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(54) WALL ELEMENT AND PROCESS FOR PRODUCING A WALL ELEMENT

WANDELEMENT UND VERFAHREN ZUR HERSTELLUNG EINES WANDELEMENTS

ELEMENT DE MUR ET PROCEDE DE PRODUCTION ASSOCIE

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Description

[0001] The invention relates to a wall element according to the precharacterizing portion of Claim 1. The invention further relates to a process for producing a wall element according to the precharacterizing portion of Claim 17.

[0002] The invention also relates to a supporting element in the style of a honeycomb according to the precharacterizing portion of Claim 26. The invention further relates to a process for producing a supporting element according to the precharacterizing portion of Claim 32.

[0003] A large number of wall elements are known from practice, in which a skin closes a boundary surface of a honeycomb supporting element. In general, these honeycomb supporting elements are a large number of small tubes bonded to one another at the sides, as is shown by DE-A-43 14 861, However, three-dimensional grid structures are also known as supporting elements, in which the boundaries of the hollow bodies cross at right angles. Furthermore, small tubes are known which have an irregular periphery but have an axial, continuous lumen, which includes, for example, 5-sided, 6-sided or other cross-sectional shapes. Finally, there are also supporting elements having honeycomb structures made of three-dimensional polypropylene cells, such as occur in nature as bee honeycombs.

[0004] DE-A-14 84 240 shows a constructional element for civil engineering, which employs a honeycomb supporting element in the form of a grid made of a large number of adjacent three-dimensional cells, of which grid one pair of opposite boundary surfaces of the three-dimensional cells is open. These open boundary surfaces are closed with concrete, in each case about one-sixth of the lumen of the hollow bodies of the supporting element being filled with concrete. Although the resulting wall element, consisting of 2 skins made of concrete and a supporting element arranged between them, withstands pressure loadings, there is the risk that in the event of tension loadings or torsional loadings under the dead-weight of the wall element, the skin will be tom out of the supporting element. In particular in the case of producing wall elements of large dimensions, this risk even occurs under the action of the force of gravity on the skins if the wall element is arranged horizontally in the gravitational field, for example in order to stack it. The mutual grip between supporting element and skinning material may possibly be loosened by shaking movements, with the result that when the wall element is lifted up once more, parts of the skin slide out of the supporting element.

[0005] DE-A-1 247 923 shows a method of producing cell-core boards having a supporting element made of plastic-impregnated paper and a skin made of porous plaster. The honeycomb supporting element comprises a plurality of paper hollow bodies connected at respectively adjacent peripheral walls and having a substantially cylindrical cross-section, one of the open planes of the supporting element being closed by a skin. Provided between the skin and the supporting element is a separating layer that surrounds the paper supporting element and has a drop-shaped cross-section, which separating layer is applied to the boundary surface of the supporting element in a separate process step. This known board is also not suitable for use as a wall element, since the material used already does not satisfy the static requirements on a supporting element. There is thus the risk that the plastic-impregnated paper will be torn or at least crushed on account of the dead-weight of the skinning material in the case of large wall elements. The provision of the separating layer between skinning material and the supporting element also does not bring about any improvement to the tensile strength of the resulting board body. This is because the connection of the separating layer to the two other parts is only as good as the poorer of the two, with the result that the additional effort is only justified when a particularly unfavourable pairing of supporting element and skin is selected. Added to this is the fact that, given a good connection of separating layer and skinning material, these two materials stand like a joint layer in relation to the supporting element, and are thus tom out together from the supporting element under relatively large tensile loadings.

[0006] DE-A-1 105 593 shows a multilayer light-weight construction board which provides, between two skins made of mortar or plaster, a supporting element which is put together from a large number of supporting walls, the hollow bodies surrounded by the supporting walls not being completely closed by the skin. Instead, the supporting element has protrusions and depressions, so that the protrusions are gripped by skinning material, while the depressions permit free circulation of air between adjacent cavities. The adhesion capacity of these supporting elements is accordingly also unfavourable. On the side of the supporting wall facing away from the protrusions and depressions, the said supporting wall is bent over by about 90° in one direction, but not in the other. This bent-over section projects into the skinning material with the same thickness as the supporting wall, but no cavities are provided in which the complete peripheral wall of the cavity exhibits such a constriction. In the case of this light-weight building board, too, no adequate values of tensile or compressive strength are reached, as are required in the case of a wall element of large dimensions. Furthermore, the known light-weight construction board lacks a further important property for use as a wall element, namely that any holes which may be made can easily be filled. In the case of the present known light-weight construction board, it would be necessary for the entire light-weight construction board to be filled, since all the cavities are connected to one another.

[0007] EP-A-0297945 shows a wall element comprising honeycomb bodies concerning all features of the precharacterizing portion of claim 1. At the known wall element the adjacent bodies are connected with the skin only at their ends, i. e. in the plane of the boundary surface of the honeycomb bodies. Furthermore, EP-A-0 297 945 teaches as method for producing said element cutting a plurality of unconnected bodies closely held together by a heated wire that is reciprocating in a first direction parallel to the material extensions to be produced and is displaced along a path following a second direction normal to said fist direction, but also parallel to the material extensions. Accordingly, the collars thus created will have a preferred orientation in a manner that the material extension will project inwardly of a body at one side and outwardly at the opposite side, wherein the projections will be oriented according to said second direction.

[0008] What is common to all the above wall elements is that they do not mutually fix opposite skins, with the result that unfavourable positional tolerances induced by twisting can occur.

[0009] It is the object of the invention to provide a wall element according to the precharacterizing portion of Claim 1 and, respectively, a supporting element according to the precharacterizing portion of Claim 26, which permits an improved connection to a skin.

[0010] According to the invention, this object is achieved by means of the characterizing features of Claim 1 and, respectively, of Claim 26.

[0011] Furthermore, the invention specifies a process for producing a wall element according to the precharacterizing portion of claim 17 and respectively a process for producing the supporting element indicated above.

[0012] The wall element according to the invention provides a particularly beneficial connection between skin and supporting element, in that, the skin penetrates through the remaining apertures in the boundary surface into the interior of the supporting element, for example by a few millimetres, the skin filling up the entire cross-section of the hollow body on the other side of the material extension before the curing, so that, on the one hand, a flat bearing is produced from the inside and from the outside against the material extension and, on the other hand, the skinning material also comes to rest against the peripheral wall. In the case of skinning materials which still expand during the hardening, a peripheral clamping that is held under tension occurs in the region of the boundary surface, the circumstance that all the hollow bodies are closed in this manner additionally making it more difficult for a hollow body to bend open in such a way that the skinning material could slide out whilst spreading out the hollow body, as a result of mutual stresses. Furthermore, the wall element according to the invention has excellent sound and thermal insulation properties, which make it particularly suitable for use in building.

[0013] The material extensions of the peripheral walls of the hollow bodies preferably form, in the boundary plane of the supporting element, a bearing surface that is expediently flat and has apertures which are arranged substantially concentrically in relation to the lumen of the hollow body, and whose opening diameters effect at least a reduction to about 80% with respect to the lumen of the hollow body. This type of shaping of the material extensions can also be referred to as bracket-like.

[0014] It is particularly advantageous if the thickness of the material extension (measured normal to the boundary plane) is greater than the thickness of the peripheral wall of the hollow bodies. By this means, buckling out or bending over of the material extension is avoided, even under very severe tensile loading. Furthermore, this advantageously results in a specific minimum thickness in the region of the remaining opening for the skin, it being necessary to take into consideration that the cross-sectional volume has to absorb the tensile, compressive and torsional loadings and therefore the formation of a blowhole in the region is particularly critical. As a result of the provision of a greater thickness, the placing of critical intended fracture points in the skinning material is effectively prevented.

[0015] The material extension will expediently be constructed as a closed circumference around the periphery of the hollow body, so that the remaining entry opening into the hollow body remains substantially centrally arranged, and the bearing surfaces formed by the material extension can transmit forces uniformly to the peripheral wall of the respective hollow body. Preferably, at least 20% of the cross-section of a hollow body is covered by the area of the material extension. However, it is possible for the covered surface to rise to more than 90%, without noticeable losses with respect to the quality of the connection between skinning material and supporting element occurring.

[0016] Expediently, those parts having a continuous lumen are used as hollow bodies of the supporting element, the said parts being connected to one another at their peripheral walls, or in the said parts the peripheral walls in each case dividing the lumen. However, it is also possible to use a hollow body which is built up from a plurality of mutually separated axial lumen. Tube-like hollow cylinders made of plastic have proven to be particularly favourable.

[0017] It is possible for the skin to fill the supporting element completely. Preferably, however, the depth of penetration of the skin into the supporting element will make up less than 1/5 of the supporting element normal to the skin, and particularly preferably less than 1/10 of the extent, which results in a relatively thick region of the supporting element remaining hollow. This unfilled region can either be filled with insulating materials for better sound insulation or thermal insulation, or else for the laying of empty pipes, lines and the like. It is possible to limit the depth of penetration of the skin by the hollow bodies being closed off at an appropriate depth. By this means, in addition to the limitation, an improved force transmission for the case of severe compressive loading is provided.

[0018] It is advantageously possible for a pre-definable number of hollow bodies in a predetermined position, for example in the comer regions of a relatively large supporting element, or at pre-determined intervals, distributed over the supporting element, for example each twentieth hollow body, to be constructed as solid bodies, differing from the remaining hollow bodies. On the one hand, this can be carried out by solid bodies being integrated into the supporting element as early as during production. Furthermore, it is possible to fill hollow bodies before skinning. However, it is particularly advantageous if individual hollow bodies are filled during the application of the skin, and expediently using the same material, so that the filling and the skin are constructed in one piece after curing and form a static constructional unit. If the filling is produced in the case of two-sided skinning, there is formed, corresponding to the position of the filling, a multiplicity of webs that penetrate the supporting element, stabilize the two skins in relation to each other and make direct force transmission between the skins possible. The webs are particularly expedient when they are provided at locations at which fittings or the like projecting from the wall element are intended to be fitted, since at these points the grip which is usual in the case of a solid material wall when drilling and recessing in the wall is encountered. Furthermore, after the hardening of the skin and after drilling a hole, it is also possible to refill hollow bodies located behind the hole later or immediately, as a result of which a pin, nail, screw or the like to be inserted into the hole can be held firmly in the solid material, if necessary further with the aid of a dowel. The expenditure for the filling is tolerable because of the low dimensions of the hollow bodies.

[0019] The wall element according to the invention is preferably implemented in a sandwich construction, that is to say in such a way that a first skin is arranged on a first boundary surface of the supporting element and a second skin is arranged on a second boundary surface of the same supporting element, the two boundary surfaces being boundary surfaces of the supporting element which face away from each other.

[0020] The skin is preferably a layer of mineral material and, in this case, in turn particularly preferably a layer of foamed gas concrete or light-weight concrete. The light-weight concrete can be let into a mould, in which the supporting element is arranged, the front side of the skin, projecting outside the boundary surfaces of the supporting element, being bounded by shuttering material, while the foamed concrete penetrates into the interior of the supporting element as a result of its foaming, and in particular foams up behind the material extensions bounding the access to the interior of the hollow bodies. This type of penetration of the skinning material has the significant advantage that no venting of the supporting element has to be provided. The capillary pressure in the hollow bodies is thus overcome in an elegant manner. The skinning material then drives behind the material extension and into a close frictional connection with the respective peripheral walls, so that after the concrete has set, the respective peripheral walls of the hollow bodies are also surrounded by the light-weight concrete in the region of the material extensions. As a rule, it is expedient if the supporting element according to the invention is produced in a separate production step, which will be explained further, before being immersed in the as yet uncured mass of skinning material. However, it is in principle possible for the material extensions to be produced by a compression operation which is performed after immersion in the skinning mass. This may be the case, for example, when the shuttering wall bounding the front skin has a temperature which is suitable for the production of the material extensions, so that the shaping can be brought about as a result of a pressing and compressing step by means of mutual axial displacement. In such a case, it is advantageously possible, starting from a blank without material extensions, firstly to produce the supporting element according to the invention and then the wall element according to the invention in the same mould. As an alternative to concrete, however, it is possible for the same material as for the supporting element to be provided, so that favourable adhesion occurs. Thus, for example, plasticized polypropylene can also be provided as skinning material.

