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(54) **AN ANCHORAGE FOR FLEXIBLE MOUNTING OF ELEMENTS OF NATURAL STONE AND SIMILAR MATERIALS ON VERTICAL WALLS**

VERANKERUNG ZUR FLEXIBLEN MONTAGE VON ELEMENTEN AUS NATURSTEIN ODER ÄHNLICHEN MATERIALEN AN VERTIKALEN WÄNDEN

ANCRAGE POUR LE MONTAGE FLEXIBLE D'ELEMENTS EN PIERRE NATURELLE OU EN MATERIAUX SIMILAIRES SUR DES PAROIS VERTICALES

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Description

[0001] The invention relates to an anchorage for flexible mounting of elements of natural stone and similar materials to vertical walls, said elements having a groove in their upper and lower horisontal side edges, respectively, and where the anchorage is provided with the connector means for fastening the anchorage to both the wall and the element, said adjacing part of connector means facing the wall has a flat portion which is provided with a fastening hole for abutment and mounting to the wall.

[0002] The use of natural stone in the form of massiv sawn plates about 20mm thick for covering and facades of buildings is increasing. Rather than supporting itself, the stone is supported by an underlying structure to which the stone elements are attached by means of anchorages. This brings with it challenges that increases the cost og using stone. Thus Lewis, ("Stone Anchorage Design. An installers Perspective", Dimensional Stone Magazine, April 1992) gives an extensive review of the conditions relating to securing of natural stone elements. He particularly points to that a natural local variation in properties of the stone requires specific knowledge concerning mounting in order not to exceed the strength of the stone under wind load and movement in the supporting structure. This is apt to happen if forces may be concentrated against the stone through the anchorages, and is one of several problems solved by the present invention. As a result, the mounting of stone no longer requires the same amount of expertice, and becomes simpler and less costly.

[0003] Various methods exist for fastening of dimensional stone to supporting structures. A number of ancorages are described in the patent litterature e.g in DE-A-3627583, which discloses an attachment system for fastening facade plates to a building structure, and in NO-A-92 0925, NO-A-127 158, NO-A-151 823, DK-A-122 137, DE-A-2 150 359, EP-A-288 326 and US-A-5 138 809. Known solutions with anchorages made from one piece result in time-consuming mounting due to exacting requirements for dimensional tolerances. Several solutions are known where the anchorage is made from two or more parts, and wherein one part may be adjusted relative to the rest to allow for wider tolerances. Such anchorages are naturally more costly to produce. One of the latter, US-A-5 138 809, has a slanting part that may appear similar to the present invention. The aim of US 5 138 809 is to mount stone elements closely together, with no openings between the elements. There is no accomodation of movement in the supporting structure, no flexibility in contact wth the stone, and no possibility for adjustment or replacement of stone in the final wall. The joint structure consists of three different parts (plus nuts and bolts), and it requires matching holes to be drilled in adjacent stone elements, with fairly close tolerances. All known anchorage solutions will concentrate forces against the stone with movements or deformations in the supporting structure.

[0004] The object of the present invention is to provide an anchorage for mounting whereby the above mentioned disanvantages are avoided.

[0005] This object is achieved with an anchorage for mounting of the type mentioned in the introduction, and characterized by the features and advantages disclosed by the appended claims.

[0006] By means of the invention an anchorage for mounting of such stone and similar materiales is obtained, to form facades or protective coverings over the underlying structure, making significant movement and setting in the underlying structure possible without damage to the stone, and reducing the transmission of sound energy, so that different patterns of stone may be created through one single type of anchorage. allowing the position of individual elements to be adjusted relative to each other during mounting and in the finished wall, and finally permitting the anchorage be produced in an integral piece of material.

[0007] Anchorages according to the invention may be used on any kind of support that provide secure holding of screws or bolts, and that will carry a load of at least 50 kg/m2 in the full height of the wall. The invention is primarily aimed at supports that "work" with changes in temperature or humidity, such as woodwork, allowing such supports to be given coverings of natural stone. The stone elements are furthermore made in standard sizes, and are relatively small and light (typically less than 0,15 m^2 and 10 kg pro element, cf fig. 4).

