastomer, and by making the body of abrasive material that constitute a working face, geometrically shaped like a cylindrical sector of the tool which is of an intrinsically rigid material, in a segmented form capable of undergoing elastic inflections of the cylindrical surface without fracturing. In practice, the segmental abrasive body is able to follow elastically the compressions endured by the elastomer layer beneath, placed between the segmented body of the generally cylindrical face of the tool and a "shank" of rigid material, shaped to solidly fit into the supporting bracket that is commonly hinged to the rotating unit.

[0013] The invention is more precisely defined in the annexed claims.

[0014] The various aspects and advantages of the invention will become even more evident through the following description of several embodiments and by referring to the annexed drawings, wherein:

Figure 1 is a general view of a rotating head of a polishing machine;

Figures 2 and 3 are a general view and a detail view of an abrasive sector mountable on the rotating head of Fig. 1, realized according to the present invention.

Figures 4 and 5 are an assembly view and an exploded view, respectively, of a grinding sector according to an alternative embodiment of the invention.

[0015] Fig. 1 shows an operating unit or rotating head 1 of a polishing machine that may be connected by means of the flange 2 to the end of a driving shaft of the machine. The working face of the unit 1 is constituted by a plurality of abrasive tools or sectors 3. The illustrated head has six abrasive sectors, fitted by means of brackets 4, that are hinged to the body of the rotating

unit.

[0016] Generally, the abrasive tools, whose working surface has the shape of a cylindrical sector, are blocks of an aggregate of particles (grains) of an abrasive material and of a bonding resin. The bonding resin may be for example an epoxy, phenolic or melaminic resin or any other suitable thermosetting resin, or even a mixture of a thermosetting and of a thermoplastic resin such as a polyurethane or a polyolefin.

[0017] Commonly, synthetic diamond powder is used as the abrasive substance; the granules may have a size ranging between 30 and 6000 mesh. The finer part may be constituted by particles with a diameter of 0.5 to 1.0 μm and the coarse part may pass through a 30 and 40 mesh sieve.

[0018] The cylindrical sectors 3 are mounted on the same plane generally normal to the axis of rotation of the rotating head 1.

[0019] The orientation of the axis of all the sectors 3 is radial and the sectors are uniformly spaced on the face of the rotating unit.

[0020] The upper part of each sector has a shape functional to solidly fit into a receiving slot of the supporting steel bracket, hinged to the rotating head.

[0021] Fig. 2 depicts a sector 3 made according to a preferred embodiment of the invention and an exploded view of the composite sector is shown in Fig. 3.

[0022] The composite structure of the sector, object of the present invention, comprises a "shank" or shaped body 5 of a rigid and mechanically strong material, generally of aluminum or of a light-weight alloy or most preferably of a reinforced polyammidic resin, e.g. of nylon®, loaded with fiberglass or carbon fiber molded to a shape suitable to fit solidly into a recovery slot of the bracket of the rotating head of the polishing machine.

[0023] According to an essential aspect of the present invention, the composite includes one or more layers, two in the illustrated example, 6 and 8 respectively, of an elastomer with a hardness generally comprised between 25 and 95 Shore, for example of a natural rubber, a synthetic rubber or a silicon rubber and the like.

[0024] In the illustrated example, an intermediate layer 7 of a substantially rigid material, for example of a reinforced nylon, has a convex face shaped as a cylindrical surface. The association of the intermediate element 7 and of the two-elastomer layers 6 and 8 constitute a resilient pad.

[0025] The aggregate body of particles of abrasive material and of bonding resin with a working surface geometrically equivalent to the surface of a cylindrical sector of the same radius of the convex face of the intermediate element 7 of the resilient pad is, according to another essential aspect of the present invention, realized in a segmented form. The aggregate body is formed in a plurality of levelled protrusions or mesas 9 rising from a relatively thin base layer 10 of the same aggregate, preferably incorporating during the molding operation, reinforcement fibers or preferably a reinforcing mesh,

for example of nylon, fiberglass, carbon fiber or the like.