[0021] Expediently, for the production of large wall elements, the skin is applied gradually, this also being able to be performed in vertical shuttering; in particular it is preferable to provide the respectively opposite boundary surfaces simultaneously with a skinning material. If wall elements that are arranged at right angles to one another, for example the four outer walls of a house with a rectangular outline, are produced at the same time by skinning on one or both sides, it is possible in this way to produce a light-weight outer cell of a house without a seam. This seam-free production results in particularly good stability of the house.

[0022] The supporting element expediently consists of a plastic, selected from the group comprising polypropylene, polyethylene, polyurethane, polyether and polyterephthalate, and preferably from a thermoplastically deformable material. These materials have a low weight and are therefore particularly suitable for the production of a light-weight wall element. Furthermore, they are exceptionally dimensionally stable, can be produced cost-effectively and can be machined using commercially available tools. Scraps cut off from the blanks can easily be recycled. The material is weather-resistant and can therefore be used advantageously even when the production takes place a relatively long time in advance or on the premises of an external supplier. According to a preferred alternative, replenishable raw materials are selected for the material. If the supporting element consists of a material which is deformable thermally but only with difficulty or not at all - such as aluminium or another metal for example - or of a material with a continuous softening characteristic - such as glass for example -

then the individual hollow bodies are bonded to one another at their side wall, if appropriate by means of the same material as adhesive. In the case of metallic materials, the ends of such a supporting element can then be thickened like a bracket by means of a mechanical action in the manner of flattening out.

[0023] For the production of the material extensions, a tool is preferably used which has a heated plate which is directed under pressure against the surface, so that on account of the pressure loading and the thermal loading the material of the peripheral wall of the hollow bodies flows in a manner similar to a forging or compressing process and is deformed into a plane located substantially parallel to the contact plane. However, it is also possible to provide metal grids, for example made of aluminium, as the supporting element, whose surfaces are made to assume an appropriate flattening by hammering or other mechanical loading. Other types of cold-forming or hot-forming, for example calendering by a roll or the like, are also possible. In order to ensure that no hollow body is inadvertently completely closed, it is possible to construct the shaping tool to have mandrels or the like which penetrate into the hollow bodies during or after the shaping operation. By selecting the mandrel size, a ratio may advantageously be predefined between the remaining residual opening of the hollow bodies, the thickness of the material extension and the shaping energy expended. Furthermore, in the case of a roll, the mandrels can also advantageously be used for the conveyance, continuously or intermittently, of the supporting element.

[0024] During the production of the wall element, before closing the lumen of the hollow bodies of the wall element, for example by means of the skin, it is possible to add an agent against the ageing of the supporting element into the enclosed volume. This agent is preferably a gas which has been added to the preferably gaseous concrete for the purpose of foaming and then partially emerges from the mass, for example CO_2. Furthermore, it is advantageously possible to provide energy stores in the hollow regions of the supporting element.

[0025] According to a preferred development of the wall element according to the invention, during its production process a suspension and/or an anchoring device, including one with a rapid-action closure, is already fitted at the statically relevant points or is cast in at the same time.

[0026] According to a further preferred development of the wall element according to the invention, the latter is constructed in such a way that an integrated pipe, channel or box system for a thermal conduction liquid or warm air is provided, that is welded or bonded to the said wall element or otherwise embedded in it. The wall element is then also preferably constructed with an absorber surface that is flange-mounted directly to the system, or constructed to be connected to the skinning material that is subsequently to be applied, which in this case is expediently thermally conductive and constructed as an absorber material.

[0027] During the production of the wall element according to the invention, it is possible for windows, casement doors, doors, staircases or other passages already to be incorporated and, by this means, to avoid the later accumulation of wall element pieces which have to be disposed of. To this end, the parts, together with appropriately suitable coverings, are arranged in the mould together with the supporting element.

[0028] As an alternative, it is possible to separate those regions to be replaced by the abovementioned components from the wall element after the production process has been completed.

[0029] In addition to the embodiments and applications already mentioned of the wall element according to the invention, this can also be constructed as an interior wall, as a solar roof with a glass plate resting on one side, as a facade cladding element with thermal insulation properties or the like.

[0030] Further expedient developments of the invention are to be taken from the dependent claims and the following description.

[0031] Embodiments of the invention will exemplarily be explained in more detail below with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Fig. 1 shows a perspective view of a an embodiment of a supporting element according to the invention.

[0033] Fig. 2 shows a further embodiment of a supporting element according to the invention.

[0034] Fig. 3 shows a cross-section through an embodiment of a wall element according to the invention.

[0035] Fig. 4 shows a cross-section through another embodiment of a wall element according to the invention.

[0036] Fig. 5 shows a cross-section through a further embodiment of a wall element according to the invention.

[0037] Figs 6, 7 and 8 show in each case a cross-section through further embodiments of wall elements according to the invention.

[0038] Figs 9 and 10 show a cross-section through a corner construction of a wall element according to the invention.

[0039] Fig. 11 shows a cross-section through three supporting elements according to the invention that are connected to one another.

[0040] Figs 12 and 13 show various forms of window reveals on wall elements according to the invention.

[0041] Fig. 14 shows a tongue and groove connection of two wall elements according to the invention.

[0042] Fig. 15 illustrates a process for producing a wall element according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0043] Referring to Fig. 1 and Fig. 2, a process for producing a honeycomb type supporting element 51 will be explained first. Starting from a blank, not shown, made of hollow cylindrical tubes 52 made of polypropylene, which are connected to one another at their peripheral walls 53, the blank is shaped in such a way that a supporting element 51 according to the invention is produced in the process. To this end it is possible both for the peripheral walls 53 of the hollow cylinders 52 to be bonded or welded to one another, and also for the walls of adjacent hollow cylinders to be constructed in one piece, that is to say that adjacent cylinders 52 share the same wall 53. The blank is preferably a large-dimensioned part which can be supplied, stacked and transported away in a large area in the manner of a mat. The mat has the appearance of a parallelepiped, the length and the width of the mat running transverse to the lumen of the hollow cylinders 52. The axial length of the tubes is expediently between 8 and 400 mm and, in the present embodiment, is about 25 mm. The length and width of the mat-like blank may in each case be several metres. The diameter of a hollow cylinder 52 will generally make up an amount of the order of magnitude of about one-sixth of the clear lumen of the hollow cylinder, and is preferably less than one quarter thereof. In the present embodiment, the diameter of a tube is about 5 mm.

[0044] In the present embodiment, the blank consists of polypropylene. However, it is possible to provide other materials, such as polyethylene, polyurethane, polyterephthalate, hard paper, aluminium or other materials, a selection or adaptation suitable for the material having to be undertaken in the processing steps described below. As an alternative, however, a supporting element made of glass tubes is also considered.

[0045] The aim of the following processing and treatment steps is to shape the blank in such a way that it has, at the boundary surfaces 56 (planes) that are formed by the openings 54 of the hollow cylinders 52, material extensions 55 which consist of the material of the peripheral wall 53 of the hollow cylinders 52 and extend in one piece from the peripheral wall 53, substantially perpendicular to the lumen of the hollow cylinders 52, the strength of the material in the shaped regions being intended not to be impaired. According to a particularly preferred feature, the thicknesses of the material extensions 55 exceed the thickness of the peripheral walls 53.

[0046] In a first process step, for this purpose the blank is gripped laterally outside the ends of the hollow cylinders 52 and held uniformly in a chuck in such a way that relative movement between the chuck and blank is no longer possible. Alternatively, it is possible, in addition to this grip from the outside, to engage into the hollow cylinders 52 from one side, so that the latter are also gripped from the inside. It should be understood that other types of holding and guiding can be considered for this.

[0047] In a subsequent step, the blank is pressed axially in such a way that a compression tool is brought up from at least one side and exerts a pressure on the boundary surfaces 56 of the blank. In this case, the boundary side 56 facing away from the compression tool may be supported against a mating bearing. Preferably, however, a compression tool is brought up on both sides, with the result that the blank is shaped on both sides. However, it should be noted that the two boundary surfaces 56 can also be subjected to this pressure one after the other; furthermore it should be noted that adjacent surface regions of the blank can also be treated successivelly with a smaller pressure area, comparable with flattening using an iron or passing under a roll or a roll pair, as is provided in the case of a calendering step. By means of the pressure exerted on the blank, pressure stresses are brought about in the material, here: polypropylene, which cause the material of the peripheral walls 53 of the hollow cylinders 52 to flow, this material being pushed in front of the compression tool in the pressure-loading direction and being backed up, the hollow cylinders 52 being forced back in the manner of a bead by the boundary plane 56 of the blank, forming a material extension 55 of the peripheral wall 53. Depending on the degree of compression of the blank, a bead which is more or less thick and more or less broad is formed, which cuts into the opening cross-section 54 of the hollow cylinder 52 and cuts into its area in proportion to the degree of compression. Depending on the initial thickness of the peripheral walls 53 and of the compression excursion travelled, it is advant-ageously possible to form a surface that is bracket-like, continuous and falling into the boundary plane 56, as is indicated in Fig. 1, which is formed in the manner of a single-piece boundary surface in which there remain only apertures 54 substantially central in relation to the lumen of the hollow cylinders 52. In the case of a low compression excursion, or in the case of peripheral walls 53 that are narrow in relation to the cylinder diameter, what is produced is rather a bead of the type illustrated in the supporting element 51 from Fig. 2, in which there is not a continuous material wall. Preferably, in the case of a material like polypropylene, or in the case of other materials whose ductility can be increased by supplying heat, a supply of heat is provided at the same time as the compression step or before initiating the compression step, by means of which heat supply the resistance of the material is reduced for the shaping and the compression force needed is correspondingly reduced. It is advantageously possible to heat the compression tool itself, comparable with an iron or a heated surface, as a result of which the transfer of heat to the material parts to be shaped is influenced in a particularly beneficial way and, at the same time, it can be ensured that, substantially or quite exclusively, the boundary surface of the blank is shaped, whereas the central region of the blank, which is advantageously held in the chuck, does not undergo any deformation. If, as described above, the compression tool is brought up from both sides, it is advantageously possible, using the process steps described, to produce a supporting element which has material extensions on both sides which are substantially located in the boundary plane 56 (normal to the lumen of the hollow cylinders 52) of the blank. As an alternative to continuous surface pressure-loading, it is possible to bring about the shaping in the surface region by hammering or shock-like machining. For mass-production, it is possible to automate the shaping in order to form the material extensions, for example by producing them in a calendering roll, an intermittent production line, or other devices known for this purpose.

[0048] In the case of a variant that is not shown, it is further possible, at the same time as the shaping step in the boundary surface 56, to fasten a material web 58 to the boundary surface 56 of the supporting element 51 or to join it to the material of the supporting element 51. In the region of the apertures 54, this web 58, which itself in turn can be constructed with apertures in the manner of a grid network, covers over the apertures 54 exposed by the material extensions 55 and, as a result of its arrangement in the boundary surface 56, enables better adhesion of a skinning material 59, as will be explained in still more detail further below.

[0049] The supporting element 51 produced in accordance with the above process is now flattened either on one or on both sides in such a way that there is formed in each core hole or in each hollow cylinder 52 a bead whose inwardly and outwardly directed flanks can absorb and transmit tensile and compressive forces. By contrast with a supporting element that is folded only on one side, the bead projects substantially at right angles away from the peripheral wall on both sides, and advantageously prevents folding over under very high tensile loads.

