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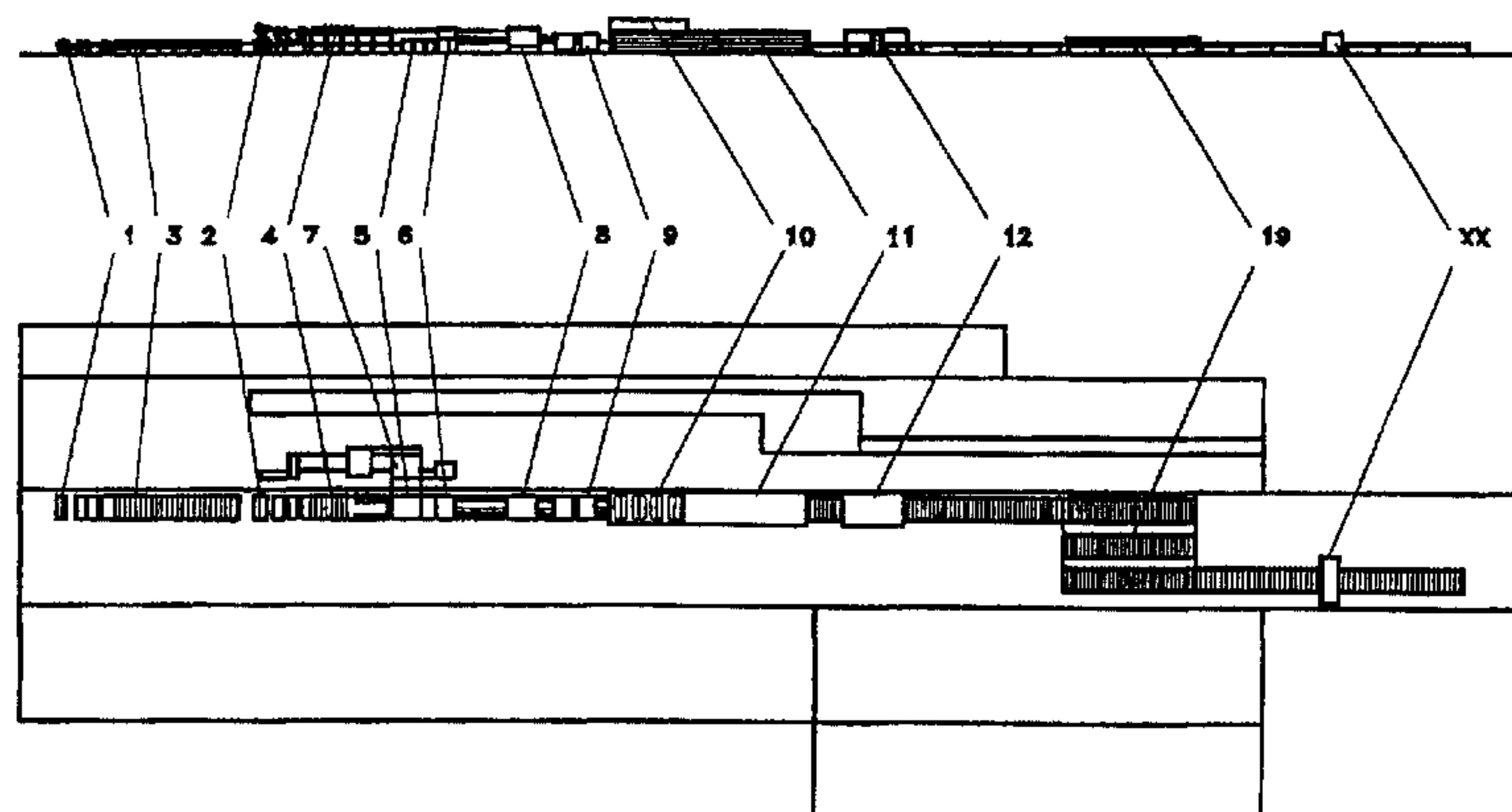
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(54) **PANNEAU LEGER ET PROCEDE ET APPAREIL**

**CORRESPONDANTS POUR FABRIQUER EN CONTINU DES
PANNEAUX LEGRS A CHARGE MINERALE**

(54) **LIGHT BUILDING PANEL, PROCESS, AND APPARATUS FOR
CONTINUOUS MANUFACTURING OF LIGHT BUILDING
PANELS WITH MINERAL FILLING**



(57) L'invention a pour objet un panneau léger ainsi qu'un procédé et un appareil correspondants pour fabriquer en continu des panneaux légers à charge minérale. Le panneau léger est rempli d'une charge minérale constituée de lamelles d'une substance minérale, en règle générale de laine minérale, qui sont disposées à l'instar d'un parquet et collées aux couches de protection inférieure et supérieure, constituées en règle générale d'une feuille de métal. Le procédé de fabrication dudit panneau comprend plusieurs stades: on commence par préparer une feuille de métal et une bande de charge minérale, puis on assemble le panneau dans un dispositif à bande double et l'on termine par découper la bande en des panneaux séparés. L'appareil pour fabriquer ce panneau se présente comment un dispositif permettant de mettre en oeuvre ledit procédé de fabrication de panneaux légers.

(57) Subject of this invention is light building panel, process, and apparatus for continuous manufacturing of light building panels with mineral filling. The light building panel comprises the mineral filling made of lamellas of mineral filling, usually mineral wool, set out in parquet-like appearance and glued to upper and lower shielding layer usually made of sheet of metal. The process for its manufacturing comprises several phases starting with sheet of metal and band of mineral filling preparation, and continuing with assembly of the panel in a double band device to be concluded by cutting the band into individual panels. The apparatus for manufacturing of the panel is a device for performing the process of the light building panel manufacturing.