[0026] The segmented structure imparts to the aggregate body 9, 10, a certain flexibility and allows for the elastic inflection of the generally cylindrical surface defined by the end faces at the vertex of the protrusions 9.

[0027] The various elements or layers that compose the tool are permanently joined together by a structural adhesive, for example a ciano acrylate resin.

[0028] Of course, as well as the "shank" 5, also the body of aggregate 9-10 is manufactured by molding.

[0029] The aggregate body 9-10 may be formed in a mold, eventually pressing over the face of the flexible thin reinforced base layer 10, an the elastomer layer 8 in order to bond the elastomer layer 8 directly onto the coupling face of the aggregate body formed in the mold. The elastomer layer 8 so incorporated during the polymerization of the aggregate in the mold, promotes a good facilitates the adherence through the adhesive to the other elastomer layer 7 of the resilient pad of the assembly, practically functioning as a priming layer.

[0030] An alternative embodiment is shown in Figures 4 and 5.

[0031] According to this alternative embodiment, the aggregate body is segmented in a different way, in this case in a unidirectional fashion.

[0032] Also in this case, the segments 9 erect from a relatively thin and flexible base layer 10, preferably reinforced by incorporating a suitable reinforcing mesh during the polymerization process in the mold.

[0033] Differently from the embodiment illustrated in Figures 2 and 3, in this case the cylindrical working face of the tool, is defined by the shape of the molded body 9-10 of aggregate, and the assembly does not contain a cylindrically shaped element 7 of rigid material as in the preceding example.

[0034] Even in this alternative embodiment, the coupling face of the aggregate body may incorporate, during the polymerization phase of the bonding resin, an elastomer layer 8, to facilitate the subsequent bonding to another elastomer layer 6 that is bonded on the face of the rigid body 5.

[0035] In this case the inflections of the cylindrical working face of the tool occur by virtue of the flexibility of the thin reinforced base layer 10, present at the base of the transversal cuts between the substantially rigid subsectors 9 raising from the base layer 10.

[0036] The grinding sectors of the invention may substitute conventional rigid sectors, monolithically formed, whenever a nonlevelling grinding is desired.

[0037] The capacity of resiliently inflecting of the grinding sectors of the invention, produce a slightly convex grinding action of the crests of the worked surface, determining an appreciable rounding off at the edges.

[0038] Moreover, this important result is obtained by using a standard polishing machine without any resilience adjusting mechanisms of the rotating unit. Naturally, in the case of machines equipped with such adjusting mechanisms, the use of grinding sectors with the

composite structure of the invention enhances the effects beyond those obtainable by the adjustment of the machine.

[0039] The segmented structure of the aggregate body may also have different geometries than those illustrated in the reported examples, remaining fundamental for the aim of the present invention to form the abrasive body in a way such to ensure a capacity of resiliently inflecting.

[0040] The elastic properties of the elastomer pad of the composite structure of the grinding sectors of the invention are designed in function of the desired degree of flexibility of the aggregate body, in order to modulate the resilience of the grinding sectors according to the type of material to be ground and in function of the desired finish.

sandwiched between said two layers (8, 6) of elastomer.

5. The polishing machine according to claim 1, characterized in that said abrasive aggregate body has a bidimensional array of said protrusions.
6. The polishing machine according to claim 1, characterized in that said abrasive aggregate body has a monodimensional array of said protrusions.

