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

(11) EP 1 398 130 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
17.03.2004 Bulletin 2004/12

(21) Application number: **02764118.2**

(22) Date of filing: **19.04.2002**

(51) Int Cl.[7]: **B28D 1/26**

(86) International application number:
PCT/RU2002/000182

(87) International publication number:
WO 2002/085592 (31.10.2002 Gazette 2002/44)

(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: **25.04.2001 RU 2001111092**

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(54) METHOD FOR PRODUCING TILE FOR FACING BUILDING STRUCTURES AND DEVICE FOR DIVIDING PIECES MADE OF BRITTLE MATERIAL

(57) The inventive method consists in producing a rough piece made of a plastic material in the form of a brick comprising at least two tiles which are connected by joints and have at least one opening area which crosses the joints. Afterwards, the rough piece is dried, heat treated and divided into two tiles along the opening area by forces applied to at least two surfaces of the piece which are crossed by the opening area, said forces being applied to the opposite sides of the opening area and directed towards each other. Initially, the forces forming the prestress of the joints less than nitimate strength are applied, said forces being increased until the joints are destroyed. The inventive device for dividing rough pieces made of a brittle material comprises a carrier (18) for arranging the piece and at least two load-bearing elements (20, 21). Each load-bearing element has a plane or conver area arranged in such a way that the distance between the projections thereof on the surface of the carrier (18) is gradually diminishing from the value equal to or greater than the distance between two parallel surfaces of the rough piece (19) towards the value which is less than said distance. The inventive device comprises also a pusher (23) interacting with the rough piece (19) and a unit for receiving parts of the divided rough piece.

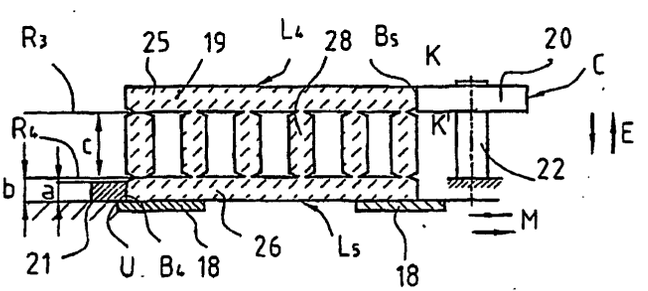


Fig 4

EP 1 398 130 A1

Description

Field of the Invention

[0001] The invention pertains to construction materials and regards the method for producing tile for facing building structures and device for dividing pieces made of brittle material.

Prior State of the Art

[0002] In the process of production of articles, specifically, ceramic facing tiles, by a method of plastic molding, the articles when molded are subjected to drying and burning in furnaces. During their transportation in the process of production, as well as during their drying and burning, to provide the required quality of the articles, no contact between their top face and the carrier is tolerable. To ensure steady position of plain articles on the carriers, the articles are usually molded in the form of rough pieces comprising two articles or a group of articles interconnected by joints and have opening areas. Mostly, the rough pieces are made in the form of bricks. For this purpose, the rough pieces are placed on the carriers with the top faces of the articles, specifically, facing tiles, arranged really vertically, thus preventing the contact between these top faces and the carriers. In this case, the size and arrangement of the joints are selected so that they should not affect the drying and burning conditions.

[0003] In such method of production of articles, especially of angular or plain tiles, for obtaining finished articles after drying and burning, the rough pieces should be divided into parts.

[0004] Widely known are the methods of facing tiles production in which rough pieces are divided into parts by joints sawing. But it is obvious that this method is rather expensive and requires costly and energy-intensive equipment for sawing. In addition, due to rather high hardness of construction ceramic articles, the abrasive wear of this equipment is also rather high which considerably rises the cost of tiles obtained by sawing.

[0005] Also know is the method for producing the tiles for facing building structures (ref. RF Patent No. 2132430) which consists in production of a rough piece made of a moldable ceramic material in the form of a brick comprising at least two tiles interconnected by joints and having at least one opening area which crosses the joints. Afterwards, the rough pieces are dried and burnt, then the pieces made of a solid ceramic material are divided into two tiles along the opening area by the forces applied to at least two surfaces of the piece which are crossed by the opening area, said forces being applied to the opposite sides of the opening area.

[0006] The rough piece opening area may be assigned, for example, by grooves made in the joints or in the points of joints connection to the back surface of the article. In this case, the rough piece may have both, one or two and more opening areas.

[0007] According to the known method, the rough pieces are divided into parts by application of pulse load, i.e. blow, thereto.

[0008] In this case, the blow is delivered to one surface of the rough piece, on its one side, substantially, along the opening area. The other part of the rough piece is secured, for example, with the aid of a stop. In this case, the dividing force is created by the pulse force applied to one part of the rough piece and by the stop response force. These forces are applied to different parts of the rough piece and are directed towards each other.

[0009] The duration of pulse effect, or blow, as it is known, is 10^{-6} to 10^{-4} s, i.e., it is, practically, an instant effect. This pulse force is applied to one point or along a line. This force is hard to control. For a batch of articles, the amount or the amplitude of pulse force is determined experimentally and this force is applied to all rough pieces at maximum intensity required for dividing all the rough pieces in the batch, since the ultimate strength values of the rough pieces in the batch are spread for some reasons, for example, the technological ones, including different composition and dosage rates of molding material components, temperature conditions of drying and burning. The value of the pulse effect is 1,5 to 2 times and over higher than that of the maximum load preceding destruction of the joints. The excess of the pulse effect value is also caused by blow inertance. For some rough pieces, such pulse effect may result in destruction of not only joints, but also of the articles proper interconnected by the joints or may cause spalling of tile edges, especially in the points of application of pulse force.

[0010] In addition, during the pulse effect, it is required that the rough piece should be fixed, which causes additional difficulties during the continuous process of ceramic tile production and increases the power consumption relating to it.

[0011] Obtaining of a facing tile as a result of the rough piece dividing is a final operation. The dividing process affects the percentage of rejects in dividing, the production output and the cost of the facing tiles. The main requirement for facing articles is quality of their top faces, with their consumer cost being also important. It should be relatively low.

[0012] The most difficult for dividing into parts with the aid of a pulse force, namely, blow, is an L-shaped rough piece of an angular tile. The L-shaped angular tile contains two plain parts arranged, inherently, at a right angle to each other. The rough piece of such tile has two opening areas, each crossing not only the joints between the holes but also one joint on the side surface of the tiles, that is why in dividing the rough piece, provision should be made for destruction of the joints avoiding destruction of the tiles in the points of their interconnection.

