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(54) **DECORATIVE MATERIAL WITH COLOUR-DYNAMIC SURFACE AND METHOD OF OBTAINING IT.**

(57) A decorative material with a colour-dynamic texture surface, having three-dimensional texture or relief elements (1) whose differently oriented areas (2,3,4,5) have different colours. The texture surface consists of three-dimensional elements (1), the relationship between the total surface of all the three-dimensional elements (1) and of the gaps between the bases of those elements, on the one hand,and the surface on which they are located, on the other hand, being equal to 1.2-24, and the relationship between the average height (H) of the three-dimensional elements (1) and the average radius (R) of curvature of their points being equal to 3-300, whereby differently oriented surface areas (2,3,4,5) of each three-dimensional element (1) have different colours or different optical properties. The surface areas (2,3,4,5) oriented in the same direction have, with at least a part of the three-dimensional elements, the same colour and/or the same optical properties.

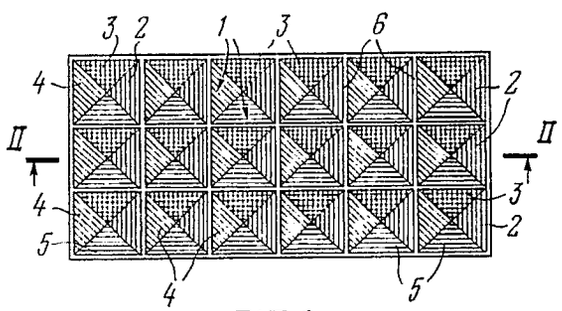


FIG.1

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# COLOURDYNAMIC DECORATIVE MATERIAL AND A METHOD OF PRODUCING THEREOF

## Field of the Invention

The present invention relates to the field of construction and architecture and in particular to a decorative material with a colourdynamic surface and a method of obtaining thereof.

The invention may be used in the manufacture of various facing and ornamental materials, construction products and also of a wide variety of adticles whose appearance is of particular importance, such as domes for lighting fixtures, decorative crokery, elements of furniture, machines and equipment, decorative grates of different purposes, natural fabrics and nonvowen materials and, respectively, various kinds of clothes, footwear, leather haberdashery, plastic articles.

When used in the civil engineering the invention allows the manufacturing of a aide range of finishing materials and construction products with a decorative colourdynamic surface, such as ceramic, gypsum, glass, polymeric and other facing tiles, facing bricks and ceramic blocks, ferroconcrete wall panels and partitions, cellular and lattice plates for suspended ceilings, glass blocks and ornamental strain-glass panels, polymeric and metal sheet materials, synthetic films and wallpaper, etc.

The invention allows imparting the decorative colourdynamic properties to practically any construction or funishing material used today.

The majority of finishing and decorative materials known nowadays are "static-colour", i.e. their face colour does not depend on the visual angle at which it is observed or on the angle of light incidence.

By contrast, the colourdynamic surfaces can change their colour both in narrow and wide colour ranges with the change of visual angle or angle of light incidence. For instance, a colourdynamic tile, if viewed at different angles, can successively look as red, orange, yellow, green, blue and violet each time acquiring a bright saturated spectral colour in compliance with the given position of the observer.

## Prior Art

The present invention is based on the principles of formation of raster dynamic representations known long before.

These principles were formed in the raster technique branch which was oriented entirely to the problems of creation of various types of raster representations.

The nature of these optical problems as well as the necessity to obtain the representations of high quality and purity imposed rather severe requirements on the methods and procedures of their solution which made the latter rather complicated, expensive and, consequently, not very suitable for use in a large-scale production as mentioned above with reference to the present invention.

As a matter of fact, a problem of manufacturing a materia with surfaces capable of changing their colour at different visual angles has never been proposed and therefore not solved in the raster optics branch since such a problem is senseless for this branch.

It is generally agreed that a raster optical system is first of all a specially organized optical system whose elements can solve this or that optical problem operating only as a combination, Therefore, further in the text the raster materials or surfaces shall be referred to as the materials which produce optical decorative effects due to the combined action of the raster components.

There is known a monoblock sandstone plate intended for coating the floors or walls and provided with a flat bottom portion equally spaced on which are the projections changing the plate appearance. The system of equally spaced projections forms varying lustre sections at which the different refraction of the light beams corresponds to the different inclination of the projections thus imparting the different appearance to these sections.

In this invention use is made of the plate ability to differently refract and reflect light in different directions depending on the conditions of its incidence and create, respectively, a different appearance for an observer who changes his position in space. But in the given case the plate does not change is colour and no colourdynamic effect takes place.

There is also known a decorative material whose surface is covered with conjugated bulging elements consisting of bulges and hollows and located along the crossing lines, the bulging element being so shaped that each of them has at least one light reflecting facet.

The difference in shape between the facets of the adjacent bulging elements changes successively and in cycles along the preset line in such a manner that the play of light during relative displacement between the surface and the observer's eye travels successively along this line.

Thus, the decorative properties of such a material are based on the light reflection from the differently oriented (in different directions) three-dimensional elements complemented by the presence of dynamic moire effects, i.e, cyclic tone-light

thickenings and thinnings appearing on the material and moving over it as the observer moves at the expense of cyclic changes of the differences in profile between the facets of the adjacent bulging elements.

Due to this feature the given material cannot be considered as a variable colour one in the above-mentioned sense.

widely known is a method of obtaining texture surfaces. The method is used in manufacturing the double-colour texture and relief ceramic plates.

The method consists in that after pressing the plates by means of a relief punch with the formation of the face texture or relief and application of a pigmented homogeneous glaze over the entire face, a glaze of the colour other than that of the glaze already applied, usually much darker, is deposited by spraying crosswise from one side. In so doing the spray cone should be directed at an acute angle to the main surface of the plate. As a result, the coloured coat of the texture or relief elements of the plate sides oriented to the spray cone is darker than that of its opposite sides which practically were not coated with the dark glaze.

This technique allows the visual revelation and emphasizing of the plate surface texture or relief, as a matter of fact rather insignificant, due to formation of artificial"painted shadows." Since the geometric parameters of the plate surface texture or relief of said plates are oriented to the solution of the decorative problem other than that of obtaining the colourdynamic effect, such an effect does not exist when observing the surface at the overwhelming majority of the possible angles of view.

The explanation consists in that, firstly, the texture and rel ef of the plates are actually developed rather insignificantly and from the majority of the real points of vision an observer can see both the dark and light sides of the texture elements simultaneously.

The degree of the texture development and that of the article relief may be characterized as a ration of the total surface area of the texture three-dimensional elements including the surface area of the spaces between the bases of these elements to the main surface area upon which said elements are located. This ratio may be also called a surface texture factor which varies in the range from 1.001 to 1.007 in said plates.