Claims

1. A polishing machine comprising at least a rotating head (1), connected through a flange (2) to the end of a drive shaft, the working face of the rotating head carrying a plurality of grinding sectors (3), held in hinged brackets (4), connected to the rotating head (1) at uniformly spaced angular positions, each grinding sector (3) being of an aggregate of abrasive particles and of a bonding resin having a cylindrical working face whose geometric axis lies on a plane normal to the axis of rotation of the head (1) and a shank portion shaped to fit into a receiving slot of the holding bracket (4), characterized in that each of said grinding sectors (3) has a laminated structure including
 - a shaped shank (5) of a rigid material and mechanically resistant to fit in said slot, at least a resilient pad at least partly of elastomer (6, 8) interposed between a face of said shank (5) and an aggregate abrasive body (9, 10) having said cylindrical working face defined by a plurality of end faces of as many protrusions (9) of aggregate rising from a relatively thin and flexible base layer (10) of said aggregate incorporating reinforcing fibers.
2. The polishing machine according to claim 1, characterized in that said shank (5), said resilient pad of elastomer (6, 8) and said body of aggregate (9, 10) are glued together.
3. The polishing machine according to claim 1, characterized in that said resilient pad comprises a first layer of elastomer (8) partly incorporated on the coupling face of said base layer of reinforced aggregate and at least a second layer (6) of elastomer.
4. The polishing machine according to claim 3, characterized in that said resilient pad includes an insert (7), shaped as a cylindrical sector, of a rigid material