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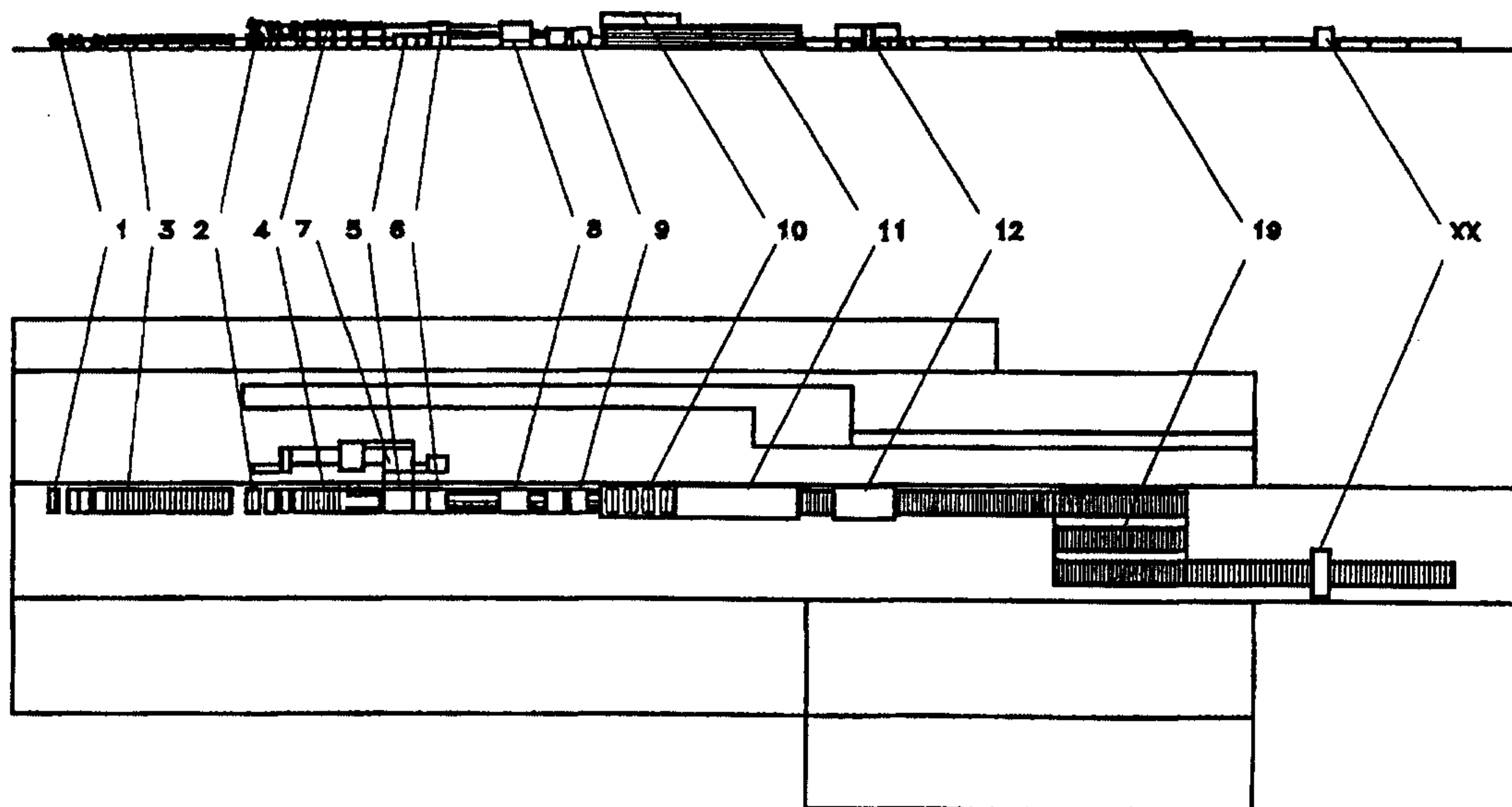
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(54) Title: LIGHT BUILDING PANEL, PROCESS, AND APPARATUS FOR CONTINUOUS MANUFACTURING OF LIGHT
BUILDING PANELS WITH MINERAL FILLING

(57) Abstract

Subject of this invention is light building panel, process, and apparatus for continuous manufacturing of light building panels with mineral filling. The light building panel comprises the mineral filling made of lamellas of mineral filling, usually mineral wool, set out in parquet-like appearance and glued to upper and lower shielding layer usually made of sheet of metal. The process for its manufacturing comprises several phases starting with sheet of metal and band of mineral filling preparation, and continuing with assembly of the panel in a double band device to be concluded by cutting the band into individual panels. The apparatus for manufacturing of the panel is a device for performing the process of the light building panel manufacturing.

LIGHT BUILDING PANEL, PROCESS, AND APPARATUS FOR CONTINUOUS MANUFACTURING OF LIGHT BUILDING PANELS WITH MINERAL FILLING

Technical field

Light building panels; continuous process; production line; technology of fastening; integral production of building panels.

Technical problem to be solved

Technical problem solved by this invention is:

- tedious changing of thin colored or colorless layers of different materials during manufacturing of fireproof light building panels causing multiple delays;
- profiles of building panels which do not enable manufacturing of said panels with thin layers of adhesives and hence lack of their fireproof ability, said panels manufactured with a filling or plurality thereof in one or multiple layered shell of colored or colorless layers;
- how to conduct change of tools and inlet materials without stopping the production line in the process of fireproof light building panels manufacturing;
- problems arising from classically built systems of fireproof light building elements;
- light building panels with inferior mechanical characteristics in view of their capability to withstand walking on them e.g. on roofs which are built using said panels;
- inferior cutting of filling lamellas of light building panels which does not permit thin layers of adhesives;

- impurities, in particular due to crushing of the fibers or lumps of fiber on the surface of light building panels fillings which prevent effective fusion of intact fibers of filling among themselves or between fillings with shell wall or plurality thereof;
- thickness and number of lamellas in existing systems for continuous production of fireproof light building panels do not allow production of several modular widths;
- existing systems of lamella sorting do not allow for automatic compensation of lamellas' lack of alignment due to existing fillings' tolerances;
- current systems require cutting and milling of side edge in singular phases causing existence of multiple sets of tools for different thicknesses;
- loss of heat due to imprecise alignment of two adjacent light building panels during their mounting;
- existing systems foresee guiding of lamellas using sliding guides causing delay of flank lamellas due to friction and subsequently loss of heat in finished products;
- existing calibrating systems of light building panels were developed for fillings of polyurethane hence their requirement for different side chains or spacers for each thickness;
- manual packing of finished products;
- cyclic regulation and synchronization of individual elements of apparatus;
- non uniform thickness of adhesive layers on the surface.

State of the art

Users of light building panels, i.e. the panels used in building to achieve thermal and hydro insulation or in function of separating walls, are well aware of solutions using polyurethane filling. However, due to request for fireproof ability these panels were replaced with those

using different kind of fillings, e.g. mineral wool. For the purposes of this application expressions mineral filling, mineral wool, rock wool, glass wool are to be used as describing the same material, known to the one skilled in the art of insulation. In addition, the users require of different fillings (e.g. mineral wool) additional benefits such as better ability to withstand fire, soundproof ability, ecological advantages during manufacturing, recyclability of built-in materials etc. depending on trends and regulations. The fillings which fulfill the above requirements are positioned within the shell, more precisely, between both outer layers of building panels in different ways, known to those skilled in the art. For example:

(a) sandwich design on the final destination - on facades by assembling sheets of metal which are profiled according to requests of the mode of assembly, spacers, mineral wool panels, profiled cover of thin profiled sheets of metal; on horizontal or up to 6° tilted roofs, however, this design comprises deep profiled sheets of metal, vapor barrier made of impermeable materials, panels of rigid mineral wool and final layer of flexible bands (e.g. bitumen, thin sheets of metal or of plastics); well known example of this type is so called Hoesch system.