Secondly, the texture elements of the plates have smooth rounded-off peaks which do not ensure a presice colour separation both in the crosswise spraying of the glaze and, respectively, in the visual colour perception of the surface. Relative sharpness of the peaks of the texture elements may be determined as the ratio of the mean height of the elements to the mean rounding radius of their peaks.

For the majority of the plate being described, the ration of the mean height of the texture elements to the mean rounding radius of their peaks varies in the range from 0.5 to 1.7.

Therefore, in spite of the presence of some similar decorative and optical properties in the given materials and apparent similarity of their production process to one of the processes proposed by the present invention, these material are not colourdynamic ones in the above described sense.

## Dislosure of the Invention

It is an object of the present invention to provide a method of obtaining a decorative material whose texture and optical properties or solution of the surface colour problem would produce a colour variation effect in a broad colour range when observed at different visual angles and under conditions of changing illumination.

The essence of the invention consists in that in a decorative material with a colourdynamic texture surface having three-dimensional elements of the texture or relief whose differently oriented sections are of different colour according to the invention, the texture surface is formed by the three-dimensional elements with the ratio of the total surface area of all the three-dimensional elements and that of the intervals between the bases of these elements to the area of the surface on which they are located lying in the range from 1.2 to 24 and with the ratio of the mean height of the three-dimensional elements to the mean rounding radius of their peaks being in the range from 3 to 300, while the differently oriented surface sections of each three-dimensional element have different colours and/or different optical properties, and, at least in a part of three-dimensional elements the similarly oriented (in one direction) surface sections of different three-dimensional elements have a similar colour and/or similar optical properties.

Preferable is a version when in all the three-dimensional elements the similarly oriented surface sections of different three-dimensional elements have a similar colour and/or similar optical properties. In this case, the differently oriented surface sections of each three--dimensional elements including the surface section between the adjacent three-dimensional elements have at least three different colours and/or three different optical properties, and, when use is made of three colours of the differentlx oriented surface sections of the three--dimensional elements, preference should be given to three main colours: red, blue and one of the colours of the yellow, yellow-green and green colour group.

Advisably, in order to obtain good decorative

properties, the texture surface is made in the form of regularly arranged projections and/or hollows representing the three-dimensinal elements whose three sides are similarly oriented in all the elements whereas the aides of each element are separated by ribs converging in a peak, the sharpness of the ribs and the peak being characterized by the ratio of the three-dimensional element height to the rounding radius of its ribs and peak lying in the range from 3 to 300, while each of the three sides has the colour and/or optical properties differing from those of the other two sides.

The texture surface may also be made in the form of alternating three-faceted projections and hollows each facet whereof is made flat.

The invention allows obtaining a basically new decorative material possessing colourdynamic properties.

The face colour of such a material changes in a wide range depending on a visual angle at which it is looked at. For instance, a ceramic plate can look red, orange, yellow, green, blue and violet when observed from different visual angles. Any other set of colours or the order of their distribution may be designed.

The material actively responds by changing its colour to the change of the angle of natural or artificial illumination. For instance, the colour of a colourdynamic wall of a building changes constantly in the course of the day if looked at from one visual position. It is orange--red in the moring, violet in the day time and blue-green in the evening.

Since a person inevitably sees different sections of a a large architectural surface at different visual angles, these sections on a colourdynamic surface will have different colour. For instance, the left part of the building may look red, the right, bottom and top parts may, respectively, look blue, yellow and violet, the colours shading imperceptibly into each other at the boundaries of the parts.

A colourdynamic surface reveals and emphasizes the nature of the architectural shape the way light and shadow do this. A cylinder becomes "rounder", a cube "more faceted". At the same time, the similarly oriented and frequently repeated architectural elements, such as balcony planes, faces of buildings etc., begin to differ in colour, and to form colour lines thus considerably decreasing the feeling of their monotony.

The reaction of colour to the angle of vision causes a gradual change of a colourdynamic building or interior complicated polychromy as the observer changes his position which imparts a basically new expressiveness to the building architecture.

A colourdynamic surface decorative material provide es a wide variety of colour problem solutions due to its diversified orientation on the surface. In this case, colourdynamic ornaments, supergraphical pictures and colour accents may be obtained.

It should be noted that the degree of presence of all the above-mentioned decorative and optical effects, i.e. an active colour variability of the material, may be widely regulated by its texture parameters.

## Brief Description of Drawings

The invention will now be described further with reference to specific embodiments thereof, taken in conjunction with the accompanying drawings wherein:

Figure 1 is a fragment of a variable-colour surface of a glass decorative material according to the invention shown(by differently directed hatchings are the different--colour sections).

Figure 2 is a sectional view of Figure 1 taken on line II - II according to the invention;

Figure 3 is assembly A of Figure 2 represented on an enlarged scale;

Figure 4 is a fragment of a colourdynamic texture surface of a decorative material made in the form of corrugated metal sheet;

Figure 5 is a sectional view of Figure 4 taken at YY-YY;

Figure 6 is a fragment of a colourdynamic surface of a decorative material made of concrete with an irregular arrangement of the texture three-dimensional elements;

Figure 7 is a sectional view of Figure 6 taken on line YII-YII;

Figure 8 is assembly B of Figure 7;

Figure 9 is a version of a colourdynamic texture surface with three-faceted three-dimensional elements;

Figure 10 is a sectional view of Figure 9 taken on line X-X;

Figure 11 is a sectional view of a version of a decorative material with a translucent protective layer;

Figure 12 is a sectional view of a version of a decorative material made in the form of plate;

## Preferred Embodiments of the Invention

Figure 1 illustrates a fragment of a colourdynamic surface of a decorative glass material made in the form of a plate. The colourdynamic surface is formed by regularly arranged alternating two-faceted three-dimensional elements 1 (Figs 1, 2). In the presented invention embodiment each three-dimensional element has two facets 2, 4 and

3, 5 having different colour or different optical properties. For instance, the facets may have a different light reflection factor or different colour, for example, the main spectrum colours: red, yellow, green, blue. In this case, the sections of the surface (facets in our example) of all the three-dimensional elements 1 have a similar colour or similar optical properties, for instance, the facets 2 are coloured red, the facets 4 in all the three-dimensional elements are coloured green, the facets 3 are coloured yellow and the facets 5 are coloured blue.

According to the invention, the texture surface formed by three-dimensional elements with the ratio of the total area of the surface of all the three-dimensional elements and of that of the intervals between their bases to the area of the surface they are located upon being within 1.2 to 24. The ratio, which is the surface texture factor, should not be less than 1.2 because the colourdynamic effect does not practically occur on the surfaces with a smaller surface texture factor.