[0013] In molding a ceramic article longitudinal holes are made in the squared beam body with their axes be-

ing practically normal to the beam opening areas dividing it into rough pieces. In manufacture of facing bricks, these holes are required for improving the article efficiency, reducing its weight, raw materials consumption, lowering power consumption for drying and burning and for improving the article thermal insulation characteristics. In production of the facing tiles, they are required for obtaining the tiles from the ceramic rough piece by dividing it into parts after burning along the opening areas crossing these holes.

Disclosure of Invention

[0014] The invention is based on the problem of development of a method for producing tile for facing building structures with such an effect on the rough piece comprising at least two parts each forming a tile, which, in its dividing, would provide the rough piece splitting along its opening area and reduce the probability of destruction of the entire rough piece or one of its parts thus reducing the tile cost.

[0015] The purpose of the invention is also creation of the device for dividing the rough piece of the article made of a brittle material, having at least one opening area and comprising at least two parts interconnected by joints, which would provide for its dividing with a minimal force thus reducing the probability of destruction of the entire rough piece or one of its parts and reducing the tile cost.

[0016] The set problem is solved such that according to the method of producing tiles for facing building structures in which the moldable ceramic material is used for producing the rough piece in the form of a brick comprising at least two tiles interconnected by joints and at least one opening area crossing the joints with subsequent rough pieces drying and burning and further dividing of the solid ceramic material rough pieces into two tiles along the opening area by applying the forces to at least two surfaces of the rough piece on the opposite sides of the opening area, according to the invention, for dividing the rough piece, initially, the forces are applied which form the prestress of the joints less than the ultimate strength is, said forces being increased until the joints are destroyed.

[0017] It would be the most efficient to direct the forces so that the projections of the resultants of forces on the rough piece opening area should be arranged at an angle of 90 to 30° to the lines crossing the opening area with the joints.

[0018] The best way is to act on the rough piece during its dividing by the forces with their resultants acting parallel to the rough piece opening area. This is the best variant in which the dividing forces are minimal, but for some reasons, in real conditions, it is rather difficult to achieve such arrangement.

[0019] The rough piece being divided can also be efficiently affected by the forces with their resultants acting at an angle of 0 to 45° o the rough piece opening area. Such arrangement of the forces resultants depends on various factors, for example, on the rough piece orientation, on process tolerances for their production accuracy, accuracy of arrangement of the load carrying elements interacting with the rough piece.

[0020] It would be purposeful when dividing the rough piece to select the duration of effect of the forces increasing from the moment of prestress creation till destruction of the joints equal to 0.1 through 1.0 s.

[0021] Both, a spread load and a concentrated one applied to a certain point or along a line can be used as the forces acting on the rough piece in its dividing.

[0022] The offered method allows to divide the rough pieces efficiently by the forces which create a stress in the joints which is essentially equal to their ultimate strength, i.e. using the minimal stress required for dividing the rough piece. Since the ultimate stress of the joints is always less than that of other parts of the rough piece, the rough piece is divided under such effect along the opening area without destruction of the rough piece parts which form facing tiles.

[0023] This force is at least half as less as the pulse effect, which considerably reduces the percentage of rejects in rough piece dividing thus reducing its cost.

[0024] The reduction of dividing forces results in reduction of power consumption for tiles dividing which also reduces the tile production cost.

[0025] With tile manufactured by this method, its cost is reduced by at least 20 %.

[0026] An important advantage of such increasing effect is the possibility of dividing the rough pieces into tiles in the process of continuous production without stoppage of the conveyor.

[0027] The set problem is also solved by the fact that the device for dividing rough piece made of a brittle material and having at least one opening area, according to the invention, comprises a carrier for rough piece arrangement which is installed horizontally or with tilt, at least two load carrying elements, each having an area with a plain or convex surface designed for interaction with the rough piece and arranged above the carrier, a pusher designed for interaction with the rough piece and installed so as to be able to move between the load carrying elements, and a device for receiving the rough piece parts after its dividing. In this case, the load carrying elements are installed opposite each other or displaced one relative to the other so that the distance between the said areas designed for interaction with the rough piece or between the projections of these areas to the carrier surface varies in the direction normal to that of the pusher travel.

[0028] With such a design, the offered device allows to divide the rough pieces by a force which creates stress in the joints and is essentially equal to their ultimate strength, i.e. by a minimal force required for rough piece dividing. This reduces the probability of rough piece destruction and therefore, the cost of the facing tile.

[0029] The power consumption for tiles dividing is essentially minimal.

[0030] Such device is rather simple in design and reliable in operation.

[0031] The offered device makes it possible to divide the rough pieces into tiles in the process of continuous production without stoppage of the conveyor.

[0032] This device allows to select different speeds of conveyor movement required by the production process when dividing the rough pieces.

[0033] When placing the rough piece on the carrier in the position in which its opening area (or areas) is parallel to the carrier it is required that the said area of one of the load carrying elements should be located in the immediate proximity to the carrier and its height should not exceed the distance from the carrier to the rough piece opening area and the said area of the other load carrying element should be vertically displaced with respect to the first area so that the projections of these areas to the vertical plane arranged along the pusher way of travel should essentially contact each other or be arranged at a distance equal to or exceeding that between the rough piece opening areas.

[0034] With the rough piece placed on the carrier in the position in which its opening area (or areas) are arranged vertically (or normal to the carrier), it is required that the said areas of the load carrying elements should be displaced horizontally one relative to the other or along the carrier surface so that the projections of theses areas to the vertical plane arranged along the pusher way of travel should essentially contact each other or be arranged at a distance equal to or exceeding that between the rough piece opening areas.

[0035] One of the load carrying elements of the device may be represented by a stop or a wedge or a roller whereas the other element may essentially be a wedge or a roller.

[0036] It is desirable that at least one load carrying element should be mounted with an ability to move for changing the distance between the areas of the load carrying elements designed for contacting the rough piece surfaces and with locking in the selected position provided.

[0037] At least one load carrying element may be mounted with an ability to move vertically or horizontally or in the plane parallel to the carrier in the direction normal and/or parallel to that of the rough piece travel.