(b) sandwich design away from the final destination - by assembling previously profiled sheets of metal and mineral wool using manual or semi-automatic processes for attaching using adhesives in moulds which is rather simple and discontinuous process, e.g. so called Paroc system described in SI 9110235 A; the characteristic of this process is staircase like scatter, lamellas which are glued together, cutting of preformed filling to desired length, coating of sheets of metal with adhesives and discontinuous pressing of sheets of metal coated

with adhesive onto the filling.

(c) sandwich design away from the final destination using continuous process comprised of cutting of mineral wool into lamellas, orientation of wool fiber perpendicularly to profiled sheets of metal (widely used and known from the reference buildings of the applicant and shown to the public on several fairs); well known continuous process is characterized mainly by side guiding using slide linear guides which causes scattering (lack of alignment) of flank lamellas and subsequent increased heat loss in finished products; the product manufactured using this system can be recognized due to its parquet-like appearance whereby the current technology does not foresee adjustments of possible scatter due to inaccuracy or system error of the process;

(d) manufacturing of suitably designed panels of mineral wool at mineral wool manufacturers which would enable assembly of sandwich design away from final destination without cutting; Rockwool corporation experiments are known.

Description of the invention

Subject of this invention is Light Building Panel, Process, and Apparatus for Continuous Manufacturing of Light Building Panels with Mineral Filling and solves the above described technical problem as shown below.

Fireproof light building panels, the subject of this invention, comprise at least three layers: upper of sheet of metal, central (middle) of filling which is mostly of mineral wool, and

lower of sheet of metal. Both upper and lower layers can be profiled. Both outer (i.e. upper and lower) layers can be attached to the middle in permanent fashion, e.g. with use of appropriate adhesives.

Light building panes, the subject of this invention, comprise at least three layers: two outer layers, i.e. upper, and lower of which at least one is made of sheet of metal, and the other either of sheet of metal or of other kind of material (e.g. bitumen band, paper, aluminum, plastic, etc.), and of middle layer of filling, preferably mineral wool. Both lower and upper layer can be profiled.

The profile of either one of the outer layers profile comprises at least of side edge which is made by bending the material of the outer layer, said side edge limiting transversal (i.e. perpendicular to the direction of production of said panel) movement of the filling and provides said panel with strength.

The upper outer layer made of materials described above performs a function of upper shielding and/or forming means whereas the lower outer layer made of materials described above performs a function of lower shielding and/or formative means. For the purposes of this application the expressions upper outer layer and/or upper layer and/or upper sheet of metal refer to upper outer shielding and/or formative means whereas the expressions lower outer layer and/or lower layer and/or lower sheet of metal refer to lower outer shielding and/or formative means.

Manufacturers deliver thin colored sheets of metal, preferably steel or aluminum which may be coated with plastic layer coiled in rolls. Using decoiling drums the sheet of metal is straightened and is through the compensation loops known in the state of the art, shears for cutting, and rollers guided to the tools for profiling which are set within so called grooving machines. The word decoil in this application means to straighten that which was previously coiled.

The profile of the particular product manufactured in grooving machines depends on several factors, in particular on efficient use of material, appropriate design to customer's liking, and manufacturing of panes of sufficient quality. Depending on these factors one determines the size of rollers and the ratio between the use of material and strength of the finished product (panel) taking into account mechanical characteristics (e.g. elastic modulus) of the material.

The tools for profiling are set within the grooving machines using particular profiling pairs of tools or using cassettes characterized in that several profiling pairs of tools are positioned on particular platform ('cassette') which enables fast and simple change of the tools for profiling.

The change of materials during manufacturing is achieved using double decoiling drums, decoiling drum with double spindle, or double carriage and single decoiling drum, all of these solutions known to one skilled in the art of manufacturing light building panels with polyurethane filling. The control of inflow of material must be capable of accelerating new material to compensate for time lost changing said material.

The new solution to the technical problem of changing thin colored or colorless layers from different material in the process of manufacturing of fireproof light building panels while keeping the interruption of production to minimum is seen in combination of technology enabling fast change of tools and materials, described below in preferred embodiment.

The new solution of profile manufacturing of panels comprised of one or plurality of fillings in one or multiple shells from color or colorless layers of various materials in the process of manufacturing of fireproof light building panels solving the problem of thin coating of shell with adhesive (which is of utmost importance to fireproof ability of the panels) is characterized in a definition of profiles. The profiles in question should be either trapezoidal or linear or combination thereof.

The new solution pertaining to fireproof ability of the panels is demonstrated by using fillings of particular mineral wool with density at least 115 kg/m^3 . In particular, the mineral wool fillings of density between 115 kg/m^3 and 135 kg/m^3 is used for fireproof light building panels with appropriate mechanical characteristics (e.g. load capacity, pressure strength), and the mineral wool fillings of density between 135 kg/m^3 and 165 kg/m^3 used for light building panels for walkable flat roofs which should without permanent deformation withstand usual loading during exploitation and local pressure applications (walkability).

With the new technical solution fireproof light building panels of length ranging between 2000 mm and 14000 mm is foreseen, and thickness ranging from 60 mm to 200 mm. These thicknesses can be achieved using presented method and apparatus whereby the mineral wool

panels supplied in lengths of up to 1200 mm can be used. At the same time the apparatus can be adjusted to manufacture final panels of widths between 800 mm and 1200 mm based on thickness of supplied mineral wool panels ranging between 70 and 76 mm, and assuming even number of lamellas. For example, 14 lamellas of thickness of 72 mm provides for 1000 mm width of finished fireproof light building panel.

The supplied mineral wool panels must be cut into lamellas, and then lamellas joined in parquet-like system prior to light building panel assembly, this already known in the state of the art, in particular in buildings equipped by the applicant. This process comprises of cutting of panels of mineral wool into lamellas, turning these lamellas for 90°, forming sets of lamellas and rearranging lamellas within its set to parquet-like assembly. A longitudinal and side forces are applied to this parquet-like assembly to form continuous band of lamellas used in further manufacturing of light building panels.

Due to inaccuracies occurring during cutting of lamellas or due to nature of material of the lamellas irregularities in parquet-like arrangement may occur, particularly, the shift of a lamella or plurality thereof may occur resulting in change of overlap of adjacent lamellas. These are overcome by instituting a feedback loop for inserting a corrective lamella which is of appropriate length so by its insertion the parquet-like arrangement is restored.

This novel solution also provides for such quality of cut during production of lamellas that thin layer of adhesive can be applied to mineral filling in the process of its attachment to the other layers.

In addition, such system for milling and trimming (cutting) of mineral filling is foreseen to provide for milling and trimming of each edge of the band of lamellas in a single phase and using same set of tools regardless of the thickness of the band of lamellas.

To remove the remnants of cutting and milling, and to remove impurities of other sources prior to final assembly of the product the surfaces of the band of lamellas are cleaned using a suction system. Following that, a thin coat (layer) of adhesive is applied to appropriate band of lamellas surfaces in order to attach it to the outer layers in the assembly process. Both the characteristics of the adhesive and its application are important to achieve fireproof ability (within meaning of this word for the one skilled in the art of manufacturing light building panels). The adhesive should be applied uniformly in film or droplet form, or by spraying it over most of the band of lamellas.