[0008] The present invention provides anchorages made from one piece of material, allowing for efficient production and for homogeneity of all parts that may be exposed to water and corrosion.

[0009] The anchorages simultaneously provide a number of functions:

1. Adjustment is possible in and out, up and down, and sideways, both during and after mounting, as in previously known solutions consisting of two or more parts (cf fig. 3).

2. Mounted stone elements are held out from the supporting structure, allowing for ventilation, for hiding of electrical installations and piping, and for transporting of water away from the supporting structure.

3. Mounted stone elements may be displaced with respect to each other, to allow for movement and settings in the supporting structure without forces being concentrated against the stone.

4. Horisontal movement (in/out) from wind forces are converted to vertical movement (up/down), resulting in nonlinear spring characteristics that counteract standing oscillation, and thus the possibility of metal fatigue and failure (cf. fig. 2).

5. Transfer of sound energy from stone elements to the supporting structure is minimized, further enhancing the good insulation properties of stone coverings against noise.

6. Individual elements in finished walls may be removed for replacement or for access to underlying structure or objects.

[0010] Stone elements are preferrably made to standard sizes (cf. fig. 4), and are held by the anchorages through grooves in their sides (cf fig. 1f). Grooves in all sides of the elements let a single type of anchorage hold elements in both standing and sidewise positions, making flexible patterns of stone possible (cf. fig 5). Anchorages may be made from any suitable material, but primarily from stainless steel, ensuring a full wallcovering construction with corrosion resistant materials, and without any organic matter that may detoriate.

[0011] The required properties in the anchorages are attained by forming them as springs in the form of sections pointing out and downwards from the supporting structure; each section either carrying an upper element. or holding a lower one in position. Fig. 1 shows a combination of two carrying and two holding sections, allowing for individual adjustment of four elements meeting in a corner (cf. fig. 5a). However, varying numbers of spring sections may be used.

[0012] Such relationship is assumed between width, thickness and stiffness that each section will carry its intended load with comfortable margin, yet may be formed (by hand or suitable tools) to ajust the position of stone elements as required. At the same time, elastic deformation accomodates movement in the supporting structure, avoiding concentration of forces against the stone.

[0013] It is the construction of anchorages as flexible springs with these properties that constitutes the essential improvement provided by the present invention.

[0014] Previously known solutions appear to have sought anchorages that are as rigid as possible, with the disanvantages that this imply in concentrating forces against the stone with movements in the supporting construction, and also for transmission of sound. The invention solves this problems and results in a simple design. This is the result of an extensive process of development, where a simple design suitable for efficient production has been one of the targets.

[0015] Dimensions of the anchorages will vary with constructions material. Weight of elements and dimensioning wind load. Dimensions as shown (cf. fig. 1) are typical of corrosion resistant steel, wind load of 1.3 KN/m^2, and elements with weight/size 7 kg/0.12 m^2 (cf. fig. 4).

[0016] The invention will now by illustrated in more detail by means of an embodiment wich is depicted in the drawings.

[0017] Fig. 1 shows the anchorage seen in a frontal and side view. A top lip (1a) is held by the screw/washer (1b) against the supporting structure, transferring (along with the screw/washer) forces from the anchorage to the support. The screw notch allows for vertical adjustment during mounting and later.

[0018] Below the screw, the anchorage is bent outward to form a slanting spring that holds the stone elements out from the supporting structure. Punched openings from below (1c) divide the spring into sections (four as shown in fig 1) that within limits may move with respect to each other. Their depth depends on plasticity and stiffness of anchorage material.

[0019] One type of spring section (1d) carries an upper stone element, and ends in an upward facing lip that grips the bottom groove of the stone element. The horisontal part supports the element, and the lip prevents its from slipping away. Another type of section (1e) has a lip pointing downward, holding the upper part of an underlying stone element to prevent it from falling out. An extension (1g) holds the element against the lip to prevent rattling and noise under wind load. Contact points between anchorage and stone are shown in fig 1f. An anchorage may have either one or both types of sections, and one or more sections of each type. As shown in fig. 1 the anchorage will carry two upper elements and hold two lower elements meeting in a corner (cf fig 5a). More anchorages may however be used pro element.