Brief Description of Drawings

[0038] Further, the offered invention is explained by specific examples of its implementation and by attached drawings showing:

Fig. 1 rough piece intended for producing tiles for facing building structures and provided with one opening area (exploded view) with the diagram of forces applied in its dividing according to the invention;

Fig. 2 rough piece provided with two opening areas with the diagram of forces applied in its dividing (cross-section) according to the invention;

Fig. 3 partial view of the device for dividing the rough piece made of a brittle material (top view) with a stop and a roller as load carrying elements, according to the invention;

Fig. 4 section along the line IV - IV in Fig. 3 according to the invention;

Fig. 5 layout view of the device with the stop and wedge as the load carrying elements (top view) according to the invention;

Fig. 6 version of the device with the pusher mounted with the ability of reciprocal movement (top view) according to the invention;

Fig. 7 version of the device with the pusher mounted with the ability of rotation (top view) according to the invention.

Best Way of Invention Implementation

[0039] The offered method for producing the tile for facing building structures consists in the following:

[0040] For producing the facing tile by the method of plastic molding, a plastic molding compound should be prepared first. Particularly, for producing the ceramic facing tile, use is made of the compound based preferably on the fossil clay with a humidity of 15 to 20 % of any known composition applicable to the method of plastic molding. This compound also contains fillers, such as chamotte, with the particles sizing 0.01 to 5 mm and over. Use can also be made of any other known plastic molding compound applicable to production of tile for facing building structures, for example, by the method of semidry molding.

[0041] The plastic molding compound is used for forming a squared beam which in its cross-section is essentially a rectangle or a square with smooth external surfaces which are the top faces of the facing tile.

[0042] In molding, the square beam is provided with longitudinal holes. The shape of the holes, their arrangement and the distance between them specify the geometry and thickness of the joints between the rough piece parts, each forming a tile, and may be different. They are selected experimentally for each specific type and dimensions of the facing tile proceeding from the condition of providing the required strength of the joints connecting the rough piece parts each forming a facing tile. Arrangement of the holes also specifies the required thickness of the tiles. The joints are provided with the grooves which are parallel to the axes of the longitudinal

holes and specify the position of the rough piece opening areas. The groove depth is also selected proceeding from the condition of providing the required strength of joints connecting the rough piece parts.

[0043] These holes are arranged in at least one line between the external surfaces of the square beam. The holes may be arranged in two and more lines, one under another and also chequerwise. The holes may also be arranged in any other technologically necessary order. For example, in the middle part of the square beam, the holes may be arranged in three lines and the parts between the middle of the brick and external surfaces of the square beam may be provided with one hole each. In so doing, the size and shape of the holes, as well as their arrangement and distance between them should be selected for each specific shape of the tile and for its dimensions. These holes may be of various shapes in a cross-section, for example, they may be rectangular, round or square in a form.

[0044] Then, the square beam is cut by means of cutting tools for producing brick-like rough pieces with separation of one or group of rough pieces at a time. In the current technologies in use, the process of square beam molding and rough pieces obtaining in the form of bricks is uninterrupted. In so doing, depending on the position of the square beam cutting planes, the rough pieces for production of square and rectangular plain and angular facing tiles may be produced. The joint in the rough piece for production of rectangular facing tile may be arranged both, lengthwise and edgewise on the tile.

[0045] Then, rough pieces are subjected to drying and burning, with treatment conditions specified for each specific molding compound and dimensions and shape of the rough piece for production of the facing tile.

[0046] As it is known, after burning the rough piece materials becomes solid and brittle. The compression strength of the construction ceramic after burning makes up 10 to 15 MPa.

[0047] After burning, the rough piece is divided into at least two tiles along the opening area or areas.

[0048] **Fig. 1** shows the diagram of forces application for dividing the rough piece (1) provided with one opening area R. The rough piece (1) is made in the form of a brick, essentially of a parallelepiped shape and consists of two parts (2) and (3). As soon as the rough piece (1) is divided, each part constitutes a facing tile with the top face L or L_1, respectively. These parts (2) and (3) in the rough piece (1) are interconnected by the joints (4) separated from each other with the aid of the holes (5) and grooves (6). The axes of the holes (5) and grooves (6) are arranged in one line, essentially, parallel to the top faces L and L_1. The grooves (6) specify the position of the opening area R which is also parallel to the top faces L and L_1 and crosses the joints (4) along the lines which are parallel to the axes of the holes (5) and grooves (6). Fig. 1 shows the line PP_1 crossing the opening area R with one joint (4).

[0049] The rough piece (1) is divided into parts (2) and (3) by the forces with their resultants - forces F and F_1 - directed towards each other. The force F is applied to the side surface B of the rough piece (1) whereas the force F_1 - to the side surface B_1 of the rough piece (1). These surfaces B and B_1 are crossed by the opening area R. The forces are applied do the opposite sides of the opening area R: the force F is applied to the area of the surface B of the rough piece (1) arranged between the face L and the opening area R, whereas the force F_1 is applied to the area of the surface B_1 arranged between the face L_1 and the opening area R of the rough piece (1).

[0050] The forces with their resultants being F and F_1 may be represented by both, the concentrated load, i.e. the force applied to the point or along a line, and the spread load, i.e. the force applied to the area on the rough piece surface. In this case, the force applied to one surface of the rough piece may constitute a spread load and that applied to the other surface of the rough piece may be a concentrated load.

[0051] Fig. 1 for clarity shows the projections of the forces F and F_1 in the position in which they are parallel to the opening area R of the rough piece (1) and are arranged at an angle of 90° to the lines PP_1 crossing the opening area R with the joints (4). With the resultants occupying this position, the forces for dividing the rough piece (1) are minimal. But in practice, it is rather difficult to achieve such arrangement of the resultants for some reasons, for example, due to the presence of production tolerances. Practically, the forces acting on the rough piece may be arranged so that their resultants are directed at an angle of to the opening area and to the lines crossing the opening areas with the joints.

[0052] To divide the rough piece (1) efficiently, it is affected by the forces with their resultants F and F_1 arranged at an angle of not in excess of 45° to the opening area R of the rough piece, and their projection to the opening area R arranged at an angle of 90 to 30 ° to the lines PP_1 crossing the opening area R of the rough piece (1) with the joints (4).

[0053] In this case, the rough piece (1) may be arranged so that its opening area R may be arranged both, horizontally and vertically.

[0054] Fig. 1 shows the rough piece (1) with one opening area R which crosses the holes (5), grooves (6) and joints (4). Thickness g of the joints (4) is at least twice as little as the minimal thickness p of each part (2) and (3). But the size and shape of the holes and grooves in the rough pieces, as well as their arrangement and the distance between them for each specific shape and dimensions of the tile may be different, such that the rough piece could be divided into parts without their destruction.