The band of lamellas should be properly introduced between both outer layers. In this novel approach, introduction of said band of lamellas from the side is used. Then, the outer layers and the mineral filling are assembled in a double band device, however, prior to assembly the band of lamellas must be aligned as the previous process may have compromised the alignment of adjacent lamellas.

Within the double band device the outer layers and the mineral filling are assembled into a continuous light building panel band to be cut into light building panels of appropriate length upon exiting from the double band device. If appropriate, an eaves is manufactured. Then, the light building panels are inspected, and loaded for transport using novel loading process.

The process, subject of this invention, can be controlled by microprocessor, built into or connected to the control panel.

The subject of this invention is further described with help of embodiments presented below and by accompanying drawings whereby the drawings are part of this application and represent:

Fig. 1. shows the layout of an apparatus with decoiling drum for an upper layer (1), decoiling drum for a lower layer (2), a grooving machine for lower layer (3), a grooving machine for upper layer (3), a device for inserting ribs of mineral filling (5), mineral filling cutter (6), a device for sorting and inserting of mineral filling (7), a preheating chamber (8), adhesive application device (9), decoiler of flexible material band (10), a double band device (11), a bandsaw (12), an upper side chain (13), a lower side chain (16), a system for unloading (19), a packaging device (20).

Fig. 2 shows a roof building panel profile with an upper sheet of metal (21), a mineral filling (22), a lower sheet of metal (23), an adhesive layer (29).

Fig. 3 shows two interconnecting roof building panel profiles before and during interconnection with the upper sheet of metal (21), the mineral filling (22), the lower sheet of metal (23), the adhesive layer (29).

Fig. 4 shows a facade building panel profile with the upper sheet of metal (21), the mineral

filling (22), a lower sheet of metal (24), the adhesive layer (29).

Fig. 5 shows two interconnecting facade building panel profiles before and during interconnection with the upper sheet of metal (21), the mineral filling (22), the lower sheet of metal (23), the adhesive layer (29).

Fig. 6 shows details of the lower sheet of metal (23) of roof panel.

Fig. 7 shows details of the upper sheet (21) of roof and/or facade panel.

Fig. 8 shows a wavy roof building panel profile with the mineral filling (22), a lower sheet of metal (25), the adhesive layer (29).

Fig. 9 shows two interconnecting wavy roof building panel profiles with the mineral filling (22), the lower sheet of metal (25).

Fig. 10 shows sealing of the facade building panel using sealing band (30).

Fig. 11 shows sealing of the roof building panel using sealing band (30).

Fig. 12 shows two embodiments of cutting of mineral filling panels of width L and L_1 into lamellas of width h_6 and h_2 whereby plurality of lamellas (26), a set of circular saws (33), the mineral filling panels (81) are shown.

Fig. 13 shows the mineral filling panel (81) sliding on a feeder (32) toward set of n circular saws (33) and a panel comprising lamellas (26) from surface of which a suction head (39) removes particles, lumps and/or dust of mineral fibers.

Fig. 14 shows an accumulation station with the set of circular saws (33) and the accumulation station (82).

Fig. 15 shows change of lamellas direction in a direction changing station (83).

Fig. 16 shows separating into individual lamellas (26) or groups thereof with a sorting feeder (84) and turning of lamellas (26) for essentially right angle around the center using a turning table (85).

Fig. 17 shows a rearranging device (87) with even (26a), and odd (26b) lamellas, a set of lamellas (86), a side guiding belt (88), band of lamellas (89), a transverse roller (90).

Fig. 18 shows a panel comprised of lamellas (26) of mineral filling as a part of band of lamellas, shifted for an overlap in longitudinal direction for even (26a) and odd (26b) lamellas.

Fig. 19 shows a panel comprised of lamellas (26) and corrective lamellas (28) as a part of band of lamellas including even (16a) and odd (16b) lamellas.

Fig. 20 shows a panel of mineral filling (36) as a part of band of lamellas sliding on a feeder toward circular saws (35) for trimming (cutting) and milling tools (37) for milling of edges of a mineral filling panel (36) as a part of the band of lamellas and suction head (39) for removing parts, particles, and/or lumps of mineral fiber.

Fig. 21 shows mineral filling for roof (22a) panel or facade (22b) panel with milled off edges (38) for better conforming to the sheet of metal.

Fig. 22 shows entering of the band of lamellas into the double band device (11), the side guiding belt (88), the band of lamellas (89), the transverse roller (90), freely rotatable side roller guides (92) which shape conform to the shape of the edge of the band of lamellas (89).

Fig. 23 shows layout of connection between the preheating chamber (8), the adhesive application device (9), and the double band device (11).

Fig. 24 shows an application of adhesive coating onto the lower surface of the band of lamellas (89) using lower mixing head (41).

Fig. 25 shows an application of adhesive coating onto the upper surface of the band of lamellas (89) using upper mixing head (41) and lower mixing head (42) whereby the upper outer layer (21), the lower outer layer (23, 24), a radius of double bending R and uncontrolled horizontal shift d are shown.

Fig. 26 shows cross section across the double band device (11) with upper chain links of side chain (13, 14), and lower chain links of side chain (16, 17) whereby the upper layer (21), the band of the lamellas (89), and the lower layer (23, 24) are shown.

Fig. 27 shows a system for attachment of a flexible material band (45) decoiling from decoiling drum for flexible material (44) and travelling through a system for preheating of bands of flexible material (46) (a.k.a. heating, detachable chamber (46)) with a system for cooled air or gas suction (47) to be regenerated whereby the band of lamellas (89), the upper mixing head (41), the double band device (41) are shown.

Fig. 28 shows loading (padding) of the panels (finished products) whereby the pads (51), L_{SVB} a net distance between the pads (51), L_{pak} a length of the panels including predetermined tolerance of loading of at least two light building panels, L_{pod} a pad (51) length, N a number of pads (51) in the package, T_{pak} a distance of an edge of the pad from an edge of the panel are shown.

For straightening of the sheet of metal the decoiling drums of at least 2,000 kg capacity should be used enabling use of the sheet of metal up to 1.50 m in width and with roll diameter up to 1.5m.

The sheet of metal to be profiled is profiled in grooving machine, i.e. the upper sheet of metal in upper grooving machine (4), and the lower sheet of metal in lower grooving machine (3).

The thickness of materials to be profiled in the upper grooving machine (4) ranges:

- colored steel sheet of metal 0.4 to 0.9 mm;
- plastic coated steel sheet of metal 0.4 to 0.8 mm;
- colored or colorless aluminum sheet of metal 0.5 to 0.9 mm;
- stainless steel 0.4 to 0.8 mm;
- surface treated steel 0.3 to 0.7 mm;
- copper sheet of metal 0.4 to 0.9 mm.