The texture factor upper limit is characterized in that its further increase does not lead to the increase of the colourdynamic effect, i.e. starting from this limit the texture factor does not affect the nature of the effect being observed any longer.

Besides, according to the invention, the ratio of height H (Fig. 3) of the three-dimensional element 1 to rounding radius R of peaks 6 of the three-dimensional elements 1 lies in the range from 3 to 300. The said ratio should not be less the 3, since in case of smaller values the quality of the light separation in the perception of the surface is considerably degraded.

The upper limit 300 is characterized in that the further decrease of the rounding radius of the peaks relative to the height of the elements, i.e. the further increase of the sharpness of these peaks has no effect on the colour separation quality and longer but impairs the operating characteristics of the surface creating an increased probability of chipping and breaking the peaks of the three-dimensional elements.

Figure 4 illustrates an embodiment of a colourdynamic surface of a decorative material made in the form of corrugated metal sheet. The colourdynamic surface is formed by regularly arranged three-dimensional elements 7 (Figs. 4, 5) and sections 8 of the surface between the adjacent three-dimensional elements, while differently oriented sections 9 and 10 of the surface of each three-dimensional element including the section 8 of the surface between the adjacent three-dimensional elements 7 have at least three different colours or three different optical properties, and the similarly oriented sections of the surface of the different three--dimensional elements including those located between the adjacent elements have a similar colour or similar optical properties.

According to the invention, the surface texture factor lies in the range from 1.2 to 24 and the ratio of the three-dimensional elements height to the rounding radius of their peaks lies in the range from 3 to 300.

Figure 6 illustrates an embodiment of embodiment of a colourdynamic surface of a decorative material made in the form of concrete plate. The colourdynamic surface is formed by the irregularly arranged three-dimensional elements 11 (Figs. 6, 7). In the given version each three-dimensional element 11 has three sections 12, 13, 14 (pigs. 6, 7, 8) of the surface of an irregular shape oriented in different directions and differing in colour or optical properties, whereas the similarly oriented sections of the surface of all the three-dimensional elements 11 have a similar colour or similar optical properties.

According to the invention, the surface texture factor lie in the range from 1.2 to 24.

In this embodiment use is made of chaotically arranged three-dimensional elements 11 having irregular shape, diverse height H (Fig. 8) and the rounding radius R of peaks 15 (Figs 6, 7, 8). Therefore the mean sharpness of the elements' peaks characterized by the ratio of the mean height H of the three-dimensional elements 11 to the mean radius R of rounding the peaks 15 lies within the range from 3 to 300.

Fig. 9 shows an embodiment of a colourdynamic surface of a decorative material having the testure made as alternating three-faceted peaks and hollows forming three-faceted three-dimensional elements 16 (Figs 9, 10), each of the facets 17, 18, 19 made flat and differing from the two other facets in colour or optical properties, while the facets oriented in one direction, say, facets 17 (Figs 9, 10) of different three-dimensional elements have a similar colour or similar optical properties.

According to the invention, the facets 17, 18, 19 (Figs 9, 10) of each three-dimensional element are separated from one another by ribs 20 meeting in one peak 21, while the sharpness of the ribs and the peak characterized by the ratio of the element height to the radius of rounding of the ribs and peak thereof lies within the range from 3 to 300.

According to the inventions the surface texture factor lies in the range from 1.2 to 24.

Figure 11 illustrates an embodiment of a decorative material provided with a translucent protective layer 22 having a smooth outer surface 23. The translucent layer 22 protects the colourdynamic texture surface against contamination.

Figure 12 illustrates an embodiment of a decorative material provided with a translucent protective material made in the form of plate. There is a gap 26 defined between the layer 25 and a texture

surface 27. Used as a protective plate in this version also may be a rigid or flexible film glued, fused or otherwise secured to the texture surface.

Thus, the colourdynamic properties can be imparted practically to all the materials upon which a texture surface or relief with the three-dimensional elements of required geometrical parameters can be obtained by using an appropriate technological process. In this case the absolute dimensions of these elements may vary in different materials within a considerably wide range, from a few tens of centimeters to the tenth fractions of a millimeter.

The colourdynamic texture surface activity, i.e. its capability to intensively change its colour even in case of the most insignificant changes of the angles of view, does not depend on the sizes of the texture or lattice three-dimensional elements. In other words, with the absolute dimensions of three-dimensional elements of a variable-colour surface texture decreased 10, 100 or 1000 times retaining the geometrical similarity of the initial and decreased elements, as well as the set of the colour components and colour orientation of them, the colour changing activity of the newly obtained fine-texture surface will be identical with that of the initial coarse-texture surface.

A method of spraying the dyes or other substances at an angle to the main surface allows obtaining not only two but three and more differently coloured coatings on differently oriented sections of the three-dimensional elements. A precise selection of the colour spraying modes allows depositing at least three markedly different colours on a fine-texture surface or lattice whose three--dimensional elements or cells have dimensions measuring tenth fractions of a millimeter and obtaining on the differently oriented sections of each cell or three--dimensional element the colour separation of a high purity and quality.

Considered as a particular but rather important is a case when three pure and bright main colours, red, yellow and blue (yellow-green or light-green colour may be used instead cf yellow colour); are applied to each element of the texture.

If a texture surface is sufficiently fine, or in case a coarse texture is observed from a distance great enought to make it impossible for the eye to distinguish individual elements of colour, a so called additional colour mining takes place. It resembles the mining occuring in the perception of TV colour representation formed by the multitude of light points of the main colours, allowing to obtain a complete set of the spectrum visible part colours at the expense of the main colours brightness combinations.

Similarly, if an observer viewing the colourdynamic surface at a certain visual angle sees only red sections of the three-dimensional elements, the entire surface for him will look red, if he sees only red and yellow sections, the surface will look orange, if he sees only yellow sections the surface will look yellow, if he sees only yellow and blue sections, the surface will look green, if he sees only blue sections, the surface will look blue, and, finally, blue and red colours if mixed will make the colourdynamic surface look violet, in the observer's eye. It is understandable that as the observer moves and the total area of projection of all monochromatic sections changes, the colours will be gradually changing through a series os shades of each colour. In this way it is possible to obtain a full set of spectrum colours.

However, the surface colour is determined not only by the observer's position but also by the light flux direction, since the brightness of the illuminated colour sections may many times exceed that of the shaded sections. Correspondingly, the colours of the illuminated sections will become dominating and it is precisely these sections that will determine the main colour of the surface even In the cases when the total area of their projections will be less for the observer than that of the shaded sections having other colours.

Colourdynamic materials may be obtained using both regular textures and lattices with linear, round, aquare, faceted and other regularly arranged cells and elements and irregular ones, for instance, the surfaces with a gravel or developed sand texture, the surfaces of various foam materials, such as foam concrete, foam glass, foam plastic, porolon, etc., the textures of many types of pile, looped and cellular cloth as well as nonvowen synthetic materials.