[0055] The rough piece (7) shown in **Fig. 2** consists of two parts (8) and (9). As soon as the rough piece (7) is divided, each of its parts constitutes an angular L-shaped facing tile. The top faces of the angular tile formed by the part (8) are the face L_2 and a section of

the surface B_2 and those of the tile formed by the part (9) are the face L_3 and a section of the surface B_3. These parts (8) and (9) are interconnected in the rough piece (7) by the joints (10) separated from each other by the holes (11). The holes (11) are arranged in one line and each hole is a rectangle in its cross-section with the longer side of the rectangle arranged essentially normal to the faces L_2 and L_3. The surface T or T_1 of the line extreme holes (11) with its resultant being the longer side of the rectangle forms the back surface of the tiles with the top face B_2 or B_3, respectively. The surfaces T_2 and T_3 of the holes (11) with their resultants being the sorter sides of the rectangle form the back surface of the tile areas with the top faces L_2 and L_3, respectively.

[0056] The rough piece (7) shown in Fig. 2 has two opening areas R_1 and R_2. In this case, the grooves 12 specifying the position of the opening area R_1 made in the joints (10) are arranged in the immediate proximity to the surfaces T_2 of the holes (11). The grooves (13) specifying the position of the opening area R_2 are arranged in the immediate proximity to the surfaces T_3 of the holes (11). The opening area R_1 also crosses the joint (14) between the grooves (15) made in the surfaces B_3 and T_1. The opening area R_2 also crosses the joint (16) between the grooves (17) made in the surfaces B_2 and T. The thickness of the joints (10) in the location of the grooves (12) and (13) is equal, approximately, to one third of their thickness in the middle part and to one third of the thickness of the parts (8) and (9) forming the tiles.

[0057] The offered rough piece (7) can be used for production of three tiles, for example, one angular tile from the part (8) and two plain tiles from the part (9), one rectangular - with the top face L_3 and one square - with the top face B3. In this case, the grooves (not shown in Fig. 2) similar to the grooves (15) may be made on the surfaces B_3 and T_1 of the rough piece (7) along the line crossing the opening area R_2.

[0058] The offered rough piece (7) may also be used for producing four plain tiles. In this case, the grooves (not shown in Fig. 2) similar to the grooves (15) and (17) may be made on the surfaces B_2 and T, B_3 and T_1 of the rough piece (7) along the line crossing the opening areas R_1 and R_2.

[0059] For dividing the rough piece (1) (ref. Fig. 1), initially, the forces F and F_1 which form the prestress of the joints (4) less than the ultimate strength are applied, said forces being increased until the joints (4) are destroyed.

[0060] For dividing the rough piece (8) (ref. Fig. 2), initially, the forces F_2 and F_3 which form the prestress of the joints (10), (14) and (16) less than the ultimate strength are applied, said forces being increased until these are destroyed.

[0061] The duration of effect of the force increasing from the moment of prestress creation till the complete destruction of the joints on the rough piece in its dividing makes up 0.1 to 1.0 s.

[0062] It is not purposeful to select the duration of this effect shorter than 0.1 s, since with such duration the effect is similar to the pulse one.

[0063] It is also not purposeful to select the duration of this effect longer than 1.0 s, since the longer duration does not result in change of its efficiency. The specific value of effect duration is mostly selected depending on the conveyor speed.

[0064] The offered method makes it possible to divide the rough pieces by the force which creates stress in the joints, in the grooves location, essentially equal to their ultimate strength, i.e. the maximum stress by the minimum force required for their destruction, i.e. for dividing the rough piece along the opening area or areas. This stress is considerably lower than the ultimate strength for destruction of the rough piece parts forming tiles. This reduces the probability of rough piece destruction and therefore - the cost of the facing tile.

[0065] Each part constitutes a tile for facing the building structures with its top face formed by one of the square beam outer surfaces and with its back surface constituting the rough piece opening area. This back surface is formed by the surface of holes and grooves for rough piece dividing, as well as by the rough surface dividing the rough piece joints.

[0066] According to the offered method of production of the tiles for facing the building structures, the process of rough pieces division into the tiles may be effected with the aid of various devices.

[0067] The offered device for dividing the rough piece made of a brittle material is described in terms of the device employed in the continuous automatic lines for production of the ceramic facing tiles. This device comprises the carrier (18) (ref. Fig. 3) intended for arrangement of the facing tiles rough piece (19) and for its travel over the surface of the carrier (18). In so doing, the carrier (18) may be arranged both, horizontally and tilted with respect to the horizontal surface, for example, like on the gravity conveyor. The rough piece (19) is made in the form of a brick having two opening areas (not shown in the drawing) and is arranged on the carrier (18) occupying the position in which its top face L_4 and the opening areas are arranged horizontally. In the described example, the carrier (18) is represented by conveyor double belt carrying a group of rough pieces (19) arranged at the assigned distance to each other so that their side surfaces B_4 and B_5 located edgewise on the tile are parallel to the direction of rough pieces (19) travel (shown with arrow N in the drawing) and the side surfaces W and W_1 are arranged essentially normal to the direction of their travel.

[0068] The device comprises at least two load carrying elements designed for creation of the increasing force when interacting with the rough piece during its division.

[0069] Used as the load carrying elements may be those each having an area with a plain or convex surface designed for interaction with the rough piece during its division and arranged above the carrier or in the imme-

diate proximity to it. One of these elements may be, for example, a stop, a wedge or a roller whereas the other one may be represented by a wedge or by a roller.

[0070] The stop may essentially be a metal plate. The wedge should have one inclined working surface, The roller may have a convex surface of any curvature, for example, a cylindrical or a spherical one.

[0071] The device version shown in **Fig. 3** employs one roller (20) with the cylindrical surface C and the stop (21) as the load carrying elements. The roller (20) is mounted on the shaft (22) providing its rotation with its cylindrical surface C intended for interaction with the rough piece (19). The stop (21) is rigidly attached to the foundation (shown for clarity in the drawing) with its flat surface U designed for interaction with the rough piece (19) facing the cylindrical surface C of the roller (20) and arranged essentially parallel to the side surface B_4 of the rough piece (19). In Fig. 3, the lines C, U and B4 are essentially the projections of the respective flat surfaces to the surface of the carrier (18).