The thickness of materials to be profiled in the lower grooving machine (3) ranges, in the first preferred embodiment:

- colored steel sheet of metal 0.5 to 1.1 mm;
- plastic coated steel sheet of metal 0.5 to 0.9 mm;
- colored or colorless aluminum sheet of metal 0.5 to 1.1 mm;
- stainless steel 0.4 to 0.8 mm;
- surface treated steel 0.3 to 0.7 mm;
- copper sheet of metal 0.4 to 0.9 mm

The thickness of materials to be profiled in the lower grooving machine (3) ranges, in the second preferred embodiment:

- colored steel sheet of metal 0.4 to 1.35 mm
- plastic coated steel sheet of metal 0.4 to 0.8 mm;
- colored or colorless aluminum sheet of metal 0.5 to 1.35 mm;
- stainless steel 0.4 to 0.8 mm;

- surface treated steel 0.3 to 0.7 mm;
- copper sheet of metal 0.4 to 0.9 mm.

The combination of technology enabling fast change of tools and material while keeping the interruption of process to minimum is seen in the following combination of technology: one decoiler of the upper layer (2), and one decoiler of the lower layer (1) using double carriage which enables change of sheets of metal during production at lower speed. The tools are positioned on cassettes which can be changed simply and fast. The facade panel cassette, for example, comprises two tools and enables the change between two different pre-chosen profiles of facade panels without interruption and further change.

To permit the coating of the shell, be it either from one or multiple layers, with thin layer of adhesive (which is of utmost importance to fireproof ability of the panel), the profiles should be either trapezoidal, or linear, or combination thereof. In the preferred embodiment for manufacturing the panel used for roofing, in the way of example the applicant presents a panel comprising upper (21) and lower (23) sheet of metal and the mineral filling (22), all elements connected between themselves using layer of adhesive (29). Said panel features lower ribs or protrusions in periodic distances between themselves ranging from 200 to 300 mm and particular endings. These features, and two adjacent interconnecting profiles are seen in accompanying Figures 2, 3, 6, 7, 10. Further the applicant presents the preferred embodiment used for facades, in the way of example, a panel comprising the upper (21) and a lower (24) sheet of metal and the mineral filling (21). The novel solution of saving and optimization of the production due to (a) symmetry of the profiles of the upper and the lower

layers, and (b) equality between the upper profiles of both roofing and facade panels is seen in Figures 4, 5, 7, 11. Further the applicant presents the novel solution of wavy roofing panel comprising the filling (22) of either polyurethane or combination of polyurethane and mineral filling, and a lower sheet of metal (25), which can be seen in Figures 8, 9. The latter embodiment features combination of materials by alternately positioned materials one on the other. Accompanying drawings show a manner of interconnecting of two adjacent profiles in the way of partial overlapping. The drawings also show protrusions which add to the strength of the panels and endings which provide means for interconnecting between adjacent panels should there be no protrusions as the panels featuring protrusions should be interconnected by partial overlapping. In addition, the profiles (sheets of metal) of different material are attached to the mineral filling by applying thin layer of adhesive (29). As stated above, the technical details of these profiles are shown in Figures 2 through 9 and are hereby incorporated into the description as their description using the words would be too complicated. As mineral filling (22) the applicant in the way of example a band of lamellas (89) cut in appropriate length is foreseen, both expressions (mineral filling and the band of lamellas) describing the same arrangement for the purposes of this application.

The protrusions and/or ribs (23), referred to in the previous paragraph, are of trapezoidal cross section with width of narrower of both base sides ranging between 20 and 30 mm, inner trapezoidal angle ranging between 23° and 33° and height ranging between 33 and 40 mm, whereby the values at which particular savings were achieved are width of narrower of both sides of 25 mm, inner trapezoid angle of 25° , and height of 37 mm, all of which originates from 1250 mm total width of outside layer. Therein, the inner trapezoidal angle

is defined as angle formed by either one of the sides of the trapezoid and the line perpendicular to both base sides of the trapezoid.

Further, in the preferred embodiment the applicant suggests use of vapor barrier between two adjacent panels in their lower junction, said barrier achieved using appropriate sealing band (e.g. O ring) (30) using standard materials. For less demanding applications this can superseded by overlapping of sheets of metal and wool layer in the junction.

The panels are manufactured using process in which the mineral filling is preprocessed and attached to the outer layers. The mineral filling is in preferred embodiment supplied in form of panels of filling (81) of width L and length $\check{S}$, whereby the filling is mineral wool. The panels (81) are cut into lamellas (26) using herewith described technology. The lamellas (26) are assembled into sets (86) comprising of plurality of adjacent lamellas, said lamellas adjoined along their longer sides. These sets of lamellas (86) are then rearranged in the parquet-like fashion and then connected into continuous body of parquet-like arranged lamellas (89), henceforth denoted band of lamellas (89).

Said panels (81) are first cut into lamellas (26) using set of at least two circular saws (33) so that lamellas of appropriate length, width, and thickness are obtained at the exit. In the way of example, for light building panel of width 1000 mm and thickness of 500 mm the set comprised of 9 circular saws (33) is used to manufacture lamellas which are 600 mm long, 150 mm wide and 72 mm thick. Then, the groups of lamellas are accelerated to accumulation station (82) and then to the direction changing station (83). The latter changes the direction

of lamellas movement from lengthwise to widthwise and facilitates the lamellas to move toward sorting feeder (84) which separates groups of lamellas in individual lamellas and feeds them synchronously onto a turning table (85) in such a fashion that each chamber of said turning table (85) is populated by one lamella (26). A transport of lamellas toward sorting feeder (84) is achieved by means of conveyer belt whose velocity is higher than accommodating velocity of sorting feeder (84) thereby achieving contact between the lamellas (26) in the direction of their movement. Actual number of lamellas which are used to form sets of lamellas from the turning table (85) depends on modular size of finished product. In the way of example for modulus of 1000 mm number of lamellas is 14 provided that the panel (81) thickness is 72 mm.

A group comprised of at least two lamellas (26) continuing their way from the turning table (85) is called a set of lamellas (86). This set is characterized in that lamellas are separated by means of separators such as guide tubes or similar and are moving along the length of the lamellas with similar velocity whereby the lamellas are essentially aligned in direction perpendicular to the direction of their movement (i.e. sidelong). The set of lamellas (a.k.a. lamella set) (86) is transported to the rearranging device (87) used only for start-up of the operation. Said rearranging device provides for rearrangement of the lamellas to form parquet-like appearance and is not needed following the start-up of the operation as lamellas are lengthwise connected thereby achieving rearrangement. Rearranging device is positioned at the end of separators, and after the rearranging device lamellas are no longer separated but connected at the sides. Using at least one side guiding belt (88) the side force is exerted on the lamellas (86) hence transforming separate sets of lamellas (86) into continuous band

of lamellas (89) characterized by its parquet-like appearance when observed from above. In the way of example, if lamellas are 600 mm long, the ideal rearrangement would consist of alternately shifted lamellas which partially overlap, said overlap of approximately 300 mm, i.e. for half of lamella's length. Said continuous band of lamellas (89) should be aligned in vertical direction by means of the transverse roller (90) positioned perpendicularly to the direction of the band of lamellas (89) movement. Said side guiding belt (88) is driven by means of an engine or an electromotor whereby its velocity is higher of that of band of lamellas (89) thereby ensuring lengthwise attachment between lamellas and protecting the parquet-like formation from disarranging. The velocity of the side guiding belt (88) exceeds that of the band of lamellas for 3% to 20%.