[0020] Fig. 2 shows how horizontal movement from wind forces (2a) acquires a vertical component (2c) from the carrying section(s) (2b), while the horizontal part of the holding spring section(s) will allow this vertical movement (2d). The result is a strongly nonlinear spring characteristic that counteracts standing oscillation and metal fatigue in the anchorage. This is an important detail, and is perhaps the reason why previous anchorage solutions have been made with high stiffness that will concentrate forces against the stone (cf paper by Lewis).

[0021] Fig. 3 shows the possibilities for adjustment by plastic bending of the anchorages. Deformation below the fastening to the support (3a), adjusts for uneveness in the supporting structure. Deformation (bending) of individual spring sections (3b) adjusts individual stone elements with respect to each other, and deformation of the protrusion of the holding spring sections (3c) adjusts for uneven thickness of individual elements (especially for slate). These adjustments in part make possible much higher tolerances in the manufacture of elements, and in parr allow for quicker mounting to finished walls. Fig. 4 shows design and dimensions for typical stone elements, and fig. 5 gives examples of how such elements may be mounted in a facade, illustrating the use of anchorages at large.

[0022] Beyond traditional facades, the invention has a wide range of applications. Thus, the inertness of materials encourages structures such as fences and noice deflection barriers, and with different coloured stone for

ornamental usage, and perhaps for trademarks and advertizing in lasting facades.

[0023] A number of patents relate to ceramic tiles (eg NO 151 823), which may be efficiently manufactured with grooves and mounted by the present anchorages. Applying electrically conductive layers to the rear side of stone elements or tiles would integrate electric heating in interior walls. Similarly transparent elements may be used for lighting, and elements in exterior walls may act as reflectors or solar panels. Heat resistant elements may be used for fire protection. Moisure tight films (eg PET-foil) between the anchorages and the supporting structure will provide water resistant walls for wet rooms.

Claims

1. An anchorage for flexible mounting of elements of natural stone and similar materials to vertical walls, said elements (fig. 4) having a groove in their upper and lower horisontal side edges, respectively, and where the anchorage (fig. 1) is formed as downward pointing spring members. and is provided with connector means for fastening the anchorage to both the wall and the element, said adjacing part of connector means facing the wall has a flat portion which is provided with a fastening hole for abutment and mounting to the wall, and said spring members are formed for positioning in the grooves of the element and for abutment against the side of the element facing the wall, characterized in that the second end of the connector means for establishing contact with the stone element is formed as an integral plate like piece of material which is divided in several, flexible, spring sections (1d,1e,1f), projecting downwardly individually from the end piece attached to the wall, thereby absorbing deformations in the supporting structure caused by setting or from variation of temperature and humidity, and that the spring section may be individually plastically deformed for adjusting the position of the stone elements by bending of the spring sections in and out (fig. 3), and down resp. up.

2. An anchorage according to claim 1, characterized in that the connection to the element is comprising at least one holding spring section (1e) with a part extending substantially vertical to the element allowing oscillation in the vertical direction. combined with at least one downward slanting, supporting spring section (1d) mainly allowing oscillation in a horisontal direction, to provide a total spring characteristic that counteract standing oscillations in the finished stone wall under wind load.

Patentansprüche

1. Verankerung zum flexiblen Anbringen von Elementen aus Naturstein und ähnlichen Materialien an vertikalen Wänden, wobei die Elemente (Fig. 4) jeweils eine Nut in ihren oberen und unteren horizontalen Seitenkanten aufweisen, und wobei die Verankerung (Fig. 1) in Form nach unten gerichteter Federelemente ausgebildet ist und mit einer Verbindungseinrichtung zum Befestigen der Verankerung sowohl an der Wand als auch dem Element versehen ist, der der Wand zugewandte angrenzende Teil der Verbindungseinrichtung einen flachen Abschnitt aufweist, der mit einem Befestigungsloch versehen ist, das an der Wand anliegt und der Anbringung daran dient, und die Federelemente so geformt sind, daß sie in den Nuten des Elementes positioniert werden und an der der Wand zugewandten Seite des Elementes anliegen, **dadurch gekennzeichnet**, daß
   das zweite Ende der Verbindungseinrichtung zur Herstellung von Kontakt mit dem Steinelement als integrales plattenartiges Teil aus Material ausgebildet ist, das in mehrere flexible Federabschnitte (1d, 1e, 1f) unterteilt ist, die einzeln von dem Endteil nach unten vorstehen, das an der Wand angebracht ist, um so Verformungen der Trägerstruktur zu dämpfen, die durch Setzen oder Änderung der Temperatur und der Feuchtigkeit bewirkt werden, und dadurch, daß der Federabschnitt einzeln plastisch verformt werden kann, um die Position der Steinelemente zu regulieren, indem die Federabschnitte nach innen und nach außen (Fig. 3) bzw. nach unten und nach oben gebogen werden.