[0072] The roller (20) and stop (21) are mounted on the opposite sides of one of the rough pieces (19) which occupies a constant position in which its side surface B_4 is in contact with the flat surface U of the stop (21) and its surface B_5 contacts the cylindrical surface C of the roller (20). With the rough piece (19) occupying this position its side surface B_4 is in contact with the area of the flat surface U of the stop (21) over the entire width of the rough piece (19), whereas the contact of the rough piece (19) with the cylindrical surface C of the roller (20) is provided essentially along the line crossing the side surface B_5 and the side surface W_1 passing through the point K.

[0073] The distance S between the surface C in the point K and the flat surface U is equal to that between the side surfaces B_4 and B_5, i.e. to the length D of the rough piece (19). The distance S_1 between the surface C in the point K_1 and the flat surface U is essentially a maximum distance between the stop (21) and roller (20). The distance S_2 between the surface C in the point K_2 and the flat surface U is essentially a minimum distance between the stop (21) and roller (20). So, the distance between the surfaces of the said areas of the load carrying elements is different, it varies in the direction normal to the direction N of rough piece (19) travel.

[0074] In this case, the distance h between the position in which the distance id equal to S and that in which the distance is equal to S_2, i.e. is the minimal, may make up from 0.1 to 1.0 width of the rough piece (19) and the difference $t = S - S_2$ may be equal to 1,0 through 10 mm. The specific magnitudes of the values h and t are determined experimentally for each type of the rough piece proceeding from the condition of the rough piece guaranteed division without its destruction.

[0075] The device comprises a pusher designed for interaction with the rough piece and mounted so as to be able to move between the load carrying elements. When interacting with the rough piece it moves the latter in the direction ensuring the decrease of the distance between the said areas of the load carrying elements, i. e. from one extreme position in which the surfaces of the load carrying elements are in contact with the side surfaces of the rough piece to the other one in which the rough piece is divided into parts. According to the version shown in Fig. 3, the device comprises the group of pushers (23) which are essentially metal plates connected to the drive (not shown in the Fig.) moving them via the chain transmission and rigidly attached to the chain (24) at the assigned distance required for arrangement of the rough pieces (19) on the carrier (18). The pushers (23) are also designed for moving the rough pieces (19) over the carrier (18) towards the load carrying elements of the offered device and get in contact with the side surfaces W of the rough pieces (19).

[0076] The device also comprises the appliance which is intended for receiving the parts (25) and (26) of the rough piece (19) after it is divided and may be represented by the receiving transporter (27) or by a collecting unit (not shown in Fig. 3).

[0077] The rough piece (19) (ref. **Fig. 4**) is made in the form of a brick with two opening areas R_3 and R_4 parallel to the top faces L_4 and L_5 of two tiles, one of them formed by the part (25) of the rough piece (19) and the other - by the part (26) of this rough piece. These parts (25) and (26) are interconnected by the joints (28).

[0078] In the presented version of the device, each rough piece (19) on the carrier (18) is installed so that its top face L_5 is in contact with the carrier (18). The opening areas R_3 and R_4 of the rough piece (19) are arranged essentially horizontally at the distance C one from the other. The side surfaces B4 and B5 of the rough piece (19) which cross the opening areas R_3 and R_4 are arranged vertically. The carriers (28) are also arranged vertically.

[0079] In such position of the rough piece (19), the load carrying elements are arranged at different distances to the carrier (18). One of the load carrying elements - stop (21) is arranged in the immediate proximity to the carrier (18). The height a of its area designed for interaction with the rough piece (19) does not exceed the length b of the surface B_4 of the rough piece (19) from the carrier (18) or its top face L_3 to the to the opening area R_4, i.e. the tile width. The cylindrical surface C of the roller (20) is displaced in height from the carrier (18). The distance between the projections of the roller (20) and stop (21) areas designed for interaction or contact with the rough piece (19) to the vertical plane arranged along the line of the rough piece travel are arranged at the distance, essentially equal to (as shown in Fig. 4) or exceeding the distance c between the opening areas R_3 and R_4 of the rough piece (19).

[0080] In the position, in which the rough piece (19) is divided (ref. Fig. 4), the roller (20) contacts the area of the side surface B_5 arranged on one side of the opening areas R_3 and R_4 whereas the stop (21) contacts the area of the side surface B_4 arranged on the other side

of the opening areas R_3 and R_4 of the rough piece (19). i.e. the stop (21) contacts the area of the side surface B between the carrier (18), or the top face L_5, and the opening area R_4, whereas the roller (20) contacts the area of the side surface B_5 arranged between the top face L_4 and the opening area R_3. The roller (20) getting in contact with the rough piece (19) along the line KK^1 applies a concentrated load to it whereas the stop (21) applies the load spread over the contact surface U with its height being equal to a.

[0081] The shaft (22) of the roller (20) can be mounted with an ability of reciprocal motion in the direction M (ref. Figs 3 and 4) normal to that of the rough piece (19) travel. This makes it possible to use the device for dividing the rough pieces of the facing tile of other dimensions by varying the value S.

[0082] The roller (20) on the shaft (22) can be mounted with an ability of reciprocal motion over the vertical line E which also makes it possible to use the device for dividing the rough pieces of the facing tile of other dimensions.

[0083] This device can also be used for dividing the rough piece (1) (ref. Fig. 1) having one opening area R by shifting the roller (20) downward to the position in which the projections of the roller (20) and stop (21) areas designed for interaction or contact with the rough piece (1) to the vertical plane arranged along the rough piece travel line are in contact with each other (not shown in the drawing). If the load carrying elements or one load carrying element are mounted with an ability to move vertically or horizontally or in the plane parallel to the carrier (18) (ref. Figs 3 and 4), in the offered device, provision should be made for the known appliances for their rigid locking in the selected position.

[0084] Use of the rollers in the offered device as a load carrying element allows to reduce the force for pushing the rough piece (19) between the load carrying elements due to reduction of friction losses since the rolling friction is in order of magnitude lower than the sliding friction. In so doing, the bigger the roller diameter, the more gradual rise of the rough piece destruction force which allows to avoid the pulse effect and destruction of the rough piece (19).