[0050] According to another variant, illustrated in Fig. 4 in the further-processed state, the blank is penetrated in a plane normal to the lumen of the hollow cylinders 52 by two dividing walls 64, likewise made of polypropylene which subdivide the hollow cylinders 52 into different intervals that are separate from each other. The dividing walls 64 divide the lumen of the hollow cylinders 52 from each other in a fluid-tight manner; this can be achieved by a polypropylene layer 64 in each case being welded on both sides by its ends onto blank mats. In this case, the hollow bodies are preferably substantially aligned, so that abutting hollow cylinders can be deliberately connected once more by boring through the layer 64 (optionally before or after the welding), so that, advantageously, individual continuous hollow cylinders may be deliberately completely filled with skinning material. These continuous webs, filled for example with light-weight concrete, additionally stiffen the wall element according to the invention. As an alternative, it is possible for the hollow cylinders 52 to have in their interior in each case one, three or more integrated dividing walls 64, which can be used to limit the filling height of the lumen.

[0051] With reference to embodiments of wall elements 60 according to the invention, in Figs 3 to 10, the production of wall elements, starting from the supporting element 51 according to the invention, by means of applying at least one skin 61, and preferably a skin 61 each on both sides, will be explained next. In this case, a supporting element 51 is firstly arranged in a preferably horizontal mould 62. It should be understood that the modifications outlined above on the supporting element 51 can be carried out. The mould 62 has, for example, the shape of a trough and is suitable to accommodate an as yet not cured skinning material in the present embodiment of a gas-expanded light-weight concrete, which is caused to foam by additives of a chemical nature. By means of a spacer element 63 (Fig. 4), the supporting element can be placed and maintained at a distance from the bottom of the trough 62 that can be predefined by the dimensions of the spacer element 63. The spacer element 63 is lost in this case and becomes a constituent part of the skin 61. The spacer element 63 is advantageously a pin or the like, with the aid of which lifting tools can subsequently be attached to the finished wall element 60.

[0052] With reference to Fig. 3, a typical wall element 61 in construction will be briefly explained. The wall element 61 has a supporting element 51, which in the present embodiment may constitute one of those in Fig. 1 or 2. The skin 61 of concrete is cured on both sides of the boundary layer 56 of the wall element 51 and closes the openings 54 of the tubes 52 in a leak-tight manner, the region of the skin 61 located within the tubes 52 at the same time nestling against the inner peripheral walls 53 of the tubes 52. A positively-locking and force-fitting connection is thus produced between skin 61 and supporting element 51, in which the material extensions 55 of the supporting element 51 absorb tensile and compressive forces acting on the skin 61. Incorporated in the region of the skin 61 outside the supporting element 51 is a bonded fabric or a mat 65, which is penetrated by the still liquid skinning material and which imparts to the skin 61 a flexural rigidity in order to avoid the formation of cracks, for example when a wall element 60 is clamped and tends to bulge.

[0053] The skinning material is preferably a concrete preparation expanded by the addition of gas, the gas preferably being prepared in such a way that foaming in the interior of the hollow cylinders 52 is achieved. In this way, a further problem that is known from practice, namely that the capillary pressure in the hollow cylinders 52 prevents liquid concrete rising up, is circumvented in an elegant manner, surprisingly in spite of the opening cross-section being reduced by the cutting-in of the material extension. It is possible to use, for the foaming of the concrete, such a gas as inhibits the ageing process of the supporting element 51, for example CO_2. By means of this surprising combination it is ensured that the wall element 60 produced according to the invention is used, as intended, for durations of use which are usually not achieved by conventional plastic supporting elements 51, as a result of ageing processes in the plastic.

[0054] With reference to Fig. 15 a preferred process for the production of the skinning material needed for the production of the wall element 60 according to the invention or of another light-weight concrete moulding will be explained briefly below:

[0055] In this case, water 2 loaded with a gas 1, preferably CO_2, is mixed in a chamber 3. The chamber 3 is preferably a sonosonde, in which ultrasonic power transducers 5 are arranged, which act on the water/gas mixture and pass it in dispersed form into a mixer 6. A cavitation disc 4, which as a mixing unit effects a particularly favourable distribution of the gas in a liquid, is also advantageously arranged in the chamber 3.

[0056] Cement 7 and further additives 8, 9 are added to the water 2 loaded with CO_2 in the mixer 6. In addition to the additives, reinforcing materials, in particular fibrous sections made of glass, carbon or other suitable materials, can be added, which are likewise uniformly distributed in the mixer 6. In order to achieve a particularly favourable uniform distribu-tion of the constituent parts of the mixture, use is preferably made once more of a cavitation means 13, in the present embodiment a cavitation disc. Furthermore, it is possible to add to the mixture a material 11, for example perlite or slate material, which has been heated and blown up in a blast furnace 12, in a precisely metered quantity and temperature, and to mix it with the mixture, as a result of which the mixture assumes a predefinable temperature. The upper layer of the material is preferably previously hydrothermally converted.

[0057] Instead of the hot perlite, it is also possible to use foamed glass, slate or other mineral material, or other granulated material preheated in another way. It is also possible for the concrete to be produced using preheated water, in order to set the predefinable temperature.

[0058] In the above, the sonochemical treatment has already been performed after the gas 1 has been added to the water 2. However, it is also possible to provide the sonochemical treatment following the mixing with the liquid concrete mixture, the sonochemical treatment also then advantageously being connected downstream of a cavitation step, which in the present embodiment has already been effected by the cavitation disc 13. The structure of a chamber for the sonochemical treatment of the liquid concrete mixture would then substantially correspond to the structure of the chamber 3. It should be noted that the sonochemical treatment step triggers, in particular, gas/liquid interactions as a result of energy loading, which last over a period of from a few seconds up to a few minutes, depending on the energy transfer, so that a particular advantage of the treatment step according to the invention is that it still continues even after the inputting of the light-weight concrete in a mould.

[0059] In the case of widespread moulds or mouldings, it is in particular possible to achieve a favourable reaction sequence by performing the sonochemical treatment step at various points, with the result that a particularly uniform energy loading in relation to a reference, for example the time of being input into the mould, is achieved. Thus, it is also possible for the mould to be provided as a treatment chamber, in which the sonochemical treatment step is carried before the setting.

[0060] Following the mixing in the mixer 6, the liquid light-weight concrete mixture is pumped into the mould 18 via a concrete pump 14 and via a line 16. The concrete pump 14 expediently comprises a sinusoidal vane 15 as pumping element, which advantageously brings about conveyance by pump in such a way that the mixture does not sediment into individual layers. The line 16 is expediently held at a predefinable temperature via a heat source 17, the waste heat from the blast furnace 12 (which was used to produce the perlite) advantageously being used to the benefit of the energy.

[0061] It is possible to let a reinforcing bonded fabric or woven fabric 19 and/or honeycomb cores 20 into the mould 18, which will generally comprise shuttering, before letting in the light-weight concrete mixture, the honeycomb cores 20 advantageously having an end face 21 of bracket-like cross-section for the purpose of better anchoring of the concrete. It is possible to preheat the mould to a settable temperature, which results in a defined setting speed being able to be set. Furthermore the introduction of the said bonded fabric or woven fabric makes possible the production of optical structures in the manner of a relief or by means of colour variation. The structures may also be provided in point form or in specific areas.

[0062] It should be understood that the abovementioned equipment and apparatus can be combined to form one or more devices and can be operated in synchronism with one another and in a manner adapted to the setting operation of the concrete. Thus, for example, it is possible to use the same chamber for the sonochemical treatment of water to which gas has been added and of liquid concrete mixture, the water sent through the chamber then effecting its cleaning at the same time. The control and regulation of the individual processes in the case of the production process according to the invention can be monitored and managed by a control unit 22, which cycles the individual process steps and matches them to one another with the effect of a continuous process. In this case, the fact that the sonochemical treatment step is self-maintaining over a relatively long time period benefits the optimization of the cycle times, because in contrast to numerous known processes, the expansion of the liquid concrete mixture is no longer a time-critical factor in the case of the process according to the invention.

[0063] By using preheated materials for the sonochemical treatment step and the mechanical cavitation step, it is possible to bring about a considerable acceleration of the setting operation, but which is not accompanied by the expansion with the effect of reducing the density of the moulding resulting from the production. The setting of the temperature of mould, concrete mixture, water and further parts involved in the production process to predefinable values leads to particularly good reproducibility of the quality of the resulting mouldings.

[0064] It is possible to treat the abovementioned perlite or slate materials before the blasting operation in such a way that the upper layer is hydrothermally converted. Furthermore, the construc-tional material may be changed in a targeted manner by means of the addition of plaster or other ceramic materials, sand, gravel or grit, plastic granules, other binders, setting accelerators and organic and inorganic additives in different proportions and in combinations to the mixture in various variations having different properties, including those in relation to heat and sound insulation, setting speed and setting ability and the adhesive properties. In this case, it should be noted that the addition of chemical additives for foam formation can also have a positive influence on the expansion operation of the liquid concrete mixture in the sense of an acceleration, with the result that a still more rapid setting is then associated with an overall still more intense acceleration of the production process. It is also possible, by treating using a frequency spectrum other than the ultrasonic frequency spectrum, to achieve further influences, in particular with regard to the temperature, by irradiation using microwaves, these effects being superimposed on the result of the sonochemical treatment step. Overall, the entire production process will be carried out automated as far as possible, and both the metering of the material and the temperature control and the dimensioning of the passage times of the individual components before and during the production operation will be controlled electronically, in order to achieve an optimum and reproducible result in the production of the light-weight concrete mouldings according to the invention, in particular with regard to their density.

[0065] After the supporting element 51 has been arranged at the envisaged position, a defined amount of concrete is put into the trough 62, whereby, as a result of a settable foaming behaviour, a specific volume of the concrete penetrates through the apertures 54 into the interior of the hollow cylinders 52 and, in particular, engages behind the inwardly directed bearing surface of the material extensions 55, and comes into complete and direct contact with the peripheral wall 53 of the hollow cylinder 52. As a result of metering the volume of the skinning material, the penetration depth can be predefined sufficiently uniformly over the supporting element 51 cf. Fig. 5.

[0066] Fig. 4 shows a wall element 60 having a supporting element 51 that has a separating layer 64 of the type outlined above, which limits the depth of penetration of the skinning material, the skinning material advantageously filling the space between separating layer 64 and boundary surface 56 of the supporting element 51, and thereby ensuring excellent transmission of tension or compression to the supporting element 51 in the event of a loading. As a result of the subsequent setting, the skinning material can advantageously shrink, without the reliable hold and the intimate connection between supporting element 51 and skinning material being impaired. Instead, the skin 61 remains firmly connected to the supporting element 51 as a result of mutual hooking, stresses in the skin 61 induced by shrinkage being passed on uniformly to the supporting element 51 and hence the elasticity, desired particularly in the case of a supporting element 51 made of plastic, being maintained. The wall element 60 produced in accordance with the invention is thus also suitable as a constructional part where tensile loadings are to be expected.

[0067] In a further process step following the setting of the first skin 61, it is possible to turn the supporting element 51 and to apply a second skin in a quite analogous manner. It should be noted that it is also possible to provide both skins 61 at the same time by means of a vertical arrangement of the supporting element 51 between appropriate shuttering. In this case, separating layers 64 are preferably provided in order to prevent the skinning material running away.

[0068] The wall element 60 according to the invention produced using the process described above is distinguished by excellent strengths, an exceptional mechanical joint between supporting element 51 and skins 61 and an extremely low weight. Thus, the concrete produced in accordance with the above- described process has a density of only about 100 kg/m^3. The supporting element is likewise of low density, because of its hollow structure and, if appropriate, as a result of the material selected. Furthermore, it can be produced cost-effectively, in particular even on a large industrial scale, wall elements 60 being able to be produced in dimensions which otherwise find a restriction in the transport weight. It is thus possible, for example, to produce a wall element 60 that forms in one piece the complete peripheral wall of a substantially rectangular house with cut-out windows, doors and the like, the weight of this house being still sufficiently low (about 10 to 15 t; 1t = 10,000 kg) that, for example, it can be lifted by a helicopter, even following the installation of floors, windows, doors, heating equipment and the like. It is also possible to construct a house ready for occupation which is of particularly low weight.