Due to inaccuracies occurring during the process the of lamellas (26) or due to nature of material of the lamellas irregularities in parquet-like arrangement may occur, particularly, the shift of a lamella or plurality thereof may occur resulting in change of overlap of adjacent lamellas. This novel solution provides for feedback loop to insert a corrective lamella (28) of different length when compared to the lamella (26). This insertion restores previously described overlap if the shift of the lamellas (26) exceeds that which is tolerated due to prescribed tolerances. In the way of example, if the lamella (26) length is 600 mm and required overlap approximately 300 mm, and further if the tolerance of the scatter is 100 mm then the overlap between adjacent lamellas (26) should not exceed 400 mm and be at least 200 mm. The overlap between adjacent lamellas changes due to mechanical characteristics of the filling and technological properties of the process (e.g. inaccurate cutting etc.). If in the way of example described overlap exceeds the tolerance, e.g. if the overlap exceeds 400

mm or is less than 200 mm then the invented process requires that the corrective lamella (28) or plurality thereof is inserted between two lengthwise adjacent lamellas, e.g. 100 mm long corrective lamella (28) so the overlap in the range 200mm to 400mm is restored. It should be stressed that these numerical examples only illustrate the inventive idea and should not be taken as limiting the use of invented technology. The applicant suggests that the length of the lamellas (26) should range between 300 mm and 1000 mm, and the length of the corrective lamellas should range between 50 mm to 300 mm.. The actual overlap is measured using optical probes. As a reference, a position of the lamella (26) in any arbitrary column of lamellas may be used. In the preferred embodiment, the lamella (26) position at the edge of the band of lamellas (89) is used.

Further, such quality of a cut while cutting the filling in a mineral filling cutter (6) is achieved that thin layer of adhesive can be successfully applied, said thin layer of importance to provide for fireproof ability of the finished product. A tolerance of the cut of ± 0.3 mm is suggested. In the preferred embodiment, the supplied mineral filling panel (81) of width L slides over a feeder (32) toward the set of n circular saws (33) whereby n is equal or greater than 2. The set of circular saws (33) provides for simultaneous cutting of said mineral filling panel (81) into lamellas (26) of width $L/(n+1)$.

The preferred embodiment also features novel system of milling and trimming (cutting) of the mineral filling using circular saws. The cutting is necessary to provide for appropriate width of the light building panel, and milling for good contact between side lamella and the outer layer of the light building panel. At least one circular saw (35), and usually at least two

circular saws (35) attached onto the same axle (coaxially) and width of the light building panel apart trims (cuts) edges of the band of lamellas (89) to the modular width (i.e. the width corresponding to particular size = modulus of the light building panel). The band of lamellas (89) thickness usually ranges between 60 to 200 mm. In addition, the saw (35) or plurality thereof breaks the cut-off (trimmed-off) edges of the band of lamellas (89) into pieces which are then removed by means of suction system described below. Thereby the normal of the plane of the circular saw (35) lies essentially perpendicular to the normal of the upper surface of the band of lamellas (89), however, other angles depending on the requirements of the final customer may be formed. The projection of the circular saw (35) plane onto the upper surface of the band of lamellas (89) plane lies is essentially parallel to the direction of the band of lamellas (89) movement. This solution addresses the technical problem of trimming requiring multiple sets of tools adjusted to different lamella sizes (thicknesses). Following the trimming, the band of lamellas (89) is transported to at least one milling station to have its edge or plurality thereof milled by at least one milling tool (37), usually in the case of facade light building panels at least two milling tools (37) on one (e.g. left) side and at least two milling tools (37) on another (e.g. right) side, and usually in the case of roof light building panels at least one milling tool (37) on one (e.g. left) side and at least one milling tool (37) on another (e.g. right) side. The milling tool (37) thereby forms appropriate profile (38) of the light building panel's edge in order to achieve proper connection between two adjacent light building panels during the mounting phase. As signified above, by using only four milling tools (mills) and/or milling tool forms (left and right milling tool for roof panels, left and right milling tool for facade panels) the whole spectrum of different dimensions for each type of roof or facade panels are covered.

The preferred embodiment of herein described process and apparatus provides of the cleaning of lumps or particles from the surfaces of the band of lamellas (89) following the trimming (cutting) and milling operation. The suction head (39) removes by means of suction various particles, fragments, and lumps from the surfaces of the band of lamellas (89) and thereby improves the mechanical characteristics of said surfaces to enable application of thin coat (layer) of adhesive means, e.g. glue. The coat is deemed to be thin if each coat (layer) of adhesive does not exceed 500 g/m^2 . Similar suction heads (39) are applied both following the trimming, and milling operations.

Special adhesives with appropriate characteristics applied in particular fashion enable manufacturing of fireproof light building panel. The adhesive should be uniformly applied in film or droplet fashion or sprayed over most of the surface of the band of lamellas (89) by the adhesive application device (9). This device ensures uniform coating of the adhesive on upper and/or lower side of the band of lamellas (89) by periodic or oscillatory moves essentially perpendicular to the movement of the band of lamellas (89). To (a) achieve sufficient strength of the union between the mineral filling and the outer layer or plurality thereof, and (b) increase fire resistance of the light building panel it is of utmost importance that quantities of applied adhesive (glue) remain locally within the suggested ranges of 90 to 110 g/m^2 . In the way of example, between 0.1 kg/m^2 and 0.5 kg/m^2 of adhesive is used for the panel of 1000 mm width, said adhesive mixed with up to 45 % total adhesive mass of water for connecting the band of lamellas (89) to the lower outer layer (23, 24, 25). The adhesive is applied to the upper surface of the band of lamellas (89) which is to be attached to the upper outer layer by upper mixing head (41), and to the lower surface of the band of

lamellas (89) which is to be attached to the lower outer layer by upper mixing head (42). Thereby the suggested velocity of the band of lamellas (89) is in the range between 4 to 8 m/min. In the way of example, the characteristics of the adhesive (glue) (preferably "Poliol-CO₂ foamed" and "Isocyanate-MDI") are as follows: viscosity up to 2 Pas; density up to 1500 kg/m³, reaction time in the laboratory: open time 15-20s, alternative open time over 64 s and developing in a double band device (11) at temperature of up to 50°C for up to 3 minutes whereby "Poliol-CO₂ foamed" and "Isocyanate-MDI" are mixed in ratio 1: (1.1 to 1.5) according to weight. In this particular embodiment the upper and the lower outer layer are made of sheet of metal.