[0085] **Fig. 5** shows the layout of the device for dividing the rough piece (19) which employs the wedge (29) and stop (30) as the load carrying elements. On the carrier (18), the rough piece (19) is mounted in a different position in which its top faces L_4 and L_5 are arranged vertically. The spread, i.e. height, of the wedge (29) and stop (30) areas designed for interaction with the rough piece (19) is essentially equal to the height of the rough piece (19). The wedge (29) contacts the rough piece (19) along the line passing through the point K_5, whereas the stop (30) contacts the surface B_5. These load carrying elements are installed in immediate proximity to the carrier (18). In this case, the wedge (29) and stop (30) are displaced relative to each other in the direction N in which the rough piece (19) travels. In the position, in which the rough piece (19) contacts the load carrying elements, the distance d between the stop (30) and the line of wedge (29) contact with the rough piece (19) passing through the point K_5 exceeds the distance between the opening areas R_3 and R_4 of the rough piece (19).

[0086] The distance S' (ref. Fig. 5) is the maximum distance between the stop 30 and wedge 29. So, the distance between the surfaces of the said areas of the load carrying elements is different, it varies in the direction normal to the direction N of the rough piece (19) travel.

[0087] The offered device for dividing the rough piece (31) (ref. Fig. 6) made of a brittle material comprises three rollers (32), (33), (34), one of which (32) of a bigger diameter is mounted on one side of the rough piece (31) while two other rollers (33) and (34) whose diameters are smaller than that of the roller (32) are installed on its other side. The roller (34) is a guiding one and serves for preventing turn of the rough piece (31) while it moves in the direction N. The roller (32) is a load bearing one and together with the roller (33) it creates the force for destroying the rough piece (31). Such version of the device allows to reduce considerably the force acting on the rough piece during its destruction since the rough piece moves between the load carrying elements due to the rolling friction.

[0088] But use of the rollers as load carrying elements is efficient only for those rough pieces during division of which the direction of force application and the position of the force application force may be arbitrary since the force applied from the roller side passes through the center of the roller rotation and through the point of contact with the rough piece which changes its position when the rough piece moves.

[0089] When splitting the rough piece, for example, of the angular tile, it is required to create the force with the direction of its application unchanged when the rough piece moves. In this case, used as a load carrying element is a wedge, i.e. a stop whose surface area interacting with the rough piece is arranged at an angle to the direction of the rough piece travel. When the wedge interacts with the rough piece, the rough piece destruction force is aimed normal to the wedge slant surface in any position of the rough piece during its travel.

[0090] The second load carrying element may be represented also by a wedge or by a stop whose surface interacting with the side surface of the rough piece is arranged parallel to the direction of the rough piece travel. Use can also be made of a stop whose surface interacting with the side surface of the rough piece is a convex cylindrical one.

[0091] During the rough piece division, the pusher designed for moving the rough piece between the load carrying elements can move progressively like in the device shown in Fig. 3. In the version of the device shown in **Fig. 6**, pusher (35) is mounted with an ability of reciprocal motion which allows to create greater forces during

the rough piece division. In this case, the rough pieces (31) are delivered to the carrier (36) in the direction shown by arrow Z.

[0092] In the version of the device shown in **Fig. 7,** use is made of the pusher (37) of a drum type which is mounted with an ability of rotation which allows to create greater forces during the rough piece division. Also this pusher (37) can be used for dividing more rough pieces at a time, for example, two (38) and (39).

[0093] In this device, for dividing each rough piece (38) and (39) use can be made of the load carrying elements represented by two wedges (40) and (41) in each.

[0094] The device for dividing the rough piece made of a brittle material operates as follows: the rough pieces (19) (ref. Fig. 3) are delivered continuously from the drying and burning section (not shown in Fig. 3) to the carrier (18). Each rough piece (19) (ref. Fig. 4) in the given variant of the device is placed on the carrier (18) in the position in which the top face L_4 of one of the tiles is arranged practically parallel to the carrier (18), whereas the top face L_5 of the other tile gets in contact with it, i. e. the top faces of the tiles and the opening areas R3 and R4 of the rough piece (18) are arranged essentially horizontally.

[0095] The pushers (23) (ref. Fig. 3) move the rough pieces (19) continuously over the carrier (18) towards the load carrying elements: the roller (20) and stop (21).

[0096] During continuous movement of the next rough piece (19), the first to contact the surface U of the stop (21) is its side surface B_4. In the position, in which the entire side surface B_4 of the rough piece (19) gets in contact with the surface U of the stop (21), its side surface B_5 contacts the cylindrical surface C of the roller (20) along the vertical line KK^1 (ref. Fig. 4). As the pusher (23) (ref. Fig. 3) further moves the rough piece (19) in the same direction N, first, all clearances are taken up due to reduction of the distance between the surfaces C and U, and then, under the action of the force of pusher (23) from the load carrying elements the following responses take place: the stop (21) acts on the rough piece (19) by a spread load, and the roller (20) acts on it by a concentrated load directed along the line KK^1. The resultant of the forces from the side of the stop (21) is directed essentially normal to the surface U, and from the side of C - through the point K and shaft (22). These response actions are directed essentially towards each other.

[0097] Under the effect of responding actions of the stop (21) and roller (20) a prestress occurs in the joints (26) of the rough piece (19) along the opening areas R_3 and R_4. Then, during further travel of the rough piece (19), the forces acting the rough piece (19) rise, thus increasing the stress in the joints (28) which, with the stress being essentially equal to their ultimate strength, are disintegrate along the opening areas R_3 and R_4, thus dividing the rough piece (19) into two parts (25) and (26), one - with the top face L_4 and the other - with the top face L_5. In case of such action on the rough piece (19), destruction of both, the entire rough piece (19) and its single parts (25) and (26), practically, does not take place, which reduces the cost of tiles.

[0098] The device shown in Fig. 5 operates, practically, in a similar way, except for the fact that during action of the wedge (29) on the rough piece (19), the direction of the resultant of the force acting from the wedge (29) does not change as the rough piece (19) moves.

[0099] The device shown in Fig. 6 operates, practically, in a similar way, except for the fact that during division of the rough piece (31) the pusher (35) moves reciprocally.

[0100] The device shown in Fig. 7 operates, practically, in a similar way, except for the fact that the pusher (35), when rotating, moves simultaneously two rough pieces (38) and (39) between the load carrying elements (40) and (41) to divide them at a time.

Industrial Use of Invention

[0101] The offered method is used for producing, mainly by plastic molding, the facing tiles of various shapes, for example, rectangular, square, hexagonal. It can also be successfully employed for production of the L-shaped facing tile which essentially consists of two plain parts of a rectangular and/or square shape made as one integral article and arranged essentially at the right angle to each other. The offered method can also be successfully employed for producing by plastic molding other, mainly plain articles whose rough pieces, for example, to ensure their stability during drying and burning, consist of two and more parts, each being a finished product.