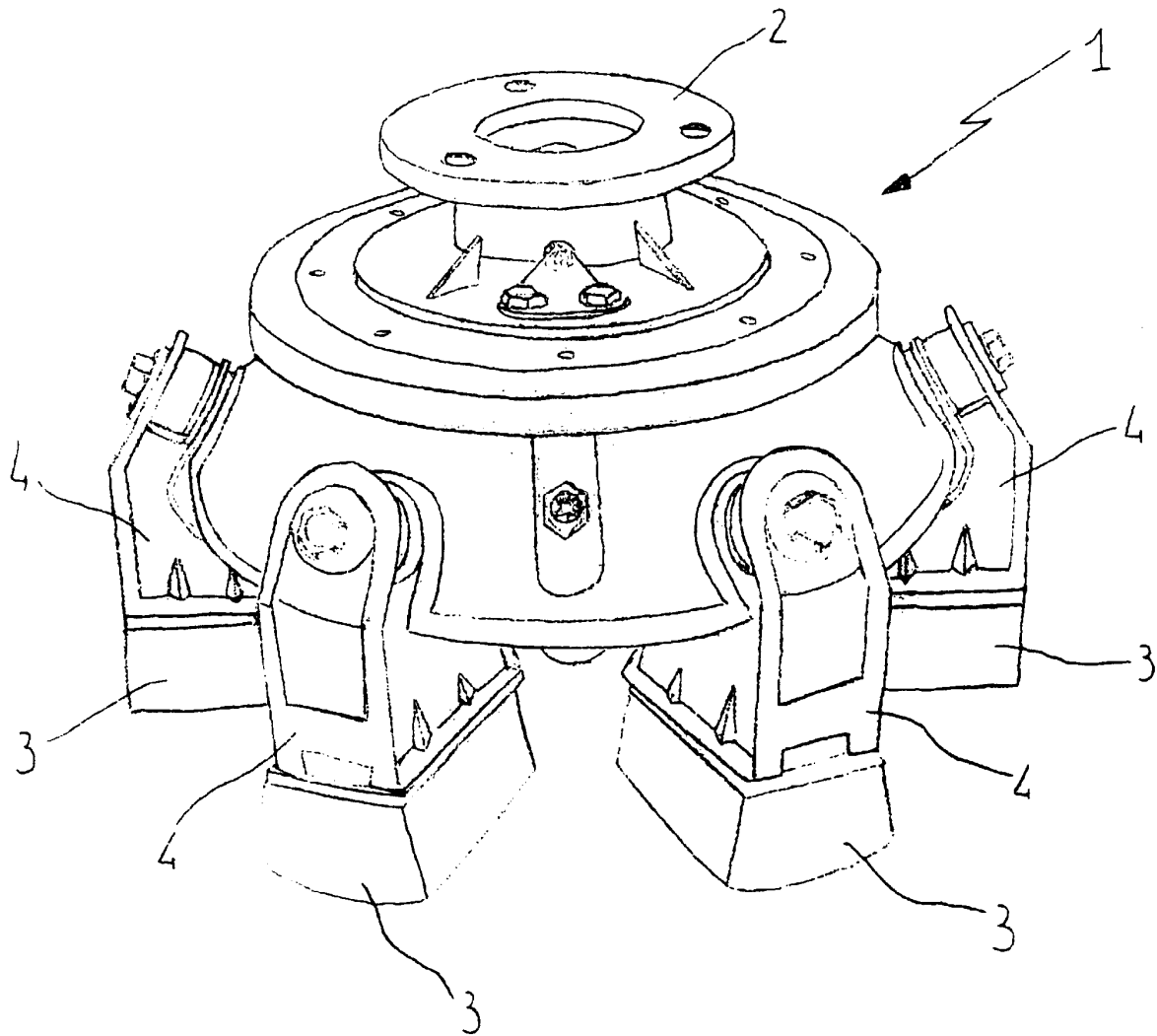


FIG. 1

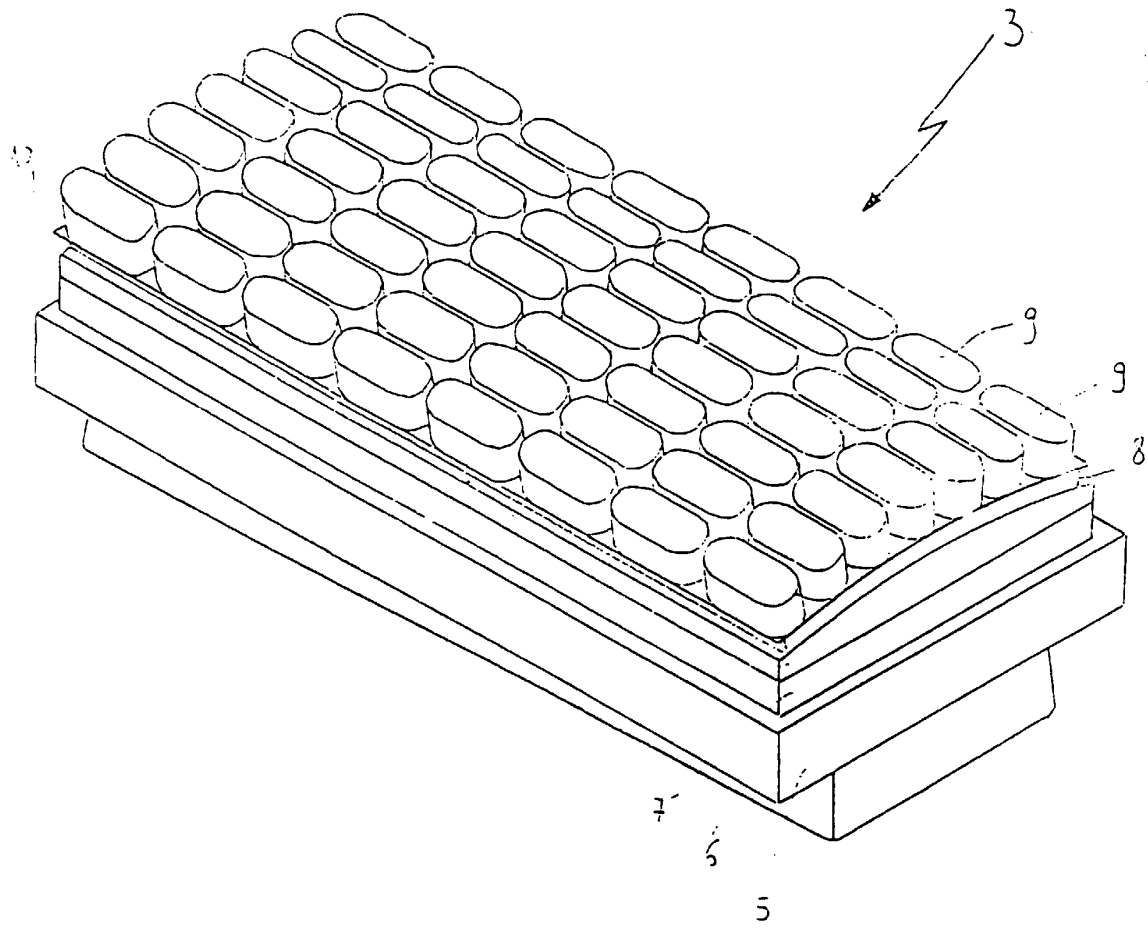


FIG. 2

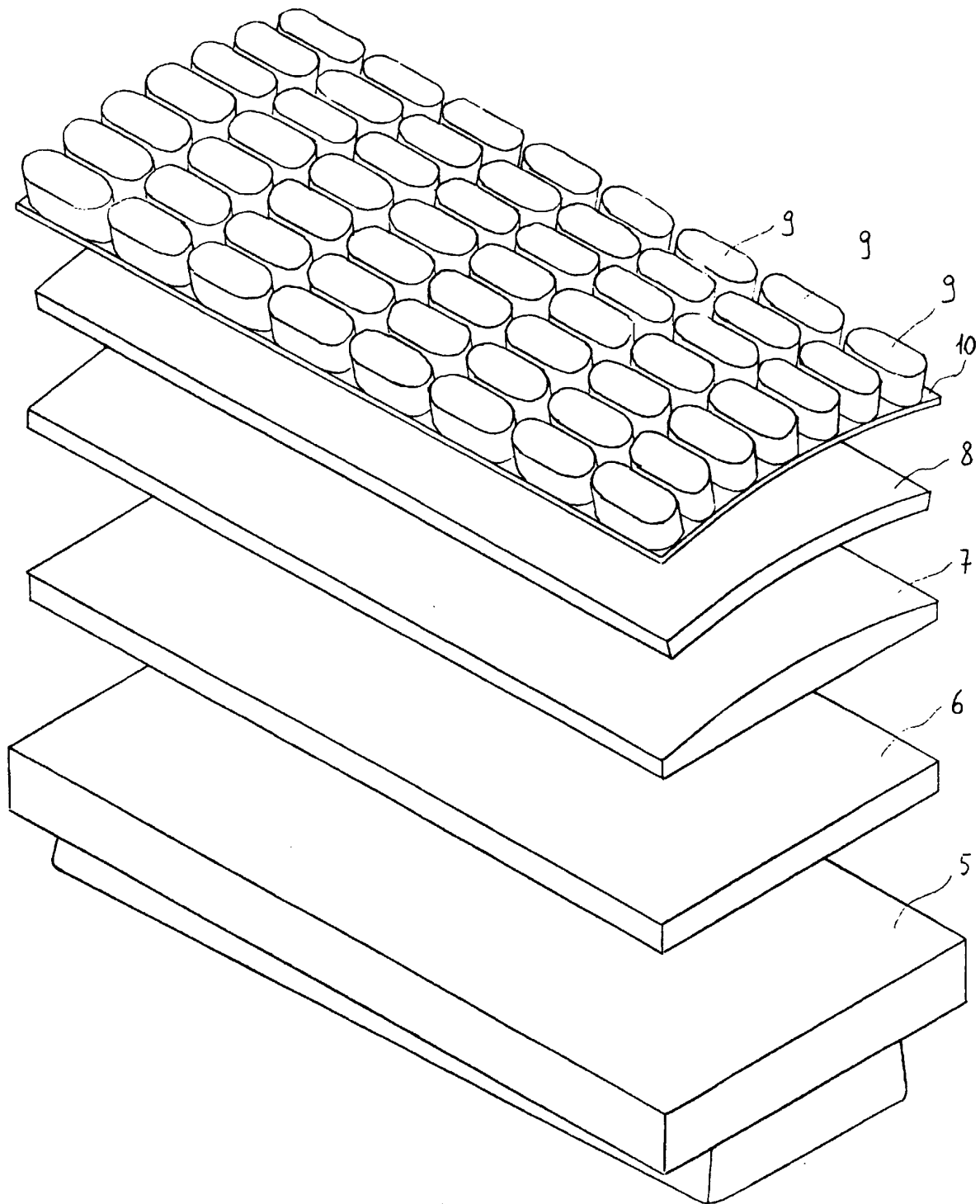


FIG. 3

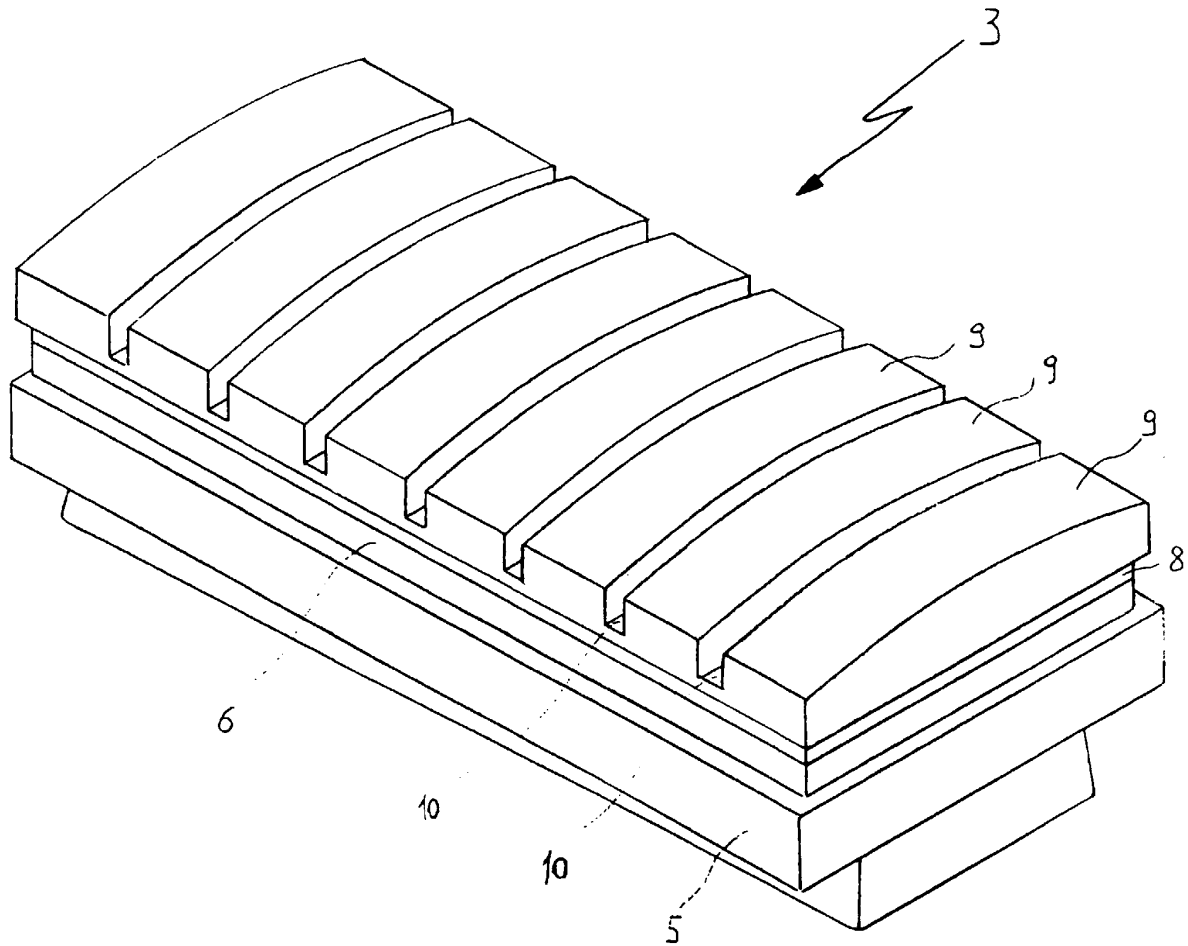