Further the new technical solution is presented by side introduction of the band of lamellas (89), which are further guided from the side. The band of lamellas (89) is introduced into the double band device (11) using side roller guides (92) which shape conform to the shape of the edge of the band of lamellas (89), said side roller guides (92) freely rotatable. The double band device (11) facilitates the permanent (i.e. non-removable) attachment of the upper outer shielding and/or formative means and the band of lamellas (89) and the lower outer shielding and/or formative means and the band of lamellas (89) by vertically applying force, resulting structure denoted as continuous light building panel band. Said light building panel band is then cut into light building panels (finished product). However, prior to introduction of said band of lamellas (89) into the double band device (11) the lamellas within the band of lamellas (89) are aligned as they may have shifted because of double bending. The suggested angle of introduction from the side is in the range between 7° and 13° with best results expected between 9° and 10°. This angle of introduction enables

introduction of band of lamellas (89) of thickness ranging from 50 mm and 250 mm with best results between 60 mm and 200 mm. The band of lamellas (89) prior to introduction into the double band device (11) is not supported due to requirements of adhesive application device (9) (mixing heads) which must perform unobstructed so the introduction (guiding) is achieved by means of freely rotatable side rollers with shape conforming to the shape of the edge of the band of lamellas (89). Said side rollers provide predetermined side force and subsequently enough friction between lamellas to enable unsupported introduction of the band of lamellas (89) onto the lower outer sheet of metal.

Entering the double band device (11) in above described fashion present another technical problem which needs to be solved, namely double bending of the band of lamellas (89) whereby said double bending is seen in side-view perpendicular to the double band device (11) movement. Said double bending is needed to lower the level of the band of lamellas (89) from the level of arrangement of lamellas (26) onto the level appropriate for introduction into the double band device (11). Double bending with a radius R causes uncontrolled horizontal shift d of lamellas (26) upon entering into the double band device (11). This technical problem is solved by means of combining side and lengthwise (i.e. along axis or main direction of the band of lamellas movement) forces. The lengthwise force is achieved by increased velocity of the band of lamellas (89) and additional driving rollers positioned above the side (edge) lamellas at the milling station, said driving rollers compensating for additional friction caused by milling. The side force is achieved by applying pressure through preset side guiding rollers (92) which may be freely rotatable. The side force is necessary to (a) cause appropriate friction among adjacent lamellas (26) which prevent shifting of lamellas

and/or gap appearance, and (b) prevent piling of lamellas by increasing the lengthwise force. Before the first bend the band of lamellas (89) is aligned by at least one alignment roller (91) whereby the alignment roller (91) is positioned above the band of lamellas (89) after the first bend area in such a fashion that its centerline lies in a plane parallel to the band of lamellas (89) plane and its centerline is perpendicular to the band of lamellas (89) direction of movement. At the same time said alignment roller (91) limits vertical shift of adjacent lamellas (26) in the band of lamellas (89). In addition, the double band device (11) exerts sufficient vertical force to compensate for possible vertical shift among adjacent lamellas (26) by partially deforming the lamellas in vertical direction and partially squeezing of the adhesive into the lamellas. The condition for successful operation of one or more alignment roller (91) is locally reduced side force and subsequently locally reduced friction among lamellas.

Within the double band device (11) the band of lamellas (89) is guided by at least one side chain. The technical problem of side chain as known to the one skilled in the art is requirement of different side chain or spacer for each type (size) of the product. This technical problem is solved in this invention by using at least two synchronously operated side chains. Existing systems which were developed for products filled with polyurethane fillings consist of double band (as continuously operating device) and side chains for calibrating the finished product. The side chains as known to the one skilled in the art are continuous endless ribbon with the shape of desired profile of the finished product side which limits expansion of polyurethane and defines the side of polyurethane type of filling. The novelty of this application is shown in such a process and apparatus for manufacturing of

fireproof light building panels which uses two separate simultaneously operated side chains which limit and guide the light building panel band in such a fashion that the contacting element (e.g. chain link) of an upper chain conforms to and by virtue of its shape limits and further via friction transmits own momentum on at least one upper edge of upper shielding and/or formative means which are comprised by the light building panel band. On the other hand, the contacting element of a lower chain conforms to and by virtue of its shape limits and further via friction transmits own momentum on at least one lower edge of lower shielding and/or formative means which are comprised by the light building panel band. The edges of upper and lower shielding and/or formative means comprised by the light building panel band which were formed prior to entering the double band device(11) using respective grooving machines (4,5) henceforth limits (restricts) the band of lamellas (89) and prevents the adhesive to expand outside the area restricted by the edge of upper and/or lower shielding and/or formative means. In the way of example, the upper sheet of metal (21) is guided using conforming elements (i.e. the contacting elements) of at least two upper side chains (13, 14) both of which can be adjusted in height to accommodate different thicknesses of particular fireproof light building panel and can be adjusted in width to accommodate different widths of particular fireproof light building panel. Thereby the conforming elements of the upper side chains (13, 14) are simplified negatives of profiles of edges of upper sheet of metal (21) and hence of upper edges of the light building panel band. In another way of example, the lower sheet of metal (23), or in the case of facade panels the lower sheet of metal (24), or in the case of wavy roof panels the lower sheet of metal (25), is guided using conforming elements of at least two lower side chains (16, 17) both of which can be adjusted in width to accommodate different widths of particular fireproof light building panel. Thereby the

conforming elements of the lower side chains (16, 17) are simplified negatives of profiles of edges of lower sheet of metal (23, 24, 25, respective on particular light building panel) and hence of lower edges of the light building panel band. Further, due do to similar profiles among the panels as described above (figure 2 through figure 9) the same upper side chains (13, 14) can be used so there is no need to change it during switching between manufacturing different types of panels. Further, the bitumen band or other flexible material (45) can be used instead of the upper sheet of metal in the same device (11).

On the side of the band of lamellas (89) and before entering of the band of lamellas (89) into the double band device (11) there is at least one device for attaching side protecting means. Said attaching is performed along the length of side surfaces (i.e. not base surfaces) of the band of lamellas (89) using polyethylene bands, PVC bands or bands of other type of material whereby these bands present technological protection of side chains against fouling by adhesive, fiber particles or other mechanical or chemical impurities while they present functional protection of finished product (i.e. light building panel) against humidity until the mounting of said panels. The widths of the bands are adjusted according to various thicknesses of light building panels.

Instead of sheets of metal one may use flexible bands such as bitumen, thin sheets of plastics, paper, or thin sheet of aluminum. In that case the presented system enables the attachment of lower surface of the band of lamellas (89) onto the lower sheet of metal while enabling the attachment of the upper surface of the band of lamellas (89) onto the natron paper, aluminum sheet, sheet of plastics, bitumen band (henceforth commonly referred to as

'flexible material'). The different materials can be switched without interrupting the process using accumulation loop and/or joining table. This system also requires device for preheating of the flexible material to soften said flexible material in order to achieve good attachment while not significantly reducing the strength or even tearing (severing) of said flexible material band. In the way of example, there is decoiling device for flexible material (44) positioned over the double band device (11) with decoiling drums (44) of capacity up to 2.000 kg, width of flexible material up to 1.3 m and diameter of roll of flexible material up to 1.2 m.