2. Verankerung nach Anspruch 1, **dadurch gekennzeichnet**, daß die Verbindung mit dem Element wenigstens einen haltenden Federabschnitt (1e) mit einem Teil, der sich im wesentlichen vertikal zu dem Element erstreckt und Schwingung in der vertikalen Richtung ermöglicht, kombiniert mit einem nach unten abgeschrägten tragenden Federabschnitt (1d) umfaßt, der hauptsächlich Schwingung in einer horizontalen Richtung ermöglicht, um eine Gesamtfeder-Kennlinie zu erzeugen, die stehenden Schwingungen in der fertigen Steinwand unter Windbelastung entgegenwirkt.

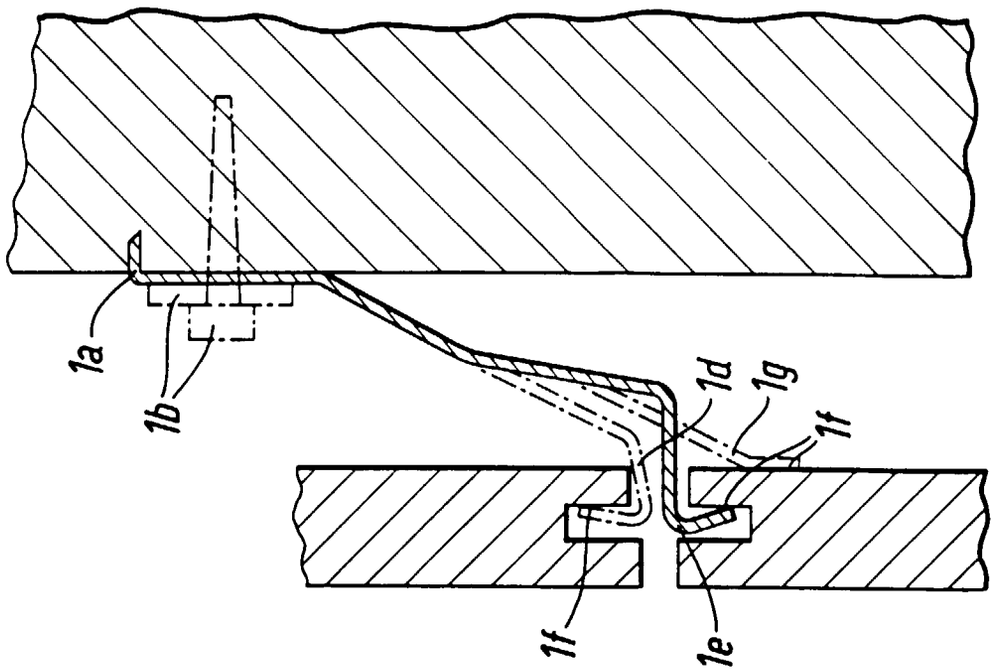
Revendications

1. Ancrage pour le montage flexible d'éléments en pierre naturelle et en matériaux similaires sur des parois verticales, lesdits éléments (figure 4) comportant respectivement une gorge dans leurs bords latéraux horizontaux supérieur et inférieur, et où l'ancrage (figure 1) est formé comme des éléments de ressort pointant vers le bas, et qui est muni de