[0069] A wall element suitable for external walls of a building and having a single supporting element contains, from the outside to the inside, the following structure: a first layer of light-weight concrete having a specific weight of 100 kg/m^3, which forms the outer skin of the wall element and has a thickness of about 8 cm. This layer is reinforced by perlite and/or glass bonded fabric, which is inlaid in the liquid light-weight concrete. The skin is applied to a honeycomb type supporting element which is likewise about 8 cm thick and consists of polypropylene, about 0.5 cm of the skinning material penetrating into the hollow cavities of the supporting element. The second skin, which is arranged on the other side of the supporting element opposite the first skin, is about 1.5 cm thick and is made of the same material as the first skin, but without perlite and glass bonded fabric, once more about 0.5 cm penetrating into the hollow bodies. The external wall thus has a total thickness of about 16.5 cm.

[0070] A wall element which is used as an internal wall is built up in a similar way as the external wall. The supporting element is likewise about 8 cm thick and is enclosed at its ends on both sides by a 1.5 cm-thick skin, about 0.5 cm of the skins on both sides penetrating into the hollow bodies of the supporting element. The skinning material also consists of light-weight concrete having a specific weight of about 100 kg/m^3. The interior wall thus has a thickness of about 10 cm.

[0071] According to a particularly preferred development, it is possible, in a subsequent further processing step, to provide the solidifying skinning material already on the external surfaces with a mortar screed, wall tiles, slate, glass, metal or brick panels, glass fibre or other wall coverings or other decorative materials, which are incorporated at the same time as the curing of the skinning material. This may be done, for example, by the tiles, for example, being arranged in the bottom region of the trough 62 before letting in the light-weight concrete. In order to implement this on a large industrial scale, it is possible to stick the tiles previously alongside one another onto a mesh and to incorporate this mesh, together with the tiles, in the skinning material.

[0072] In addition, it is expediently possible to heat the moulds, for example the trough 62 described above, during the production process, in order to accelerate the setting operation of the skinning material. Provision can be made in this case for a separation web (not shown) for example made of Teflon® between mould 62 and skin 61 to prevent these two parts adhering to one another.

[0073] Different embodiments of bonded fabrics or woven fabrics 65, for example made of glass or glass fibres, are illustrated in Figures 6 to 8. After the setting of the skinning material 61, these are embedded and covered in its region projecting beyond the boundary surface 56, the skinning material 61 penetrating the said fabrics, as a result of which the strength properties that are of interest here, and other field properties of this penetration structure, having a positive influence on the properties of the wall element according to the invention.

[0074] The three-dimensional supporting element designs shown in Figs 9 and 10 are in each case joined from individual supporting elements in such a way that the boundary surfaces provided with the openings 54 of the tubes 52 in each case turn out to be parallel to the future external surfaces of the wall elements to be produced, as a result of which the already mentioned favourable connections between supporting element 51 and skin 61 are achieved.

[0075] Fig. 11 shows, in schematic form in cross-section, three supporting elements 51 that are in each case arranged at right angles to each other in pairs, and are assembled with one another in the manner of a double-T support. The proportions indicated are in this case not reproduced to scale. The contact region of the two outer supporting elements 51 at their boundary surface 56 with the lateral peripheral walls of the central supporting element 51 is connected by welding, or alternatively by bonding. A first beneficial possibility is to skin all the remaining boundary surfaces, so that the wall element which results in this case also assumes the shape of this double-T support. However, an advantageous variant is to skin the boundary surfaces which face away from each other, and thus to provide a five-layer wall element in the manner of a sandwich.

[0076] Figures 12 and 13 illustrate, in schematic form and in cross-section, the construction of a wall element as a building wall, which comprises moulds for window reveals. It can be seen that the boundary surface 56 of the supporting element 51 accordingly runs non-continuously. It should be understood that the boundary surface does not necessarily have to be associated with the idea of plane in space, but also curved or spherical surfaces or those having discontinuous points are also included.

[0077] With reference to Fig. 14, a further advantageous variant is explained, in which a plurality of wall elements 60, 60' according to the invention have a tongue and groove, so that these can be used variably at any time, for example for fitting-out purposes, and can be removed once more or displaced or combined with other wall elements 60, which are likewise provided with tongue and groove. It goes without saying that other joining systems can be considered, for example riveting, bonding, screw-fitting, stapling. It is possible for a wall element provided with such a joining system also to be fastened to other parts than to other wall elements 60.

[0078] It can be seen from the above description that the elements and production process described according to the invention can be applied commercially particularly advantageously in order to produce entire walls or facades of a house, in special cases even the complete house, in the manner of a prefabricated house. The advantages of the wall element according to the invention, in particular its low weight and its low production costs, then accrue to the benefit of the house constructed in this way, as a result of which it is uniquely transportable. Because of this ability to be transported, production on an industrial scale can be carried out, which permits, for example, the bringing out of series and the reuse of moulds and the like, as a result of which the three important cost factors in house construction - material costs, trans-port costs and production costs - can be reduced to an extremely low amount with an enhanced and constant quality.

[0079] The wall element according to the invention has been explained above using the embodiment constructed as a house. It goes without saying that other wall elements, for example intermediate floors or roof constituent parts, can also be formed by the wall element according to the invention. It is thus possible, for example, to construct a wall element as a solar roof.

[0080] Expediently, empty pipes for the supply and discharge of water, power and the like or for the laying of cables for telephones, communication systems inside the house and the like, are provided in the skinning material, but also in the supporting element, and are simultaneously incorporated or pressed in, so that the wall element of this type makes leading such supply lines over the surface unnecessary.

[0081] Embodiments of the invention have been described hereinbefore where the boundary surface 56 was a mainly flat surface. It has to be noted that the boundary surface can also be shaped in any curvature and shape, while the angle between lumen 52 or another honeycomb type element and the boundary surface accordingly undergoes a change.

Claims

1. Wall element , comprising

a honeycomb supporting element (51), comprising hollow bodies (52) connected to one another at their respectively adjacent peripheral walls (53); and
at least one skin (61) closing a boundary surface (56) of the supporting element (51);
the skin (61) on one side engaging in the hollow bodies (52) in such a way that their opening (54) is fully closed,
whereby the peripheral walls (53) of the hollow bodies (52) have, at the boundary surface (56), a material extension (55) of the peripheral wall (53) which narrows the access to the interior of the hollow bodies (52) and runs in the plane of the boundary surface (56),

characterized in that
the skin (61) engages behind the material extension (55), and in that the skinning material (59) is supported against the inner peripheral wall (53) of the hollow bodies (52), directly contacting to the boundary surface (56) of the inner peripheral wall (53), and projects on the other side outside the boundary surface (56) of the supporting element (51).

2. Wall element according to Claim 1, **characterized in that** the material extensions (55) of adjacent peripheral walls (53) form an apertured, bracket-like surface merging into one another and constituting the boundary surface (56) of the supporting element (51).

3. Wall element according to Claim 1 or 2, **characterized in that** the thickness of the material extension (55) is greater than the thickness of the peripheral wall (53) of the hollow body.

4. Wall element according to one of Claims 1 to 3, **characterized in that** the material extension (55) takes up at least 20% of the cross-section surface defined by the peripheral wall (53) of a hollow body.

5. Wall element according to one of Claims 1 to 4, **characterized in that** the material extension (55) projects from the peripheral wall (53) of the hollow body, on both sides of the latter, and has a closed circumference.

6. Wall element according to one of Claims 1 to 7, **characterized in that** the hollow bodies (52) of the supporting element (51) have a continuous lumen which runs substantially perpendicular to the boundary surface (56) of the supporting element (51).

7. Wall element according to one of Claims 1 to 6, **characterized in that** the depth of penetration of the skin (61) into the supporting element (51) makes up less than 1/5 of the extent of the supporting element (51) normal to the skin (61).

8. Wall element according to one of Claims 1 to 7, **characterized in that**, - furthermore, a reinforcing web (58) is let into the skin (61), in the region of the thickness projecting beyond the supporting element (51).

9. Wall element according to one of Claims 1 to 8, **characterized in that** a reinforcing web (58) is arranged on the boundary surface (56) of the supporting element (51) and is connected to the said surface.

10. Wall element according to one of Claims 1 to 9, **characterized in that** the hollow bodies (52) of the supporting element (51) comprise a plurality of tubes connected to one another at their cylindrical walls.

11. Wall element according to one of Claims 1 to 10, **characterized in that** a further skin (61) is arranged on a boundary surface (56) of the supporting element (51) which faces away from the boundary surface (56) having the first skin (61).

12. Wall element according to one of Claims 1 to 11,

characterized in that at least one intermediate layer (64) is provided which runs substantially parallel to the boundary surface (56) and separates the supporting element (51) into two parts sealed off from each other, and in that that region of the thickness of the skin (61) that engages into the hollow bodies (52) does not project beyond the intermediate layer (64).

13. Wall element according to one of Claims 1 to 12, **characterized in that** the supporting element (51) comprises an insulating material accommodated in the hollow bodies (52).

14. Wall element according to one of Claims 1 to 13, **characterized in that** the skin (61) is concrete.

15. Wall element according to one of Claims 1 to 14, **characterized in that** power, heating, communication or other line systems are arranged in the supporting element (51), sealed off from the supporting element (51) and running substantially parallel to the skin (61).

16. Wall element according to one of Claims 1 to 15, **characterized in that** the skin (61) comprises spacer elements (63) in the region of the thickness projecting beyond the boundary surface (56).

17. Process for producing a wall element (60), comprising the steps

(a) immersing a honeycomb supporting element (51) comprising hollow bodies (52) connected to one another at their respectively adjacent peripheral walls (53) in an as yet uncured mass of skinning material (59); and
(b) allowing the skinning composition to set to form a skin (61) that is firmly connected to the supporting element (51),

characterized in
that before immersing the supporting element (51) in the as yet uncured skinning material (59), the boundary surface (56), to be immersed, of the supporting element (51) is subjected to a pressure loading acting normal to the boundary surface (56) in such a way that, as a result of the flow of the material of the supporting element (51) running substantially normal to the pressure-loading direction, on both sides of the peripheral wall (53) of the hollow bodies (52) forming the supporting element (51), a projecting material extension (55) is formed, that it penetrates behind the material extension (55) of the supporting element (51) and comes directly to rest against the inner peripheral wall (53) of the hollow bodies (52)_as a result of which the cross-sectional area of the apertures (54) of the supporting element (51) is in each case reduced, and
that the skinning material (59) penetrates behind the material extension (55) of the supporting element (51) and comes to rest against the inner peripheral wall (53) of the hollow bodies (52).

18. Process according to Claim 17, **characterized in that** the skinning material (59) is a foaming material.

19. Process according to Claim 17 or 18, **characterized in that**, before laying the supporting element (51) in the skinning material (59), the boundary surface (56) of the supporting element (51) is adheringly provided with a web (58).

20. Process according to one of Claims 17 to 19, **characterized in that** the setting step is accelerated by the supply of heat.

21. Process according to one of Claims 17 to 20, **characterized in that**, after the skinning material (59) has set, the boundary surface (56) of the supporting element (51) opposite the skin (61) is provided with a skin (61).

22. Process according to one of Claims 17 to 21, **characterized in that** a web (58) is laid in the skinning material (59) before the setting of the skinning material (59).

23. Process according to one of Claims 17 to 22, **characterized in that** two wall elements (60) are connected to each other at their unskinned boundary surfaces (56), which face away from the skins (61) in each case, in such a way that the resulting wall element (60) has two skins (61) facing away from each other.