Basically, there are two main methods of obtaining decorative materials with a colourdynamic surface each of which may have a series of process modifications.

The first method, very universal and widely used in industry, consists in that the texture surface is formed of three-dimensional elements with the ratio of the total area of the surface of all three-dimensional elements and of the intervals between the bases of these elements to the area of the surface on which the elements are located ly lying in the range from 1.2 to 24 and the ratio of the three-dimensional elements mean height to the main rounding radius of their peaks being in the range from 3 to 300, whereupon the different colours and/or different optical properties are imparted to the differently oriented sections of the three-dimensional elements in such a way that similarly oriented sections of the different three--dimensional elements have a similar colour and/or similar optical properties.

The second method, somewhat less universal but also widely used in industry, differs from the

first one by the fact that the three-dimensional texture elements are formed from the sections to which different colours or optical properties were preliminarily imparted, with the ratio of the total area of the surface of all three-dimensional elements and of the intervals between the bases of these elements to the area of the surface upon which these elements are located lying in the range from 1.2 to 24, and the ratio of the three-dimensional elements means height to the mean rounding radius of their peaks being in the range from 3 to 300 so that the similarly oriented sections of different three-dimensional elements acquire a similar colour and/or similar optical properties.

The description of the production processes and methods of obtaining decorative materials with a colour-dynamic surface texture deals with consideration of the first of the two proposed methods which, in its turn, consists of two main production operations:

- formation of a surface texture or relief lattice consisting of three-dimensional elements;
- imparting different colours or different optical properties to differently oriented sections of three-dimensional elements.

To form the textures having necessary geometrical parameters of three-dimensional elements on the surface of a decorative material, use may be made of various production processes and techniques:

- pressing and stamping glass, ceramic, metal, plastic, rubber and other materials with the aid of a relief punch;
- rolling the metal, glass, polymeric, paper and other sheet and roll materials, and also some kinds of per piece, (for instance, ceramic and glass) articles; between texture-forming shafts;
- shaping the construction articles and facing materials in moulds having a texture or relief on one or several surfaces, ferroconcrete wall panels and construction blocks, concrete, cement, gypsum, ceramic and other facing tiles and articles;
- extrusion of the material through relief-forming dies sometimes combined with rolling the material surfaces between texture-forming shafts, as in case with facing bricks, ceramic blocks, and various polymeric materials;
- relief-mould (metal and other) casting the metal, glass, ceramic, polymeric and other materials, including die-casing;
- foaming the materials and obtaining the articles with a foam face, such as foam concrete, foam glass, foam plastic, porolon etc, In so doing, subjected to foaming maybe not the entire mass of the material but only its thin face layer. For Instance, in such a way a ferroconcrete wall panel with a foam concrete face may be obtained;
- introduction of admixtures burning out in the process heat treatment into the main mass of the material or into its surface only. In particular, hard granulated substances may be pressed into a ceramic or glass mass in the process of rolling or stamping the articles which allows obtaining a texture resembling the foamed one after burning;
- powdering the frontal faces of materials with a gravel, glass, ceramic and other comminuted crumb using appropriate bonding compounds;
- machining the surfaces of the materials with the aid of various vibration appliances, milling cutters and other tools;
- chemical pickling of surfaces of materials and articles;
- lattice constructions may be manufactured by casting, moulding, rolling and also by assembling from individual plates or individual plates or individual relief elements;
- texture of decorative cloth may be obtained as a result of respective thread weaving, buckling, teasing and using other well-known and widely used production processes.

To impart different colours or different optical properties to differently oriented sections of the surface of three-dimensional elements, use may be made of the following production processes:

- Deposition of various colour dyes and other substances by spraying at an angle to the main surface of the material. The deposition may be performed with the aid of a conveyer which moves per-piece articles, sheet or roll materials past stationary installed lines of spraying injectors. In this case, the injectors are arranged in such a way that each line of the injectors spraying a dye of one colour imparts this colour only to the texture three-dimenskonal elements surface sections oriented in one direction, i.e. to the cone of the given colouring compound. When dyeing the articles having considerable mass and overall dimensions and also in some other cases, use may be made of mobile spraying devices moving at a constant speed past stationary installed articles. Such devices may be used, in particular, in decorating the surface texture of wall panels.

The method may be considered as the main one since it is most universal and efficient, however, it calls for a precise selection of dye spraying modes for each particular texture and steady maintenance of these modes throughout the production process.

Deposition of dayes or other colouring stuffs

with the use of relief meshed templates exluding the application of a dye onto the sections of the texture elements it is not intended for.

This method does not require a precise selection of the spraying modes. A dye may be deposited both manually and with the aid of various pulverizers but it is less efficient in comparison with the previous method and is used mostly in dyeing the regular texture surfaces and lattices.

- Deposition of metal and other coatings by the flame of gas burners or plasma torchers performed at an angle to the main surface of the material. In this method, which is similar to the main one, the lines of spraying injectors are replaced with the lines of burners put into the flames of which are evaporizing metals and other depositing substances.
- Deposition of metal coatings by evaporation and subsequent precipitation of metals on the respective sections of the three-dimensional elements performed in a vacuum chamber.

In this method an article in the vacuum chamber is positioned at an angle to the parallel stream of precipitating particles.

- Deposition of various substances including metal coatings on respective sections of three-dimensional elements by galvanization.
- Formation of coatings differing in colour by a photo-chemical method on differently oriented sections of three-dimensional elements. In this method a homogeneous pigmented photo emulsion is applied over the entire texture surface, whereupon the three-dimensional elements sections oriented in one direction are illuminated by a precisely directed parallel light flux of a certain colour oriented at an angle to the main surface of the material. As a result of a successive or simultaneous illumination of the differently oriented sections of the three-dimensional elements by differing in colour light fluxes and a subsequent photochemical treatment a colour-dynamic material can be obtained. The texture of such materials can be also obtained by rolling the traditional sheet and roll photo materials (colour photo paper or photo fabric for instance) with the use of texture forming shafts. When obtaining a photo fabric, use may be also made of its natural fabric texture.
- Formation of a colour relief rester by a polygraphic method, in which method the dyes different in colour are printed on a roll or sheet texture material after its preliminary rolling with the use of texture forming shafts. A version of this method is represented by the polygraphic printing process which takes place simultaneously with the texture formation of texture thanks to the use of special polygraphic texture shafts.

The production methods discussed above allowing imparting different colours and different optical properties to the differently oriented sections of the texture three-dimentional elements are not the only possible ones. Apart from them, use can be made of chemical pickling processes, machining of the surface, application of dayes by means of rotating shaft-like brushes, etc. Besides, the above described methods may used in various combinations. For instance, a colour glaze may be deposited on the facets of a ceramic article by spraying, while the other facets of this article ma be coated with metal using a plasm or vacuum deposition method.