moyens de connexion pour fixer l'ancrage à la fois à la paroi et à l'élément, ladite partie adjacente des moyens de connexion tournée vers la paroi possède une partie plate qui est munie d'un trou de fixation pour la mise en butée et le montage sur la paroi, et lesdits éléments de ressort sont formés pour être placés dans les gorges de l'élément et pour venir en butée contre le côté de l'élément tourné vers la paroi, caractérisé en ce que

la seconde extrémité des moyens de connexion pour établir un contact avec l'élément en pierre est formée comme une pièce semblable à une plaque de matériau d'un seul tenant qui est divisée en plusieurs sections de ressort, flexibles (1d, 1e, 1f), faisant saillie vers le bas individuellement depuis la piéce d'extrémité fixée à la paroi, absorbant ainsi les déformations dans la structure portante entraînées par la détermination ou à partir des variations de températures et d'humidité, et en ce que la section de ressort peut être déformée individuellement et de manière plastique pour ajuster la position des éléments en pierre en cintrant les sections de ressort à l'intérieur et à l'extérieur (figure 3), vers le bas et respectivement vers le bas.

2. Ancrage selon la revendication 1, caractérisé en ce que la connexion à l'élément comprend au moins une section de ressort de maintien (1e) avec une partie qui s'étend sensiblement à la verticale par rapport à l'élément, ce qui permet une oscillation dans la direction verticale, combinée avec au moins une inclinaison vers le bas, la section de ressort portante (1d) permettant principalement une oscillation dans la direction horizontale pour fournir une caractéristique de ressort totale qui compense les oscillations verticales dans la paroi en pierre finie sous la charge du vent.