24. Process according to one of Claims 17 to 23, **characterized in that** there is provided, in the hollow bodies (52) of the supporting element (51), a penetration-limiting means for the skinning material (59), and in that the supporting element (51) is immersed in the skinning material (59) no deeper than this limiting means.

25. Process according to one of Claims 17 to 24, **characterized in that** the skinning material (59) is held in a trough running substantially horizontally, and in that spacer elements (63) arranged in the trough serve as stops for the supporting element (51), so that, as a result of the dimensions of the spacer elements (63), a predefinable region of the thickness of the skin (61) projects beyond the boundary surface (56) of the supporting element (51).

26. Supporting element in the style of a honeycomb, comprising hollow bodies (52) connected to one another along their respectively adjacent peripheral walls (53),

at least one skin (61) closing a boundary surface (56) of the supporting element (51);
the skin (61) on one side engaging in the hollow bodies (52) in such a way that their opening (54) is fully closed,
whereby the peripheral walls (53) of the hollow bodies (52) have, at the boundary surface (56), a material extension (55) of the peripheral wall (53) which narrows the access to the interior of the hollow bodies (52) and runs in the plane of the boundary surface (56),

characterized in that
the skin (61) engages behind the material extension (55), and in that the skinning material (59) is supported against the inner peripheral wall (53) of the hollow bodies (52), directly contacting to the boundary surface (56) of the inner peripheral wall (53), and projects on the other side outside the boundary surface (56) of the supporting element (51).

27. Supporting element according to Claim 26, **characterized in that** the supporting element (51) consists of a plastic, selected from the group comprising polypropylene, polyethylene, polyurethane, polyether and polyterephthalate.

28. Supporting element according to Claim 26 or 27, **characterized in that** the hollow bodies (52) are constructed as tubes running parallel, whose lumen is cut into by the material extension (55) in the boundary surface (56).

29. Supporting element according to Claim 26 or 27, **characterized in that** the hollow bodies (52) have a grid structure, the lumen of the grid cells being cut into by the material extension (55) in the boundary surface (56) running substantially normal to this lumen.

30. Supporting element according to one of Claims 26 to 29, **characterized in that** the material extension (55) of the hollow body exposes less than one quarter of the lumen of the hollow body as an aperture (54).

31. Supporting element according to one of claims 26 to 30, **characterized in that** the plane of the boundary surface (56) is a curved sphere in space.

32. Process for producing a supporting element (51) in the style of a honeycomb, in which a plurality of hollow bodies (52) are connected along their peripheral walls (53) to form a dimensionally stable and flexurally rigid honeycomb body,

(a) immersing a honeycomb supporting element (51) comprising hollow bodies (52) connected to one another at their respectively adjacent peripheral walls (53) in an as yet uncured mass of skinning material (59); and
(b) allowing the skinning composition to set to form a skin (61) that is firmly connected to the supporting element (51),

characterized in
that before immersing the supporting element (51) in the as yet uncured skinning material (59), the boundary surface (56), to be immersed, of the supporting element (51) is subjected to a pressure loading acting normal to the boundary surface (56) in such a way that, as a result of the flow of the material of the supporting element (51) running substantially normal to the pressure-loading direction, on both sides of the peripheral wall (53) of the hollow bodies (52) forming the supporting element (51), a projecting material extension (55) is formed, that it penetrates behind the material extension (55) of the supporting element (51) and comes directly to rest against the inner peripheral wall (53) of the hollow bodies (52) as a result of which the cross-sectional area of the apertures (54) of the supporting element (51) is in each case reduced, and
that the skinning material (59) penetrates behind the material extension (55) of the supporting element (51) and comes to rest against the inner peripheral wall (53) of the hollow bodies (52).

33. Process according to Claim 32, further comprising a thermal treatment step of the honeycomb body.

34. Process according to Claim 32 or 33, **characterized in that** adjacent surface regions of the honeycomb body are successively subjected to the pressure loading.

35. Process according to one of Claims 32 to 34, **characterized in that** the boundary surfaces (56) of the honeycomb body that face away from each other are shaped at the same time.

Patentansprüche

1. Wandelement, umfassend

ein wabenartiges Tragelement (51), umfassend an ihren jeweils benachbarten Umfangswänden (53) miteinander verbundene Hohlkörper (52); und
wenigstens eine eine Begrenzungsfläche (56) des Tragelements (51) verschließende Beplankungsschicht (61);
wobei die Beplankungsschicht (61) auf der ei-

nen Seite derart in die Hohlkörper (52) eingreift, daß deren Öffnung (54) vollständig verschlossen ist,
wobei die Umfangswände (53) der Hohlkörper (52) an der Begrenzungsfläche (56) einen den Zugang zum Inneren der Hohlkörper (52) verengenden, in der Ebene der Begrenzungsfläche (56) verlaufenden Materialfortsatz (55) aufweisen,

dadurch gekennzeichnet,
daß die Beplankungsschicht den Materialfortsatz (55) hintergreift und
daß das Beplankungsmaterial (59) sich gegen die innere Umfangswand (53) der Hohlkörper (52) abstützt in direktem Kontakt zu der Begrenzungsfläche (56) der inneren Umfangswände (53) und auf der anderen Seite außerhalb der Begrenzungsfläche (56) des Tragelementes (51) vorsteht.

2. Wandelement nach Anspruch 1, **dadurch gekennzeichnet, daß** die Materialfortsätze (55) benachbarter Umfangswände eine durchbrochene, ineinander übergehende und die Begrenzungsfläche (56) des Tragelements (51) darstellende konsolenartige Fläche bilden.

3. Wandelement nach einem der Ansprüche 1 oder 2, **dadurch gekennzeichnet, daß** die Dicke des Materialfortsatzes (55) größer ist als die Dicke der Umfangswand (53) des Hohlkörpers.

4. Wandelement nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, daß** der Materialfortsatz (55) wenigstens 20% der von der Umfangswand (53) eines Hohlkörpers umgebenen Querschnittsfläche einnimmt.

5. Wandelement nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, daß** der Materialfortsatz (55) beiderseits der Umfangswand (53) des Hohlkörpers von jener absteht und einen geschlossenen Umfang aufweist.

6. Wandelement nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, daß** die Hohlkörper (52) des Tragelementes (51) ein durchgehendes Lumen aufweisen, das im wesentlichen senkrecht zu der Begrenzungsfläche des Tragelements (51) verläuft.

7. Wandelement nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, daß** die Eindringstiefe der Beplankungsschicht (61) in das Tragelement (51) weniger als 1/5 der Erstreckung des Tragelements (51) normal zur Beplankungsschicht (61) ausmacht.

8. Wandelement nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, daß** ferner in der Beplankungsschicht (61) in dem über das Tragelement (51) vorstehenden Dickenbereich eine Bewehrungsbahn (58) eingelassen ist.

9. Wandelement nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet, daß** eine Bewehrungsbahn (58) auf der Begrenzungsfläche (56) des Tragelementes (51) angeordnet und mit dieser verbunden ist.

10. Wandelement nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, daß** die Hohlkörper (52) des Tragelements (51) eine Mehrzahl von an ihren Zylinderwänden miteinander verbundenen Rohren umfassen.

11. Wandelement nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, daß** eine weitere Beplankungsschicht (61) auf einer Begrenzungsfläche (56) des Tragelementes (51) angeordnet ist, die der Begrenzungsfläche (56) mit der ersten Beplankungsschicht (61) abgekehrt ist.

12. Wandelement nach einem der Ansprüche 1 bis 11, **dadurch gekennzeichnet, daß** wenigstens eine im wesentlichen parallel zu der Begrenzungsfläche (56) verlaufende, das Tragelement (51) in zwei voneinander abgedichteten Teilen trennende Zwischenlage (64) vorgesehen ist, und daß der in die Hohlkörper (52) eingreifende Dickenbereich der Beplankungsschicht (61) nicht über die Zwischenlage (64) hinausgeht.

13. Wandelement nache einem der Ansprüche 1 bis 12, **dadurch gekennzeichnet, daß** das Tragelement (51) ein in den Hohlkörpern (52) aufgenommenes Dämmaterial umfaßt.

14. Wandelement nach einem der Ansprüche 1 bis 14, **dadurch gekennzeichnet, daß** die Beplankungsschicht Beton ist.

15. Wandelement nach einem der Ansprüche 1 bis 14, **dadurch gekennzeichnet, daß** in dem Tragelement (51) gegen das Tragelement (51) abgedichtete und im wesentlichen parallel zu der Beplankungsschicht (61) verlaufende Energie, Heizungs-, Kommunikations- oder andere Leitungssysteme angeordnet sind.

16. Wandelement nach einem der Ansprüche 1 bis 15, **dadurch gekennzeichnet, daß** die Beplankungsschicht (61) in dem außerhalb der Begrenzungsfläche (56) vorstehenden Dickenbereich Abstandshalteglieder (63) umfaßt.

17. Verfahren zur Herstellung eines Wandelementes (60) umfassend die Schritte

a) Eintauchen eines wabenartigen Tragelementes (51) umfassend an ihren jeweils benachbarten Umfangswänden (53) miteinander verbundene Hohlkörper (52) in eine noch nicht ausgehärtete Masse aus Beplankungsmaterial (59); und
b) Aushärtenlassen der Beplankungsmasse zur Bildung einer mit dem Tragelement (51) fest verbundenen Beplankungsschicht (61),

dadurch gekennzeichnet,
daß vor Eintauchen des Tragelementes (51) in das noch nicht ausgehärtete Beplankungsmaterial (59) die einzutauchende Begrenzungsfläche (56) des Tragelementes (51) einer normal zur Begrenzungsfläche (56) wirkenden Druckbeanspruchung unterworfen wird, derart, daß durch Fließen des Materials des Tragelementes (51) im wesentlichen normal zur Druckbeanspruchungsrichtung verlaufende, beiderseits der Umfangswandung (53) der das Tragelement (51) bildenden Hohlkörpern (52) ein überstehender Materialfortsatz (55) erzeugt wird, daß es hinter die Materialfortsätze (55) des Tragelementes (51) eindringt und in direkter Anlage gegen die innere Umfangswand (53) der Hohlkörper (52) gelangt, wodurch die Querschnittsfläche der Durchbrüche (54) des Tragelementes (51) jeweils herabgesetzt wird, und
daß das Beplankungsmaterial (59) hinter die Materialfortsätze (55) des Tragelementes eindringt und in Anlage gegen die innere Umfangswand (53) der Hohlkörper (52) gelangt.

18. Verfahren nach Anspruch 17, **dadurch gekennzeichnet, daß** das Beplankungsmaterial (59) ein schäumendes Material sein kann.

19. Verfahren nach Anspruch 17 oder 18, **dadurch gekennzeichnet, daß** vor Einlegen des Tragelementes (51) in das Beplankungsmaterial (59) die Begrenzungsfläche (56) des Tragelementes (51) mit einer Bahn (58) anhaftend versehen wird.

20. Verfahren nach einem der Ansprüche 17 bis 19, **dadurch gekennzeichnet, daß** der Abbindeschritt durch Zufuhr von Wärme beschleunigt wird.

21. Verfahren nach einem der Ansprüche 17 bis 20, **dadurch gekennzeichnet, daß** nach Abbinden des Beplankungsmaterials (59) die der Beplankungsschicht (61) gegenüberliegende Begrenzungsfläche (56) des Tragelementes (51) mit einer Beplankungsschicht (61) versehen wird.

22. Verfahren nach einem der Ansprüche 17 bis 21, **dadurch gekennzeichnet, daß** eine Bahn (58) vor dem Abbinden des Beplankungsmaterials (59) in das Beplankungsmaterial (59) eingelegt wird.