[0102] The offered device for dividing the rough piece made of a brittle material is used for producing, mainly plain articles from hard and brittle material, particularly, the construction ceramic articles. Such articles mainly include facing tiles, plain and angular L-shaped, whose rough pieces after drying and burning comprise at least two facing tiles interconnected by joints. The offered device is used mainly in universal continuous automatic lines for production of ceramic tiles for facing building structures.

Claims

1. The method for producing tiles for facing building structures according to which a plastic ceramic compound is used for obtaining rough pieces in the form of a brick, each comprising at least two tiles interconnected by joints and having at least one opening area crossing the joints, then the rough pieces are dried and burnt, then, the rough pieces made of a hard ceramic material are divided into two tiles along the opening area by the forces applied to at least two surfaces of the rough piece on

the opposite sides of the opening area which is **characterized by** the fact that during the rough piece division, initially, the forces are applied creating a prestress in the joints which is less than the ultimate strength, and then the forces are increased till destruction of the rough joints

2. The method as per para 1, differing in that that the forces are directed so that the projections of the resultants of the forces acting on the rough piece opening area should be arranged at an angle of 90 to 30° to the lines crossing the opening areas with the joints.

3. The method as per para 1 or 2, differing in that the rough piece during its division is subjected to the action of forces whose resultants are arranged parallel to the rough piece opening area.

4. The method as per para 1 or 2, differing in that the rough piece during its division is subjected to the action of forces whose resultants are arranged at an angle of 0 to 45° to the rough piece opening area.

5. The method as per any of the paras 1 through 4, differing in that during division of the rough piece the duration of forces, rising from creation of prestress till destruction of the joints is selected to be from 0.1 to 1.0 s.

6. The method as per any of the paras 1 through 4, differing in that during division of the rough piece the latter is subjected to the action of the spread load and/or concentrated load - the force applied to the point or along the line.

7. The device for dividing the rough pieces made of a brittle material and having at least one opening area differs in that it comprises:

the carrier (18) for arrangement of the rough piece placed horizontally or with tilt; at least two load carrying elements (20) and (21) each having an area with a plain or convex surface designed for interaction with the rough piece (19) and arranged above the carrier (18);
the pusher (23) designed for interaction with the rough piece and mounted so as to be able to move between the load carrying elements (20) and (21);
and the appliance (27) for receiving the rough piece parts after its division.

In this case, the load carrying elements are installed one opposite the other or displaced one relative to the other so that the distance between the said areas intended for interaction with the rough piece or between the projections of the said areas to the carrier surface decreases in the direction normal to the direction N of the pusher (23) travel.

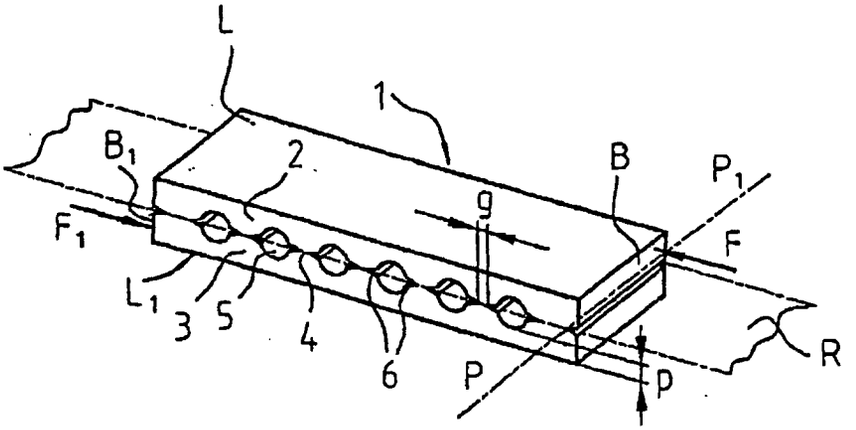
8. The device for dividing the rough pieces made of a brittle material as per para 7 differing in that the said area of one of the load carrying elements (21) is arranged in the immediate proximity to the carrier (18) and its height does not exceed the distance from the carrier (18) to the rough piece (19) opening area R_4, and the said area of the other load carrying element (20) is displaced from the first area in vertical so that the projections of these areas to the vertical flat surface directed along the way of the pusher travel are essentially in contact with each other or arranged at a distance equal to or exceeding that between the opening areas R_3 and R_4 of the rough piece (19).

9. The device for dividing the rough piece made of a brittle material as per para 8 differing in that the said areas of the load carrying elements (20) and (21) are displaced one relative to the other along the horizontal plane or along the surface of the carrier (18) so that the projections of these areas to the vertical plane arranged along the way of carrier (18) travel are essentially in contact with each other or arranged at a distance equal to or exceeding that between the opening areas R_3 and R_4 of the rough piece (19).

10. The device for dividing the rough piece made of a brittle material as per any of the paras from 7 to 9 differing in that one of its load carrying elements is represented by the stop (21, 30), or wedge (29), or roller (32), and the other one - by the wedge (29) or roller (33).

11. The device for dividing the rough piece made of a brittle material as per any of the paras from 7 to 10 differing in that at least one its load carrying element (20) is mounted so as to be able to move for changing the distance between the areas of the load carrying elements (20, 21) intended for contacting the surfaces of the rough piece (19) and with locking provided in the selected position.

12. The device for dividing the rough piece made of a brittle material as per para 11 differing in that at least one its load carrying element (20) is mounted so as to be able to move vertically and/or horizontally and/or in the plane parallel to the carrier (18) in the direction normal and/or parallel to the way of the rough piece (19) travel.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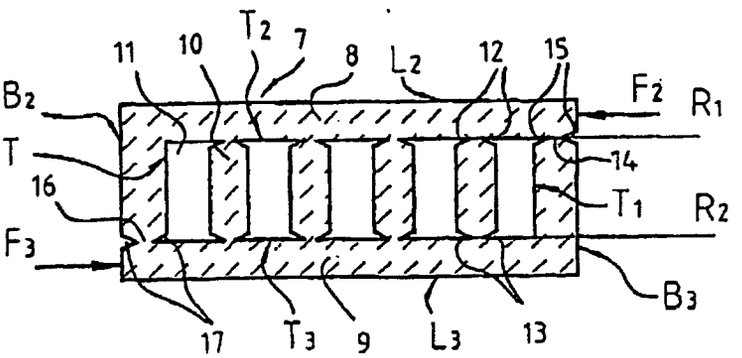
R