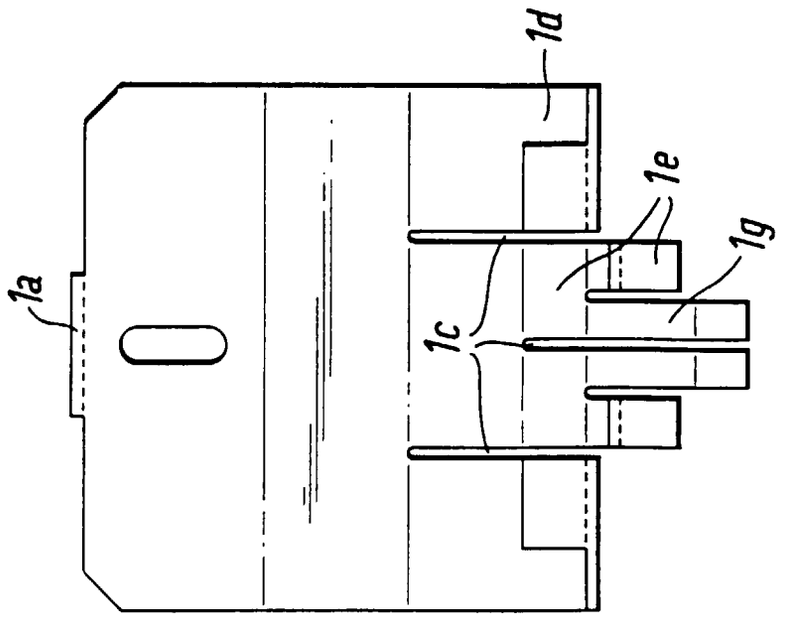


Fig. 1

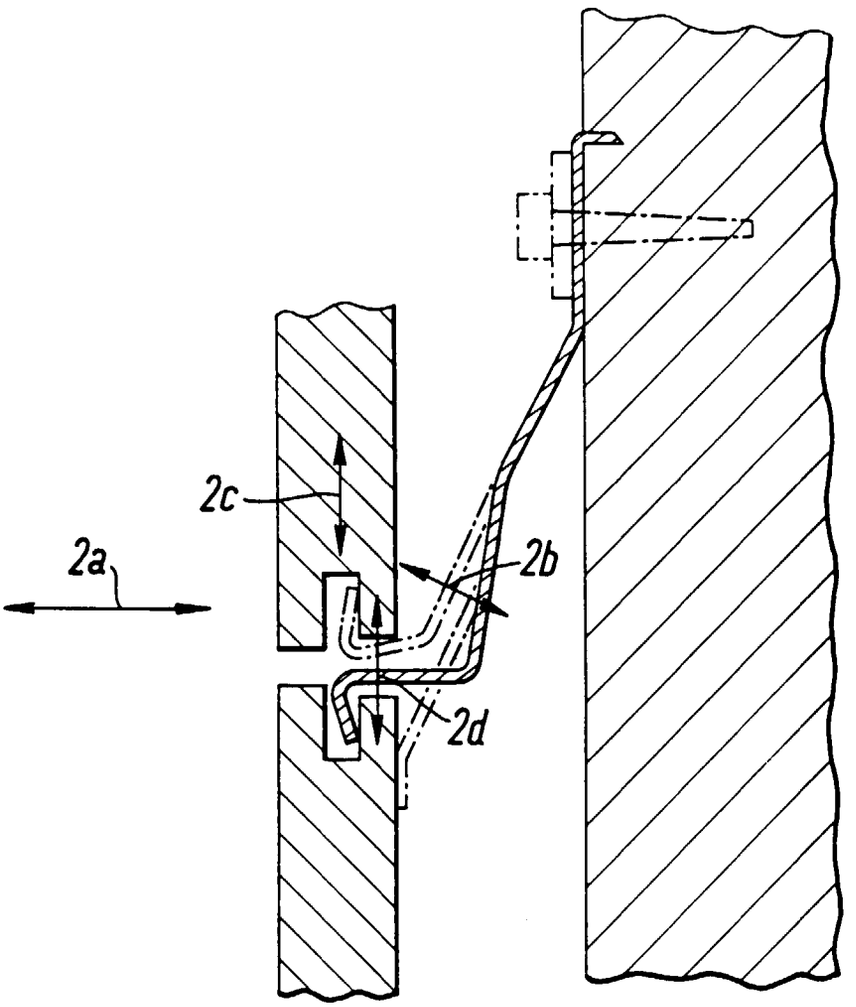


Fig. 2