23. Verfahren nach einem der Ansprüche 17 bis 22, **dadurch gekennzeichnet, daß** zwei Wandelemente (60) an ihren unbeplankten Begrenzungsfläche (56), die den Beplankungsschichten (61) jeweils abgewandt sind, miteinander verbunden werden, derart, daß das resultierende Wandelement (60) zwei einander abgekehrte Beplankungsschichten (61) aufweist.

24. Verfahren nach einem der Ansprüche 17 bis 23, **dadurch gekennzeichnet, daß** in den Hohlkörpern (52) des Tragelementes (51) eine Eindringbegrenzung für das Beplankungsmaterial (59) vorgesehen ist, und daß das Tragelement (51) nicht tiefer in das Beplankungsmaterial (59) eingetaucht wird, als diese Begrenzung.

25. Verfahren nach einem der Ansprüche 17 bis 24, **dadurch gekennzeichnet, daß** das Beplankungsmaterial (59) in einer im wesentlichen horizontal verlaufenden Wanne gehalten wird und daß in der Wanne angeordnete Abstandshalteglieder (63) als Anschläge für das Tragelement (61) dienen, so daß durch die Abmessungen der Abstandshalteglieder (63) ein vorgebbarer Dickenbereich der Beplankungsschicht (61) außerhalb der Begrenzungsfläche (56) des Tragelementes (51) vorsteht.

26. Tragelement nach Art einer Wabe, umfassend an ihren jeweils benachbarten Umfangwänden (53) miteinander verbundene Hohlkörper (52), wenigstens eine eine Begrenzungsfläche (56) des Tragelementes (51) verschließende Beplankungsschicht (61);

wobei die Beplankungsschicht (61) auf der einen Seite derart in die Hohlkörper (52) eingreift, daß deren Öffnung (54) vollständig verschlossen ist,
wobei die Umfangswände (53) der Hohlkörper (52) an der Begrenzungsfläche (56) einen den Zugang zum Inneren der Hohlkörper (52) verengenden, in der Ebene der Begrenzungsfläche (56) verlaufenden Materialfortsatz (55) aufweisen,

dadurch gekennzeichnet,
daß die Beplankungsschicht den Materialfortsatz (55) hintergreift und
daß das Beplankungsmaterial (59) sich gegen die innere Umfangswand (53) der Hohlkörper (52) abstützt in direktem Kontakt zu der Begrenzungsfläche (56) der inneren Umfangswände (53) und auf der anderen Seite außerhalb der Begrenzungsflä-

che (56) des Tragelementes (51) vorsteht.

27. Tragelement nach Anspruch 26, **dadurch gekennzeichnet, daß** das Tragelement aus einem Kunststoff besteht, ausgewählt aus der Gruppe umfassend Polypropylen, Polyethylen, Polyurethan, Polyäther und Polyteraphtalat.

28. Tragelement nach Anspruch 26 oder 27, **dadurch gekennzeichnet, daß** die Hohlkörper (52) als parallel verlaufende Rohre ausgebildet sind, deren Lumen in der Begrenzungsfläche (56) durch den Materialfortsatz (55) eingeschnürt ist.

29. Tragelement nach Anspruch 26 oder 27, **dadurch gekennzeichnet, daß** die Hohlkörper (52) eine Gitterstruktur aufweisen, wobei das Lumen der Gitterzellen in der im wesentlichen normal zu diesem Lumen verlaufenden Begrenzungsfläche (56) durch den Materialfortsatz (55) eingeschnürt ist.

30. Tragelement nach einem der Ansprüche 26 bis 29, **dadurch gekennzeichnet, daß** der Materialfortsatz (55) des Hohlkörpers (52) weniger als ein Viertel des Lumen des Hohlkörpers als Durchbrechung (54) freigibt.

31. Tragelement nach einem der Ansprüche 26 bis 30, **dadurch gekennzeichnet, daß** die Ebene der Begrenzungsfläche (56) eine im Raum gebogene Kugel ist.

32. Verfahren zur Herstellung eines Tragelementes (51) nach Art einer Wabe, bei dem eine Mehrzahl von Hohlkörpern (52) an ihren Umfangswänden (53) zu einem form- und biegefesten Wabenkörper verbunden sind,

a) durch Eintauchen eines wabenartigen Tragelementes (51) umfassend an ihren jeweils benachbarten Umfangswänden (53) miteinander verbundene Hohlkörper (52) in eine noch nicht ausgehärtete Masse aus Beplankungsmaterial (59); und
b) Aushärtenlassen der Beplankungsmasse zur Bildung einer mit dem Tragelement (51) fest verbundenen Beplankungsschicht (61),

dadurch gekennzeichnet,
daß vor Eintauchen des Tragelementes (51) in das noch nicht ausgehärtete Beplankungsmaterial (59) die einzutauchende Begrenzungsfläche (56) des Tragelementes (51) einer normal zur Begrenzungsfläche (56) wirkenden Druckbeanspruchung unterworfen wird, derart, daß durch Fließen des Materials des Tragelementes (51) im wesentlichen normal zur Druckbeanspruchungsrichtung verlaufende, beiderseits der Umfangswandung (53) der das Tragelement (51) bildenden Hohlkörpern (52) ein überstehender Materialfortsatz (55) erzeugt wird, daß es hinter die Materialfortsätze (55) des Tragelementes (51)eindringt und direkt in Anlage gegen die innere Umfangswand (53) der Hohlkörper (52) gelangt, wodurch die Querschnittsfläche der Durchbrüche (54) des Tragelementes (51) jeweils herabgesetzt wird, und
daß das Beplankungsmaterial (59) hinter die Materialfortsätze (55) des Tragelementes eindringt und in Anlage gegen die innere Umfangswand (53) der Hohlkörper (52) gelangt.

33. Verfahren nach Anspruch 32, femer umfassend einen thermischen Behandlungsschritt des Wabenkörpers.

34. Verfahren nach Anspruch 32 oder 33, **dadurch gekennzeichnet, daß** benachbarte Flächenbereiche des Wabenkörpers sukzessive der Druckbeanspruchung ausgesetzt werden.

35. Verfahren nach einem der Ansprüche 32 bis 34, **dadurch gekennzeichnet, daß** einander abgekehrte Begrenzungsflächen des Wabenkörpers zeitgleich umgeformt werden.

Revendications

1. Elément mural, comprenant

un élément-support (51) de forme alvéolaire, comprenant sur ses parois circonférentielles (53) respectivement voisines des corps creux (52) reliés entre eux et
au moins une couche de revêtement (61) fermant une périphérie (56) de l'élément-support (51), la couche de revêtement (61) pénétrant sur un côté dans le corps creux (52) de manière que son ouverture (54) soit complètement fermée,
les parois circonférentielles (53) des corps creux (52) présentant sur la périphérie (56) une saillie (55) rétrécissant l'accès à l'intérieur du corps creux (52) et passant au niveau de la périphérie (56),

caractérisé par le fait que
la couche de revêtement est en prise arrière avec la saillie (55) et que le matériau de revêtement (59) prend appui contre la paroi circonférentielle intérieure (53) du corps creux (52) en contact direct avec la périphérie (56) des parois circonférentielles intérieures (53) et, de l'autre côté, qu'elle se trouve en dehors de la périphérie (56) de l'élément-support (51).

2. Elément mural selon revendication 1, **caractérisé par** le fait que les saillies (55) des parois circonférentielles voisines forment une surface en forme de console discontinue emboîtée et représentant la périphérie (56) de l'élément-support (51).

3. Elément mural selon l'une des revendications 1 ou 2, **caractérisé par** le fait que l'épaisseur de la saillie (55) est supérieure à l'épaisseur de la paroi circonférentielle (53) du corps creux.

4. Elément mural selon l'une des revendications 1 à 3, **caractérisé par** le fait que la saillie (55) occupe au moins 20 % de la section entourée par la paroi circonférentielle (53) d'un corps creux.

5. Elément mural selon l'une des revendications 1 à 4, **caractérisé par** le fait que la saillie (55) des deux côtés de la cloison circonférentielle (53) du corps creux est en retrait de celle-ci et présente une circonférence fermée.

6. Elément mural selon l'une des revendications 1 à 5, **caractérisé par** le fait que les corps creux (52) de l'élément-support (51) présentent une lumière continue essentiellement perpendiculaire à la périphérie de l'élément-support (51).

7. Elément mural selon l'une des revendications 1 à 6, **caractérisé par** le fait que la profondeur de pénétration de la couche de revêtement (61) dans l'élément-support (51) est inférieure à 1/5^{e} de l'extension de l'élément-support (51) normal par rapport à la couche de revêtement (61).

8. Elément mural selon l'une des revendications 1 à 7, **caractérisé par** le fait qu'une bande d'armature (58) se trouve dans la couche de revêtement (61) dans la zone d'épaisseur en saillie de l'élément-support (61).

9. Elément mural selon l'une des revendications 1 à 8, **caractérisé par** le fait qu'une bande d'armature (58) est posée sur la périphérie (58) de l'élément-support (51) et qu'elle est solidaire de celui-ci.

10. Elément mural selon l'une des revendications 1 à 9, **caractérisé par** le fait que les corps creux (52) de l'élément-support (51) présentent une multitude de tubes reliés entre eux sur leurs parois cylindriques.

11. Elément mural selon l'une des revendications 1 à 10, **caractérisé par** le fait qu'une autre couche de revêtement (61) est disposée sur une périphérie (56) de l'élément-support (51), laquelle est opposée à la périphérie (56) portant la première couche de revêtement (61).

12. Elément mural selon l'une des revendications 1 à 11, **caractérisé par** le fait qu'au moins une couche intermédiaire (64) pratiquement parallèle à la périphérie (56) séparant l'élément-support (51) en deux parties étanches l'une par rapport à l'autre est prévue et que la zone épaisse de la couche de revêtement (61) pénétrant dans les corps creux (52) ne va pas au-delà de la couche intermédiaire (64).

13. Elément mural selon l'une des revendications 1 à 12, **caractérisé par** le fait que l'élément-support (51) entoure un matériau isolant mis en place dans les corps creux (52).

14. Elément mural selon l'une des revendications 1 à 14, **caractérisé par** le fait que la couche de revêtement consiste en du béton.

15. Elément mural selon l'une des revendications 1 à 14, **caractérisé par** le fait que des systèmes de chauffage, de communication ou autres sont disposés dans la section énergie se trouvant dans l'élément-support (51), étanchéifiée contre l'élément-support (51) et principalement parallèle à la couche de revêtement (61).

16. Elément mural selon l'une des revendications 1 à 15, **caractérisé par** le fait que la couche de revêtement (61) entoure des écarteurs (63) dans la zone épaisse en saillie en dehors de la périphérie (56).

17. Procédé de fabrication d'un élément mural (60) comprenant les étapes

a) mise en place d'un élément-support (51) de forme alvéolaire présentant sur ses parois circonférentielles (53) respectivement voisines des corps creux (52) reliés entre eux dans une masse encore non durcie constituée d'un matériau de revêtement (59) et
b) durcissement de la masse de revêtement pour former une couche de revêtement (61) fermement solidaire de l'élément-support (51),

caractérisé par le fait que,
avant la mise en place de l'élément-support (51) dans le matériau de revêtement (59) non encore durci, la périphérie (56) de l'élément-support (51) devant être mise en place soit soumise à une pression normale agissant sur la périphérie (56), de manière que, en raison de l'écoulement du matériau de l'élément-support (51), une saillie (55) essentiellement normale par rapport au sens de la pression soit générée des deux côtés de la paroi circonférentielle (53) des corps creux (52) formant l'élément-support (51), qu'il pénètre à l'arrière des saillies (55) de l'élément-support (51) et qu'il arrive par application directe contre la paroi circonféren-

tielle intérieure (53) des corps creux (52), suite à quoi la section des percées (54) de l'élément-support (51) est respectivement abaissée et que le matériau de revêtement (59) pénètre derrière les saillies (55) de l'élément-support et qu'il arrive contre la paroi circonférentielle intérieure (53) des corps creux (52).