A natural colour of a material, for instance, red colour of the facing brick or light colour of a bleached fabric may be used as a component of the material colour in production of some colour-dynamic materials.

The majority of the above described methods make it possible to print various pictures on the surface of the material in the process of production through use of masks and stencils closing a part of the article surface in case of aerosol, plasm, vacuum, photo-chemical snd other methods of application of variable-colour coatings.

However, as was already mentioned above, the representation obtaining problem not only makes the colour-dynamic materials production process complicated and expensive, but also decreases considerably their combinatory potential and deprives them of a number of other advantages.

In other words, the formation of raster representations on colourdynamic materials pays only in those rare cases when the dimensions of representations being created are comparable with the dimensions of the naturally percepted colour-dynamic surfaces. But even this problem may be in the majority of cases be solved by more natural and cheaper method at the expense of combining the orientations of non-descriptive colourdynamic articles, such as plates or pieces of a homogeneous colourdynamic material.

The second of the two proposed methods of obtaining the raster decorative colourdynamic texture surfaces consists, like the first method, of two main production operations:

- obtaining of the colour elements capable of forming, as a result of their connection or joining, of a raster colourdynamic surface or lattice having necessary geometrical parameters of three-dimensional elements of the texture;
- connection and securing of the colour elements in the process of the manufacture of a material or article.

Used as differing in colour or in optical properties texture forming elements may be depending on the problem to be solved various parts and articles, such as small--size colour ceramic plates, preliminarily coloured metal of polymeric plates, elements of a flat colour raster, (paper raster, for instance) colour thread and other articles.

For instance, a variable colour raster surface of a safety panel may be obtained as a result of a mechanical or automated placing of ceramic colour plates against a form provided with an appropiate relief of the lower surface. In so doing, the plates of one colour are oriented in one direction. After all the plates and necessary fittings are placed in the form, the latter is filled with concrete. The article extracted from the form after aquiring the necessary strength represents a panel faced with ceramic plates with a variable colour surface.

In the manufacture of multi-purpose decorative lattices, such as suspended ceilings lattices or balcony guards, the construction parts of the lattices may function as relief forming colour elements. Used as such elements can be metal strips painted in different colours on both sides and provided with equally spaced slots to receive differing in colour but otherwise identical metal plates at some angle during assembly. For instance, in assembly of a vertical lattice with aquare meshes, the vertical plates may be fainted red and green and the horizontal ones, blue and yellow. In this case, each mesh will be represented by four colours corresponding to four sides of a square - red, yellow, green and blue.

Naturally, there may be other lattices with trigonal, pentagonal, hexagonal and other meshes including unequally spaced ones. In this case, used as colour elements can be not only straight but also bent plates or individual relief elements.

Colourdynamic surfaces may be also obtained by corrugating (crimping) or extruding the texture on per-piece, roll and sheet materials provided with a preliminarily printed colour raster. The colour raster may be printed by traditional in particular, typographical methods and the texture may be formed by pressing the per-piece articles with relief punches or by rolling the roll and sheet materials between texture forming shafts.

The second method of obtaining the raster variable-colour surfaces may be of a particular importance in the production of a variety of colourdynamic fabrics, knitted goods, carpet coatings etc. because it allows obtaining a special purity of component colours provicded the manufacturing process is automated and, respectively, achieving a high productivity.

In the manufacture of colourdynamic fabrics and knitted goods use may be made of special weaves of colour threads allowing to obtain a texture with respective colour orientation of the three-dimensional elements. Regarded as such weaves may be, first of all, the weaves of various looped and meshed fabrics with a "wafer" or "honeycomb" surface texture.

After a variable-colour surface is obtained, a wide variety of materials may be given a special translucent protective layer.

For instance, the face of a colourdynamic ceramic of glazed concrete plate may be given a coat of a transparent glaze applied in a layer 22 (Figure 11) which completely or partially conceals the texture of the plate. In case of fine textures, the coat may be, respectively, rather thin, Similarly, the glass facing plates (Figures 1, 2) may have a colour texture on the inside providing simultaneously a good cohesion of the plates with concrete or mortar and a smooth surface. An effect of light Variation, in this case, is percepted by observing the appearance of "day light" through a transparent glass layer. Some decrease of the light-variation activity of such materials occuring as a result of the light refraction in the translucent layer and causing a visual flattening of the texture three-dimensional elements may be compensated for by a respective decrease of an actual texture factor of the surface being coloured.

It should be also noted that practically no colour variation activity takes place when using a thin sheet protective layer 25 (Figure 12), a sheet glass, for instance, with an air gap 26 (Figure 12) between the translucent layer and a colour-carrying texture surface 27.

Such a layer can be obtained by fusing, glueing or otherwise securing the sheet translucent material to the texture surface or lattice.

An embodiment of the present invention is presented a method in which a texture surface is formed at the beginning and then various substances including different colour dyes are deposited by spraying an an angle to the main surface of the material onto the differently oriented sections or the texture three dimensional elements. The main advantage of this method, as was already mentioned, consists in high productivity and universality which allows obtaining the diverse colourdynamic materials with regular and chaotic textures.

Since the texture elements geometry is of substantial importance for the production and use of materials, it is expedient to give an overview of the main geometrical classes of these elements.

The simplest is a class of linear three-dimensional elements 7 (Figures 4, 5), having a prismatic or any other extended shape and located parallel to each other.

In a trivial case each three-dimensional element should be painted in different colours on two sides. However, the decorative merits of this em-

bodiment are not high since the colour variation effect is limited by a narrow colour range consisting of two components.

The linear textures having three component colours due to the introduction of the third colour into gaps 8 (Figures 4, 5) between three-dimensional elements 7 possess considerably higher decorative characteristics.

The advantage of the linear textures consists in the fact that in case of a vertical arrangement of extended material, the latter are much less subject to contamination in use in comparison with all other textures.

However, a colour-variation effect of the linear texture surfaces is a one-coordinate and due to this principally limited. This means that the vertical component is not present in the colour expansions occuring on the architectural and other forms and also on the three-dimensional forms when use is made of linear textures with vertical elements. Correspondingly, the linear texture materials are limited inttheir combination Potentialities since subject to the condition that the three-dimensional elements 7 (Figures 4, 5) are vertical, only two positions of the material on the vertical surface are possible.

The second class of the three-dimensional elements included all the diversity of non-linear elements forming both regular and chaotic texture surfaces and lattices (Figures 1, 2, 6, 7).

These textures allow obtaining a full-value (i.e. two-coordinate) colourdynamic effect and, respectively, have considerably greater combination and decorative potentialities as compared with the linear textures.