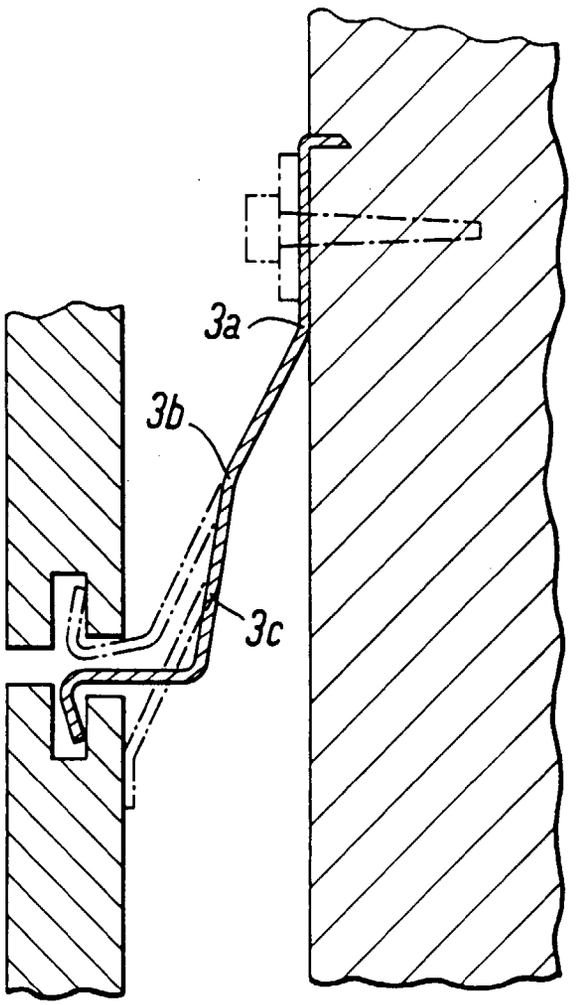


Fig. 3

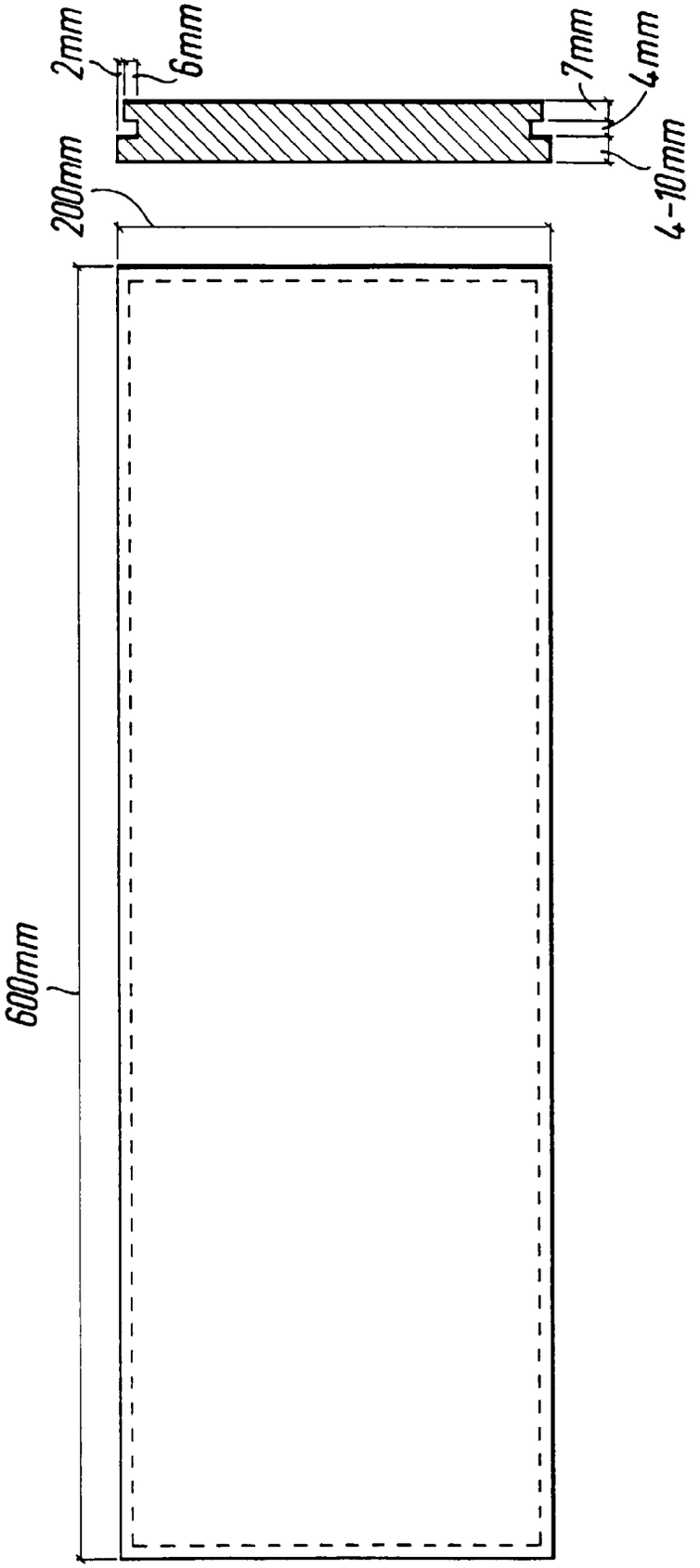
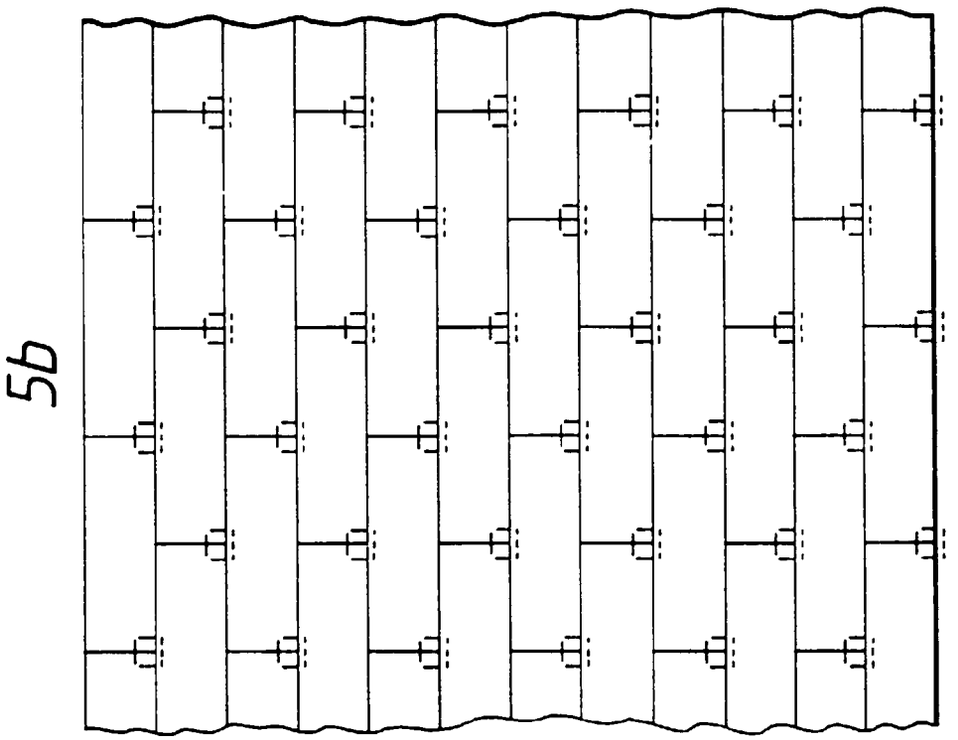