FIG. 4

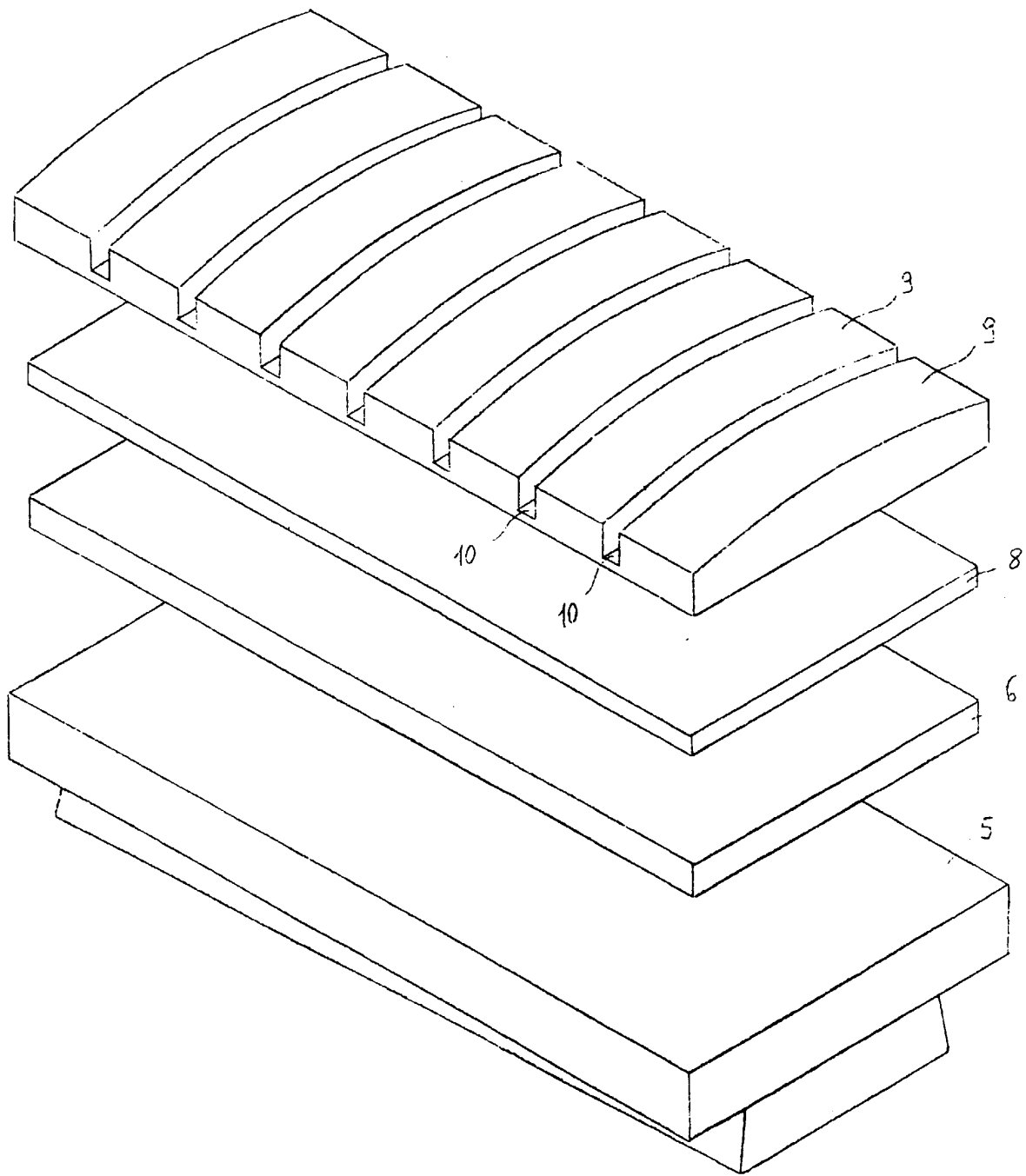


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0221

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION
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			TECHNICAL FIELDS SEARCHED
			B24D B24B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21 September 1999	Examiner Eschbach, D
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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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 83 0221

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