18. Procédé selon revendication 17, **caractérisé par** le fait que le matériau de revêtement (59) peut consister en une matière moussante.

19. Procédé selon revendication 17 ou 18, **caractérisé par** le fait qu'avant de mettre en place l'élément-support (51) dans le matériau de revêtement (59), la périphérie (56) de l'élément-support (51) est munie d'une bande (58) de manière adhésive.

20. Procédé selon l'une des revendications 17 à 19, **caractérisé par** le fait que la prise est accélérée sous l'effet de la chaleur.

21. Procédé selon l'une des revendications 17 à 20, **caractérisé par** le fait qu'après la prise du matériau de revêtement (59), la périphérie (56) de l'élément-support (51) opposée à la couche de revêtement (61) est munie d'une couche de revêtement (61).

22. Procédé selon l'une des revendications 17 à 21, **caractérisé par** le fait qu'une bande (58) est mise en place dans le matériau de revêtement (59) avant la prise du matériau de revêtement (59).

23. Procédé selon l'une des revendications 17 à 22, **caractérisé par** le fait que deux éléments muraux (60) sont reliés entre eux sur leur superficie (56) non revêtue et respectivement opposés aux couches de revêtement (61) de manière que l'élément mural (60) qui en résulte présente deux couches de revêtement (61) opposées.

24. Procédé selon l'une des revendications 17 à 23, **caractérisé par** le fait qu'une limitation de pénétration pour le matériau de revêtement (59) est prévue dans les corps creux (52) de l'élément-support (51) et que l'élément-support (51) ne descende pas plus bas dans le matériau de revêtement (59) que cette limitation.

25. Procédé selon l'une des revendications 17 à 24, **caractérisé par** le fait que le matériau de revêtement (59) est maintenu dans une cuve essentiellement horizontale et que les écarteurs (63) mis en place dans la cuve servent de butées pour l'élément-support (61) de manière que, en raison des dimensions des écarteurs (63), une zone épaisse pouvant être pratiquée de la couche de revêtement (61) se trouve en saillie en dehors de la périphérie (56) de l'élément-support (51).

26. Elément-support du type alvéolaire, comprenant des corps creux (52) reliés entre eux sur leurs parois circonférentielles (53) respectivement voisines, au moins une couche de revêtement (61) fermant une périphérie (56) de l'élément-support (51), la couche de revêtement (61) pénétrant sur un côté dans le corps creux (52) de manière que son ouverture (54) soit intégralement fermée, les parois circonférentielles (53) des corps creux (52) sur la périphérie (56) présentant une saillie (55) rétrécissant l'accès à l'intérieur des corps creux (52) et passant au niveau de la périphérie (56), **caractérisé par** le fait que la couche de revêtement entre en prise à l'arrière avec la saillie (55) et que le matériau de revêtement (59) prend appui contre la paroi circonférentielle intérieure (53) des corps creux (52) en contact direct avec la périphérie (56) des parois circonférentielles intérieures (53) et que, de l'autre côté, il soit en saillie ne dehors de la périphérie (56) de l'élément-support (51).

27. Elément-support selon revendication 26, **caractérisé par** le fait que l'élément-support consiste en une matière plastique choisie à partir du groupe des polypropylène, polyéthylène, polyuréthane, polyéther et polytéraphtalate.

28. Elément-support selon revendication 26 ou 27, **caractérisé par** le fait que les corps creux (52) ont la forme de tubes parallèles dont la lumière est rétrécie par la saillie (55) dans la périphérie (56).

29. Elément-support selon revendication 26 ou 27, **caractérisé par** le fait que les corps creux (52) présentent une structure quadrillée, la lumière des cellules quadrillées étant rétrécie par la saillie (55) dans la périphérie (56) essentiellement normale pour cette lumière.

30. Elément-support selon l'une des revendications 26 à 29, **caractérisé par** le fait que la saillie (55) du corps creux (52) libère moins d'un quart de la lumière du corps creux comme traversée (54).

31. Elément-support selon l'une des revendications 26 à 30, **caractérisé par** le fait que le niveau de la périphérie (56) consiste en une sphère courbée.

32. Procédé de fabrication d'un élément-support (51) de forme alvéolaire, pour lequel une multitude de corps creux (52) sont reliés sur leurs parois circonférentielles (53) en un corps alvéolaire résistant à la flexion et de forme robuste,

a) par mise en place d'un élément-support (51) de type alvéolaire comprenant des corps creux

(52) reliés entre eux sur leurs parois circonférentielles (53) respectivement voisines dans une masse non encore durcie constituée d'un matériau de revêtement (59) et

b) durcissement de la masse de revêtement pour former une couche de revêtement (61) fermement solidaire de l'élément-support (51),

caractérisé par le fait que
avant la mise en place de l'élément-support (51) dans le matériau de revêtement (59) non encore durci, la périphérie (56) de l'élément-support (51) devant être mise en place soit soumise à une pression normale agissant sur la périphérie (56), de manière que, en raison de l'écoulement du matériau de l'élément-support (51), une saillie (55) essentiellement normale par rapport au sens de la pression soit générée des deux côtés de la paroi circonférentielle (53) des corps creux (52) formant l'élément-support (51), qu'il pénètre à l'arrière des saillies (55) de l'élément-support (51) et qu'il arrive par application directe contre la paroi circonférentielle intérieure (53) des corps creux (52), suite à quoi la section des percées (54) de l'élément-support (51) est respectivement abaissée et que le matériau de revêtement (59) pénètre derrière les saillies (55) de l'élément-support et qu'il parvient contre la paroi circonférentielle intérieure (53) des corps creux (52).

33. Procédé selon la revendication 32, comprenant d'autre part un traitement thermique du corps alvéolaire.

34. Procédé selon revendication 32 ou 33, **caractérisé par** le fait que les surfaces voisines du corps alvéolaire sont successivement exposées à la sollicitation par pression.

35. Procédé selon l'une des revendications 32 à 34, **caractérisé par** le fait que les périphéries opposées du corps alvéolaire sont déformées en même temps.

Fig. 1

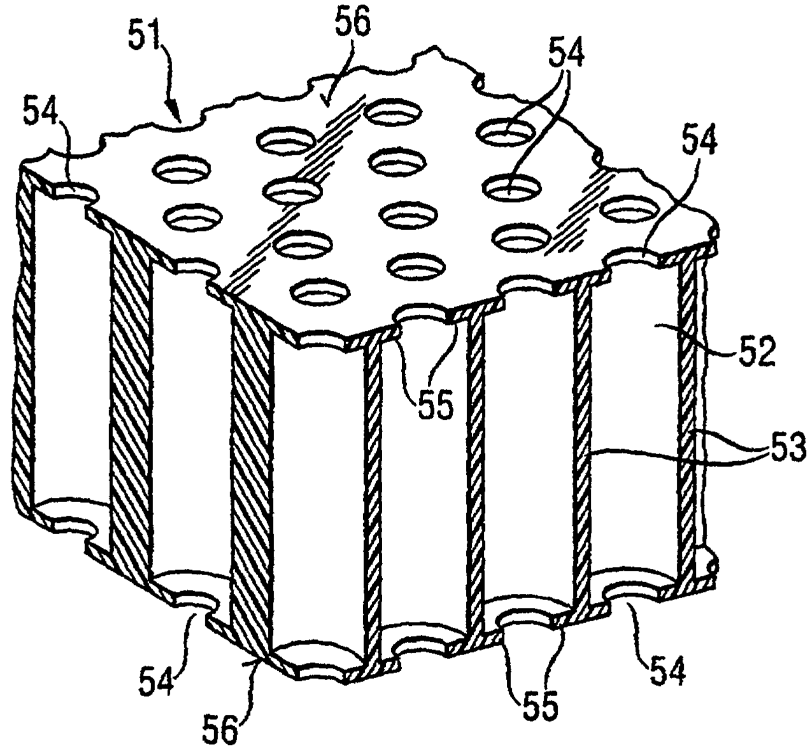
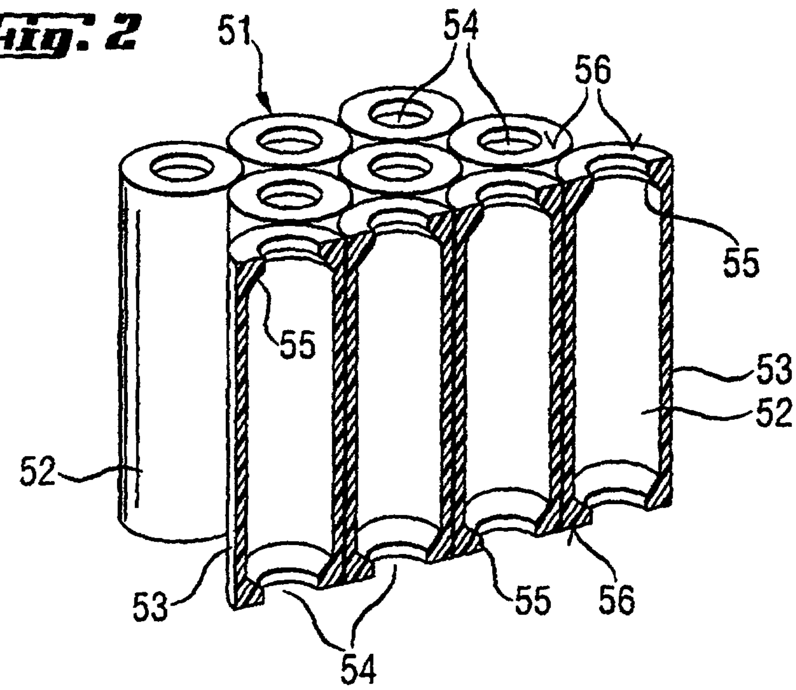