Fig. 1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L3
13

Fig 2

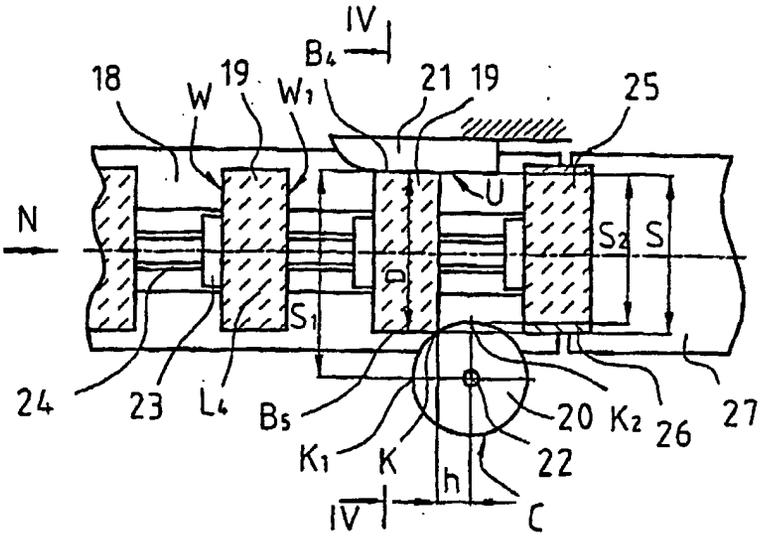
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Fig. 3

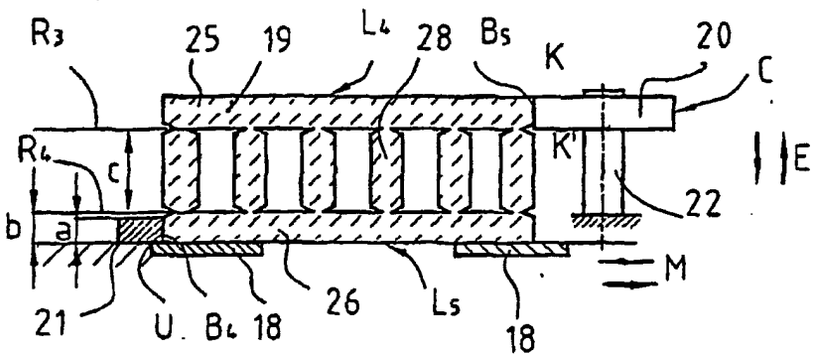
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Fig 4

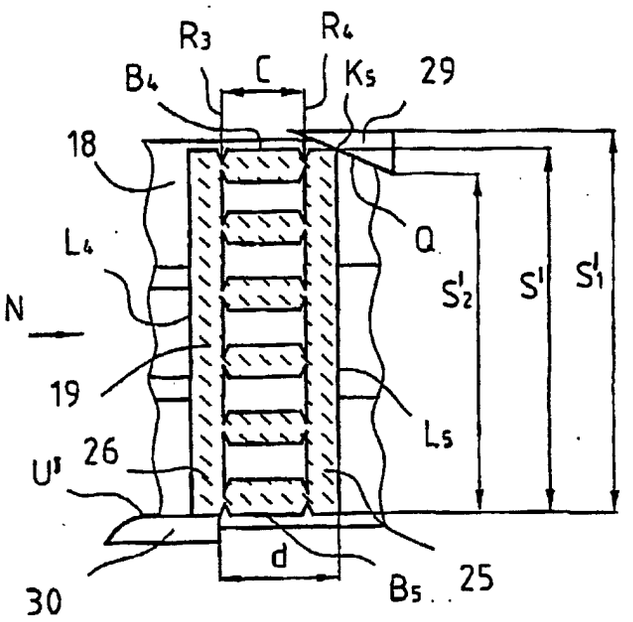

Fig. 5

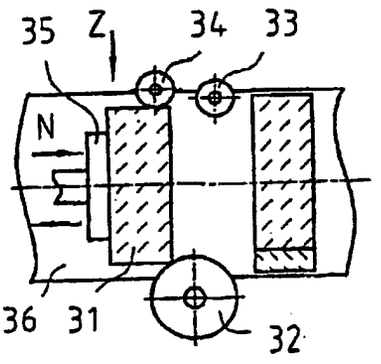

Fig. 6

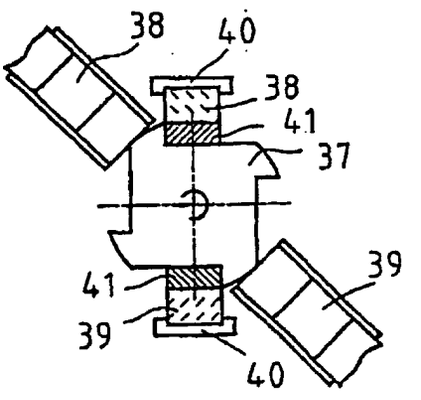

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 02/00182

A. CLASSIFICATION OF SUBJECT MATTER
B28D 1/26

According to International Patent Classification (IPC) or to both national classification and IPC 7

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols) IPC 7
B28D 1/26-1/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	RU 2132430 C1 (OTKRYTOE AKTSIONERNOE OBSCHESTVO KUDINOVSKY KOMBINAT KERAMICHESKIKH IZDELY et al.), 1999.06.27, the claims	1, 3-4, 6
A	SU 1560434 A1 (INSTITUT AVTOMATIKI AN KIRGSSR),	2, 5
Y	30.04.1990, column 4, lines 2-8	1, 3, 6
A	SU 637259 A (NAUCHNO-ISSLEDOVATELSKAYA LABORATORIYA FIZIKO-KHIMICHESKOI MEKHANIKI MATERIALOV I TEKHNOLOGICHESKIKH PROTSESSOV GLAVMOSPROMSTROIMATERIALOV NA PRAVAKH INSTITUTA) 18.12.1978	1-12
A	SU 66106 A (B.D. DOBROVOLSKY), 30 April 1946 (30.04.46)	1-12
A	RU 2024746 C1 (KHAN A.A. et al.), 1994.12.15	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"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 when the document is taken alone
"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

Date of the actual completion of the international search	Date of mailing of the international search report
28 August 2002 (28.08.02)	**29 August 2002 (29.08.02)**
Name and mailing address of the ISA/ **RU**	Authorized officer
Facsimile No.	Telephone No.

Н. Березин

Form PCT/ISA/210 (second sheet) (July 1992)