Unfortunately, these textures have a common drawback for all colourdynamic surfaces consisting in that all of them when used on vertical planes, have horizontal (or close to horizontal) sections of the three-dimensional elements which readily collect dust and become dirty in a short time.

Besides, when colouring like textures by spraying dyes at an angle to the main surface, as well as when it is required to obtain three and more component colours, a need arises to resort to a series of production processes since the geometry of these textures three-dimensional elements by itself does not ensure a precise colour separation during deposition of dyes.

Trihedral elements 16 (Figures 9, 10) fall into a special group of the second class of non-linear three-dimensional elements which compare favourably with all other elements by production and performance characteristics. It should be noted that the presence of three colour components is a necessary and sufficient quantity providing for a full-value two-coordinate colour-dynamic effect and quite a wide range of additional colour mixings up to the full set of spectrum colours. Therefore, the textures illustrated in Figures 9 and 10 consisting of the trihedral three-dimensional elements 16 are highly competitive with the described above textures (Figures 1, 2, 6, 7) in decorative and combination potentialities and compare favourably with them in their capacility to ensure a high quality of colour separation during deposition of dyes.

This is attributable to the fact that during the dye deposition on one side or facet, a facet 17 (Figure 9) for instance, of each trihedral three-dimensional texture elements, two other facets 16, 19 (Figure 9) of the element 16 are covered by the first facet 17 which prevents the dye from getting onto them. A similar situation holds when depositing other colours on the other facets of the elements.

Apart from the said production advantage ensuring a high quality of the colour separation, the textures having the trihedral elements are considerably less subject to contamination in use since there exist three possible positions of the three-dimensional elements on a vertical surface which have no horizontal sections of the prone to quick contamination.

For instance, it three-dimensional elements 1 of the texture shown in Figures 1, 2 have sections 5 inclined at 60° to the vertical plane, the three-dimensional elements 16 of an identical texture so fas as colourdynamic activity is concerned, illustrated in Figures 9 and 10 have sections 18 and 19 inclined to the vertical plane at an angle of 30°. That is, the almost horizontal sections (inclination of 60° ) are replaced in the second case with the almost vertical sections (inclination of 30°).

To ensure a full-value additional mixing of component colours and increase the comfort of visual perception of the colourdynamic effects observed on the material, it is desirable that the texture elements of its surface should be fine enough to ensure the basic characteristics of its perception.

In case of interior materials to be observed from small distances, it is expedient to use the three-dimensional texture elements whose height is 10 to 12 mm and less.

## Industrial Applicability

All the described below production modifications of the methods of obtaining the raster decorative colourdynamic texture surfaces are industrially applicable, however, each modification has its advantages and disadvantages. Generally it can be noted that a high productivity and versatility are the main advantages of the first method and first of all of its main aerosol version, Particularly an industrial installation for deposition of dyes and other sub-

stances by spraying onto the surface of the articles moved by the conveyer may be used in production of most diverse colourdynamic articles and materials, from large-size facing plates and blocks to fabrics and wall paper subject to the condition that respective dyes are used.

A major advantage of the second method consists in a high quality of colour separation when using the scale of gradation of component colours. Considered as disadvantages of this method are its relatively lower productivity and poor versatility, since each kind of material, when using this method, calls for its individual production process and, respectively, individual fixtures, appliances and equipment.

## Claims

1. A decorative material having a variable-colour textured surface three-dimensional elements (1) of the texture or relief, whose differently oriented sections have different colours, **characterized** in that the texture surface is formed of three-dimensional elements (1) with the ratio of the total suface area of all the three-dimensional elements (1) and the intervals between the bases of these elements to the area of the surface they are located upon lying in the range from 1.2 to 24, and the ratio of mean height (H) of the three-dimensional elements to the mean radius (R) of rounding of their peaks being in the range from 3 to 300, the differently oriented sections (2, 3, 4, 5) of the surface of each three-dimensional element (1) have different colours and/or different optical properties, while the similarly oriented (in one direction) surface sections of different three--dimensional elements have a similar colour and/or similar optical properties in at least a part of the three-dimensional elements (1).

2. A decorative materials claimed in Claim 1, **characterized** in that in all the three-dimensional elements (1) the similarly oriented sections (2, 3, 4, 5) of the surfaces of the different three-dimensional elements (1) have a similar colour and/or similar optical properties.

3. A decorative material as claimed in Claim 1, **characterized** in that the differently oriented sections (2, 3, 4, 5) of the surface of each three--dimensional element (1) including the section of the surface between the adjacent three-dimensional elements have at least three different colours and/or three different optical properties.

4. A decorative material as claimed in Claim 3, **characterized** in that when using the three colours of the differently oriented sections of thre three-dimensional elements surface three main colours (red, blue and one of the colours of the yellow, yellow-green and green colour group) are selected.

5. A decorative material as claimed in Claim 1, **characterized** in that the texture surface is made in the form of regularly arranged projections and /or hollows manufactured as three-dimensional elements (16) with three sides similarly oriented in all the three-dimensional elements, whereas the sides of each three-dimensional element are separated by ribs converging in a peak, and the sharpness of the ribs and peak characterized by the ratio of the element height to the radius of rounding of its ribs and peak lies in the range from 3 to 300, and each of the three sides has a different colour and/or optical properties other than those of two other sides of the element.

6. A decorative material as claimed in Claim 5, **characterized** in that the texture surface is made in the form of the alternating three-faceted projections and hollows each facet (17, 18, 19) of which is made flat.

7. A decorative material as claimed in Claim 1, **characterized** in that it is provided with a translucent protective layer (22) with a smooth external surface.

8. A decorative material as claimed in Claim 7, **characterized** in that a protective layer (25) is made in the form of flat translucent plate and a gap (26) is provided between this layer and the colour-dynamic texture surface.

9. A method of producing a decorative material having a colourdynamic texture surface with a plurality of three-dimensional elements (1), the differently oriented sections of whose surface have different colours and/or optical properties, characterized in that the texture surface is formed by the three-dimensional elements (1) with the ratio of the total area of the surfaces of all the three-dimensional elements and the intervals between the bases of these elements to the area of the surface they are located upon laying in the range from 1,2 to 24 and the ratio of the three-dimensional elements mean height (H) to the means radius (R) of rounding of their peaks being in the range from 3 to 300, and different colours and/or optical properties are imparted to the differently ori-

ented sections (2, 4, 3, 5) of the three-dimensional elements surface in such a way that the similarly oriented sections of the surfaces of the different three-dimensional elements have a similar colour and/or similar optical properties.

**10.** A method as claimed in Claim 1, **characterized** in that the different colours or different optical properties are imparted to the differently oriented sections of the three-dimensional elements surfaces by deposition of various substances including dyes performed at an angle to the material surface on which the three-dimensional elements are formed.