Fig. 2



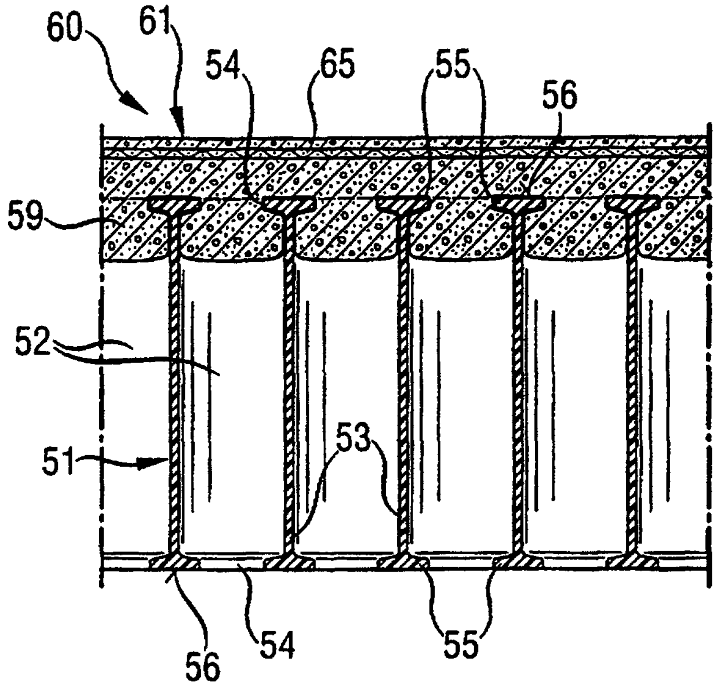


Fig. 3

Fig. 4

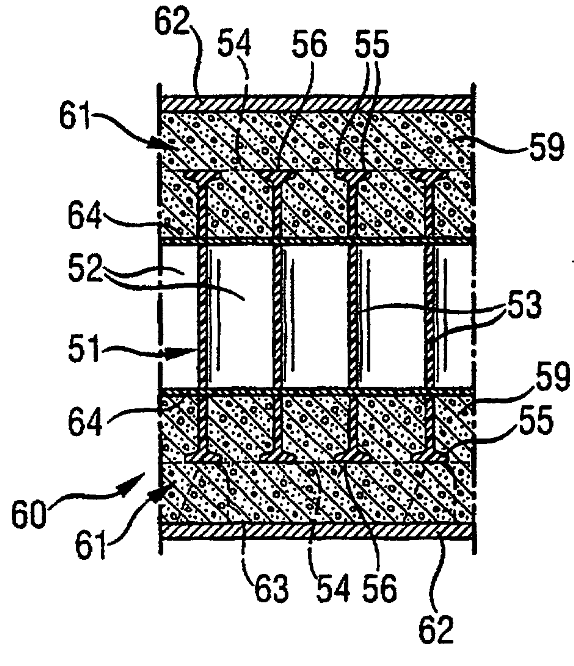


Fig. 5

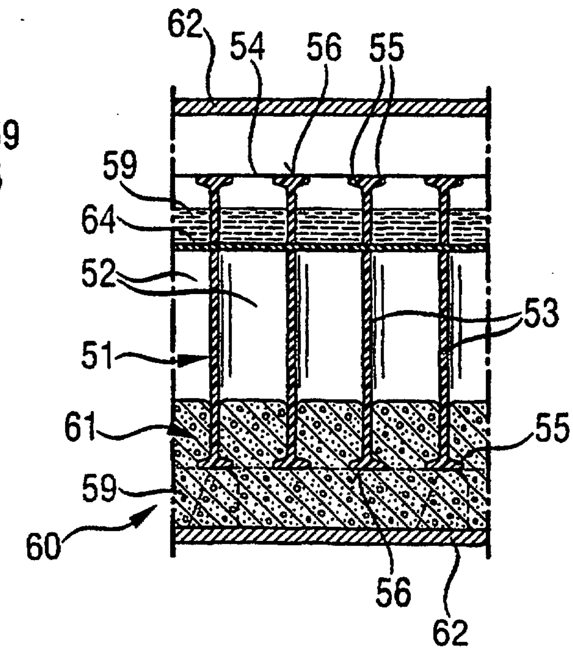


Fig. 6

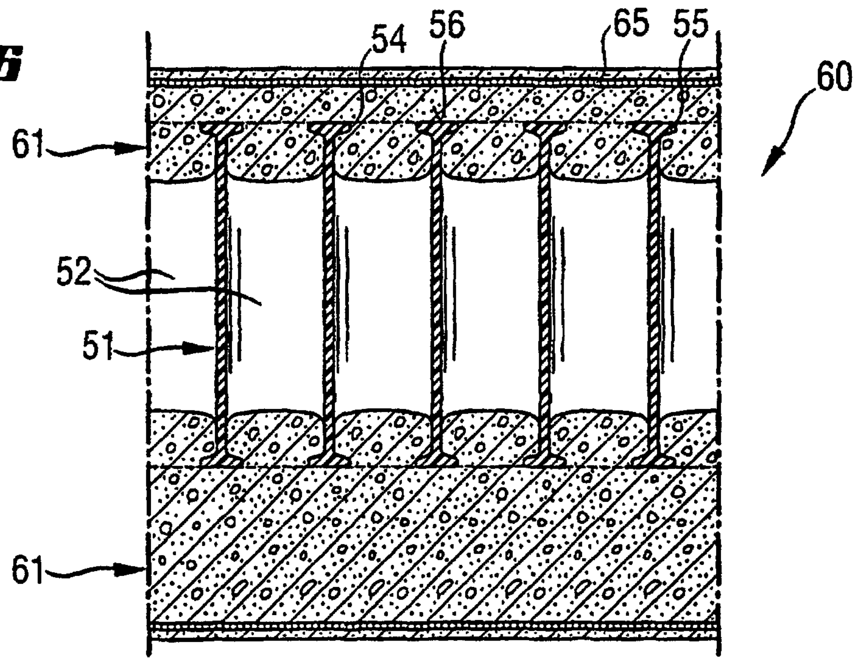


Fig. 7

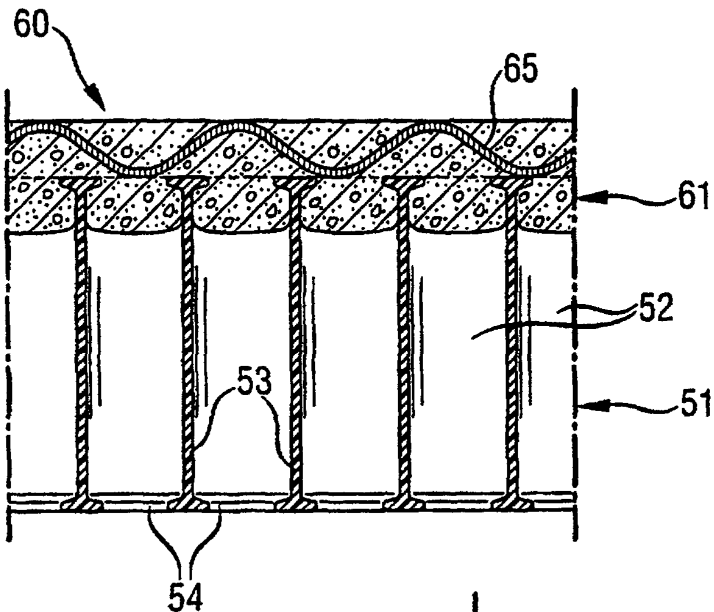
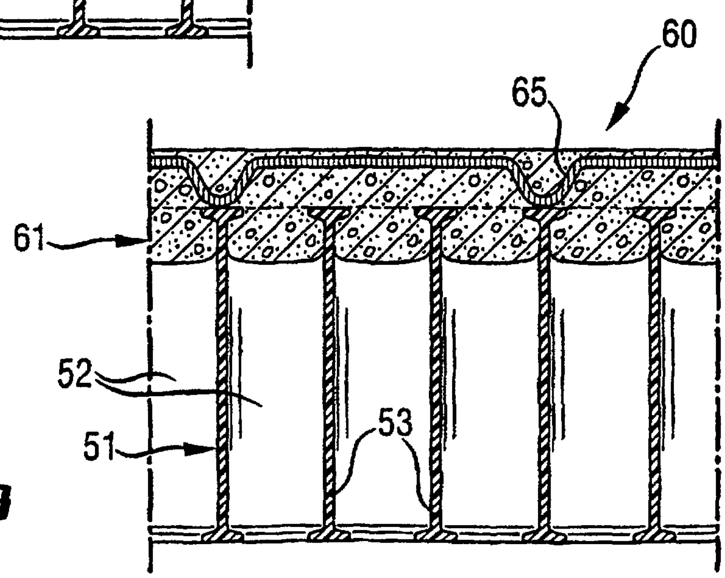


Fig. 8



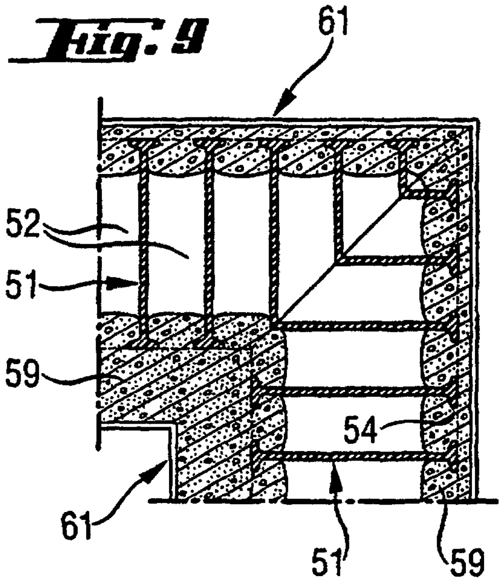


Fig. 9

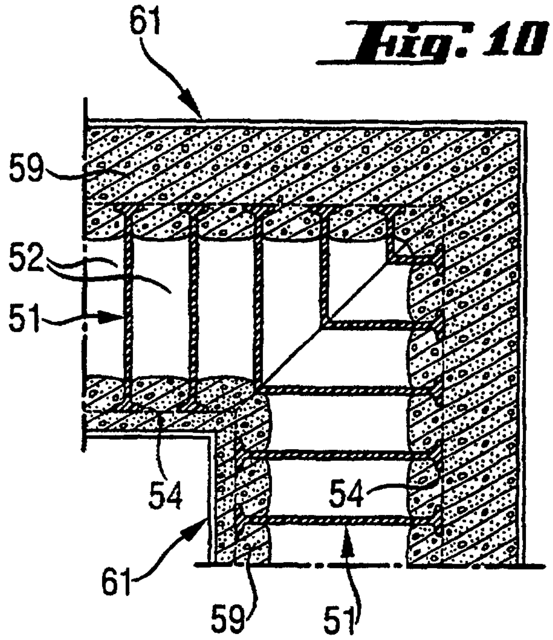


Fig. 10

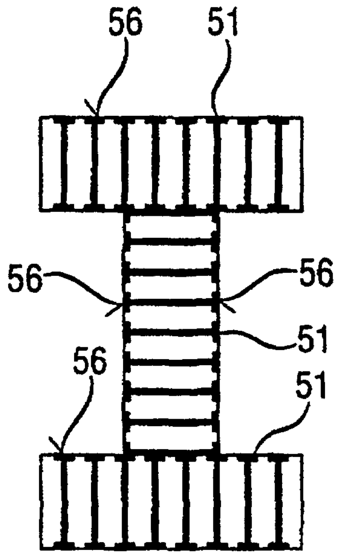


Fig. 11

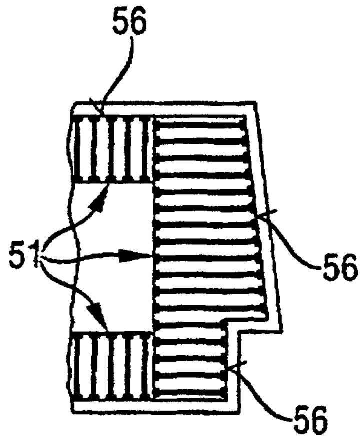


Fig. 12

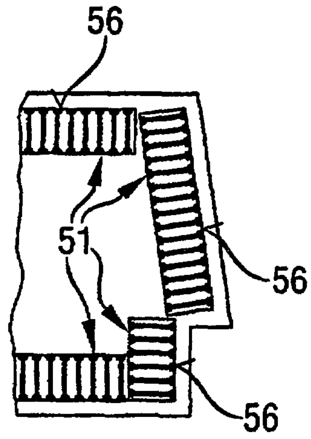


Fig. 13

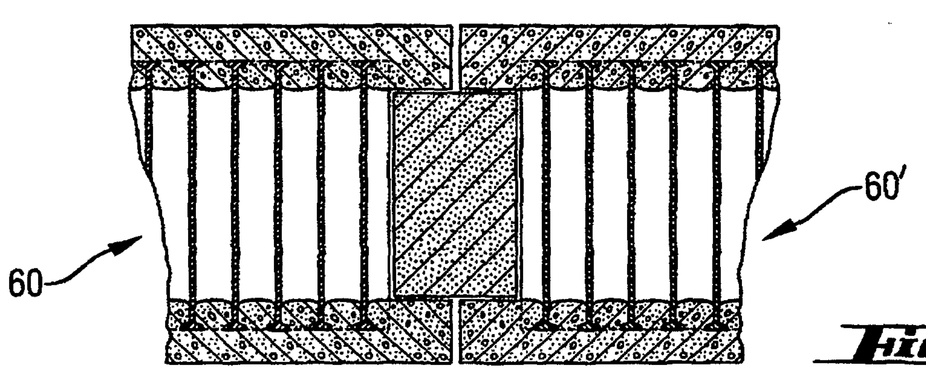


Fig. 14

Fig. 15