Fig. 4



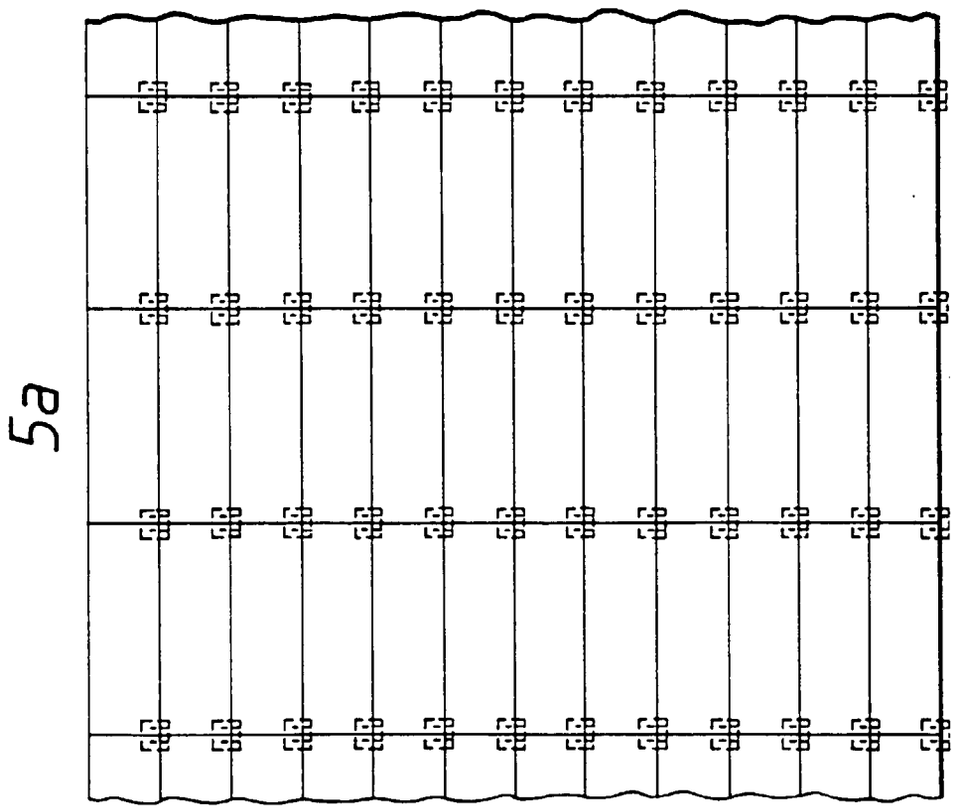


Fig. 5