**11.** A method as claimed in Claim 10, **characterized** in that different colours are obtained by the deposition of dyes by spraying, the axis of the spray cone being positioned at an angle 3 to 5° less than the tilt angle of the three-dimensional elements to the surface they are located upon.

**12.** A method of producing decorative material having a variable-colour textured surface with a plurality of the three-dimensional elements (1) whose differently oriented sections have different colours, characterized in that the texture three-dimensional elements are formed by the sections of the surface to which the colours or optical properties differing from each, other were preliminarily imparted the ratio of the total area of the surfaces of all the three-dimensional elements (1) and the intervals between these elements to area of the surface upon which they are located lying in the range from 1.2 to 24, and the ratio of the three-dimensional elements mean height (H) to the mean radius (R) of rounding of their peaks being in the range from 3 to 300 so that similarly oriented sections of the surfaces of different three-dimensional elements acquire a similar colour and /or similar optical properties.

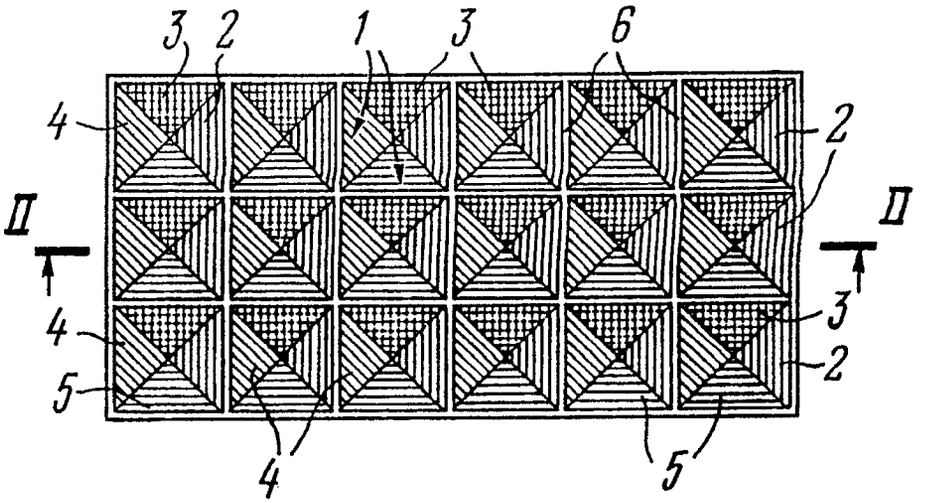


FIG.1

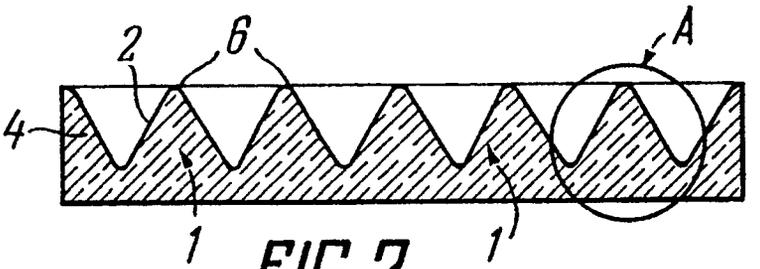


FIG.2

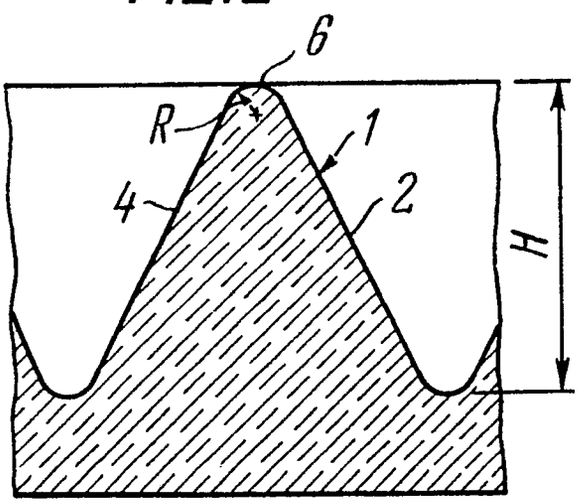


FIG.3

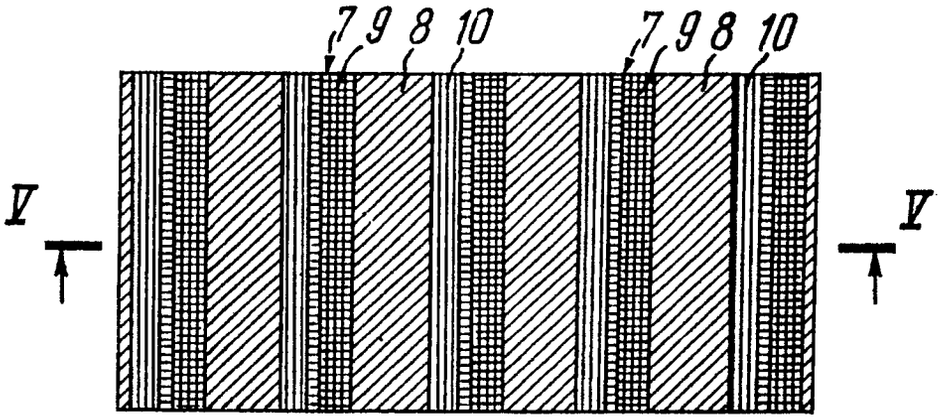


FIG.4

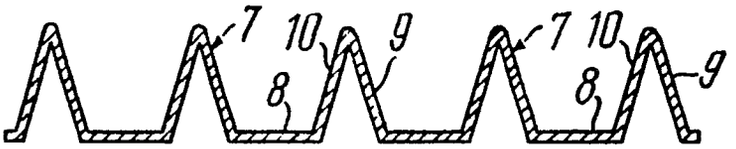


FIG.5

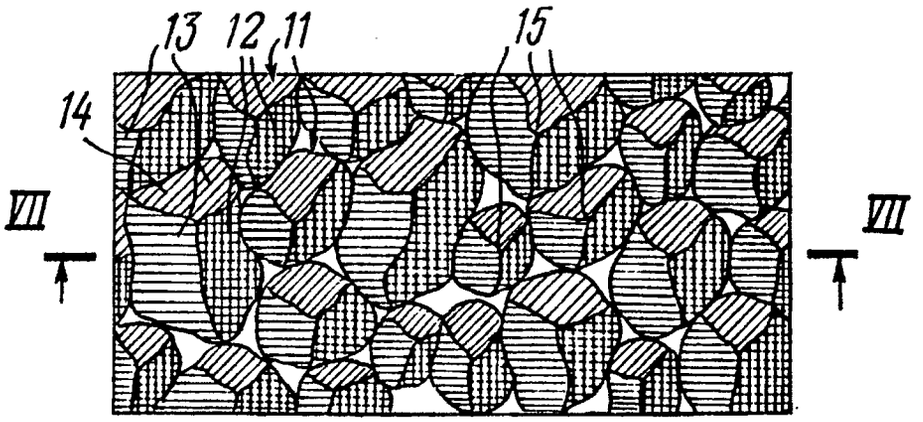


FIG.6

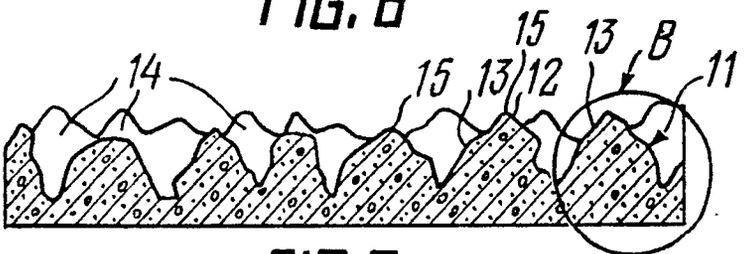


FIG.7

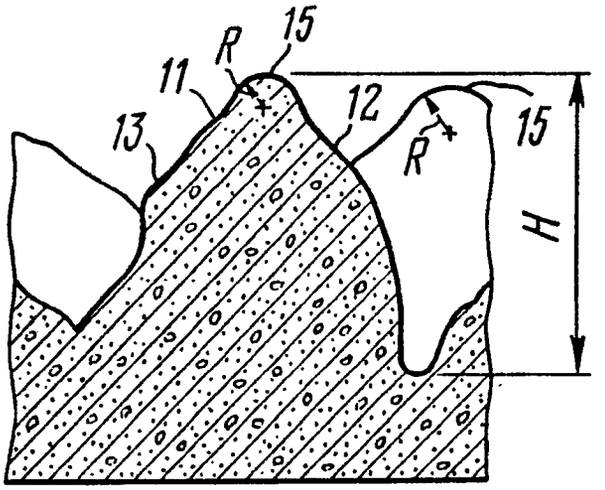


FIG.8

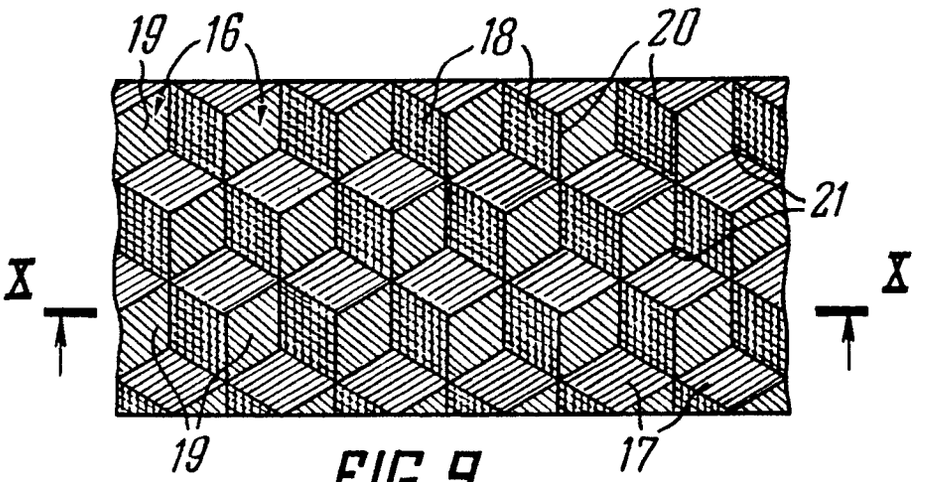


FIG.9

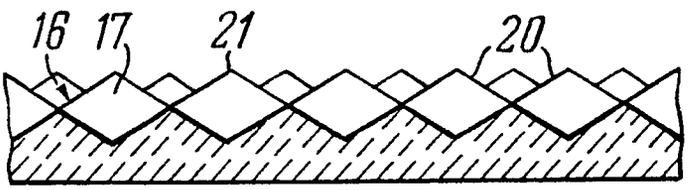


FIG.10

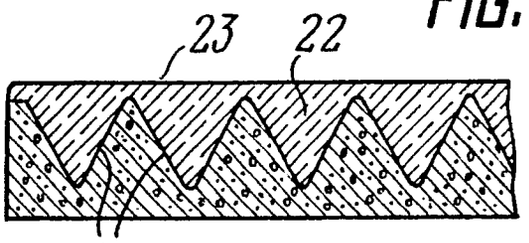


FIG.11

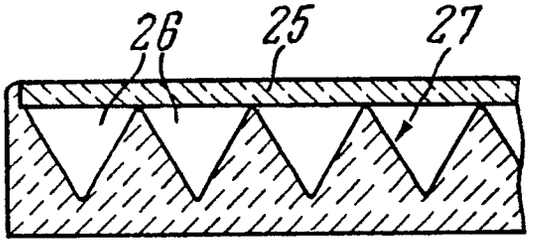


FIG.12

# INTERNATIONAL SEARCH REPORT

International Application No PCT/SU 89/00065

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl.[5] B44C 5/00, E04F 13/00

## II. FIELDS SEARCHED

**Minimum Documentation Searched [7]**

| Classification System | Classification Symbols |
|---|---|
| Int.Cl.[5] | B44C 1/28, 5/00,5/08, B44F 1/00:1/10, E04F 13/00, E04F 13/08, 13/14, B44C 5/04 |

**Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]**

## III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

| Category * | Citation of Document, [11] with indication, where appropriate, of the relevant passages [12] | Relevant to Claim No. [13] |
|---|---|---|
| A | US, A 3875716 (DYNAMIT NOBEL AKTIENGESELLSCH SCHAFT), 8 April 1975 (08.04.75), see the abstract | 1-12 |
| A | FR, A1, 2066865 (JOSS PIERRE EMMANUEL), 13 August 1971 (13.08.71), see the claims, figures 1-4 | 1-12 |
| A | FR, A5, 2106691 (FONTENILLE HENRI ANTOINE GILBERT et al.), 5 May 1972 (05.05.72), see the claims, figures 1,2 | 1-12 |
| A | DE, B2, 2230037 (D. SWAROVSKI & CO), 17 January 1974 (17.01.74), see the claims , figures 1-18 | 1-12 |

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

## IV. CERTIFICATION

| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report |
|---|---|
| 1 November 1989 (01.11.89) | 6 December 1989 (06.12.89) |
| **International Searching Authority** | **Signature of Authorized Officer** |
| ISA/SU | |