The attaching using adhesives in the embodiment using at least one flexible band is performed prior to entering the double band device (11) with at least two mixing heads (41) which are positioned on the oscillating devices, said mixing heads (41) by transversing motion in both directions uniformly coating the lower and/or upper side of mineral filling (22) by adhesive to ensure its attachment to the upper and/or lower outer layer (23, 24, 25) taking into the account the parameters discussed earlier.

In the way of example, from the decoiling device for flexible material (44) the flexible material band (45) is decoiled and led through the system for preheating of the flexible material bands (46). The band (45) is heated using hot air or other gas of temperature ranging between 100°C and 200°C whereby the band is between 1 mm and 5 mm thick and feeding velocity is between 3 m/min and 9 m/min so the band achieves the temperature ranging between 40°C and 75°C. The band (45) is heated in detachable chamber (46) which features the suction system (47) using which the cooled air or other gas is sucked and

reheated (regenerated), said chamber being of closed or half-opened type. Following the treatment in the heating chamber (46) the band (45) is coated by adhesive using airless spraying uniformly across the whole width using, in the way of example, from 0.1 to 0.5 kg/m² for each individual layer (coating). The coat is applied to the upper side of the lower band (45). The adhesive is applied to preheated surface whereby the best results were achieved at temperatures of preheated surface ranging between 40°C and 50°C. The process of final reaction is performed within the double band device (11) at temperatures of up to 50°C, and the finished products are stocked for up to 24 hours at temperatures above 15°C.

In the case of the panels using flexible band a condensate shielding coating can be applied instead of mineral filling. In the way of example, a polyurethane coating can be used whereby the quantity of said condensate shielding coating should not exceed 1.5 kg/m². Thereby, the flexible band is used as technological protective cover for manufacturing of the light building panel with condensate shielding coating in the range of 2 to 10 mm, usually 8 mm. In the way of example, the condensate shielding coating can be applied by expansion of the adhesive between the upper layer of light building panel (e.g. flexible material band), and the lower sheet of metal. In that case the flexible material band serves as a barrier between the coating and the double band device (11), and has also aesthetic function.

In preferred embodiment the light building panel band or the fireproof light building panel band is manufactured using the above described process and apparatus. Said band is cut upon exiting from the double band device (11) into preset lengths using a bandsaw (12) with prescribed direction of cutting upward to turn the chip inside and removal of chip on the

upper sheet of metal using special cutter (knife). A surprising technical effect of final cut of high quality is thereby achieved due to damping of the vibrations. The opposite direction of cutting or cutting using circular saws would cause the vibrations because of softer middle layer of the light building panel with mineral filling. During the cutting the movements of the panel is restricted using special pressing and/or restricting elements to decrease the effect of vibrations, hence cut of higher quality is achieved. The preferred embodiment also includes production of eaves by previous separating the lower layer from either mineral filling or other middle layer material using separating means (e.g. fluid coating of separating means which prevents attachment of mineral filling and lower outer layer) and cutting of said middle layer material transversely to the direction of the light building panel band movement. The eaves for the purposes of this application denotes protruded part of light building panel's lower sheet of metal and can be used for either overlapping part during the mounting of adjacent panels or as the eaves of the roof. The production of eaves is performed using circular saw. In the way of example, when producing eaves ranging from 50 mm to 200 mm in length one first removes the upper sheet of metal and middle layer (i.e. filling between the upper and the lower sheet of metal) so the lower sheet of metal becomes longer than the upper sheet of metal and the filling. In this way the protruded portion of the lower sheet of metal serves as the eaves or overlap in extended roofs.

The manufactured panels are loaded on the pallets or other depositing surfaces (hereinafter pad). In the case of roof panels the panels are stacked in pairs, i.e. two panels form a single entity whereby the flat surfaces are turned outward, and wavy surfaces (presented on figures 2 through 9) inward (one toward another) as to protect the wavy surfaces from deformation

during transport and increase transport efficiency. The finished products are loaded on pads (51). The new solution is presented in the way of novel arrangement of pads (51) according to different packages length and different loads which are due to various combinations of materials built into the final product. Thereby the package comprises of at least vertically stacked (positioned one upon another) light building panels. The process (algorithm) for preferred embodiment is therefore as follows:

(i) there are at least two pads (51).

(ii) the pad (51) at the very end of the lowest panel (acting as a bottom surface of the package) is positioned outward from the edge of the lowest panel for a distance T_{pak} to be used for packaging and protection of panels whereby the T_{pak} ranges between 5 in 25 mm.

(iii) the distance between pads (51), on which the package rests, is calculated according to the following formula:

$$L_{SVE} = ((L_{pak} + 2 * T_{pak}) - (N * L_{pod})) / (N - 1)$$

whereby the values are seen in figure 20 and

L_{SVE} is the net distance between the pads (51)

L_{pak} is the length of the panels including predetermined tolerance of loading of at least two light building panels

L_{pod} is the pad (51) length

N is a number of pads (51) in the package

T_{pak} is shown in (ii)

(iv) the values for particular parameters depending on thickness dd of the panel and the density of the mineral filling r are summarized in the following table whereby all the values are in meters unless stated otherwise and the length refers to L_{pak} from (iii).

	medium $dd = 80 \text{ mm}$ $r = 100 \text{ kg/m}^3$		heavy $dd = 60 \text{ mm}$ $r = 150 \text{ kg/m}^3$		light $dd = 200 \text{ mm}$ $r = 60 \text{ kg/m}^3$	
Number of pads N	Length of panels (default) from to		Length of panels (max) from to		Length of panels (min) from to	
2	2.00	3.60	2.00	3.20	2.00	4.50
3	3.61	6.30	3.21	5.30	4.51	7.00
4	6.31	9.20	5.31	7.20	7.01	10.00
5	9.21	12.00	7.21	9.20	10.01	14.00
6	12.01	14.00	9.21	11.40	-	-
7	-	-	11.41	14.00	-	-

Based on this process the computer program performing the above described steps is executed. Three possibilities are can be chosen according to the loading, either light, medium, and heavy. The possibility taking into account larger or smaller number of pads (51) is hence chosen (e.g. by an operator of the disclosed apparatus) whereby the pads (51) which also perform a function of support are made of wood (pallets), polystyrene (styrofoam), and/or other suitable material.

In the way of example, the data for the panel of thickness 80 mm and density of the wool

100 kg/m³ will be taken from the table above, column "medium".

In addition, the preferred embodiment is controlled and regulated using control algorithm with a help of a microprocessor, built into or connected to control panel whereby the microprocessor uses the instructions whereby:

- it reads, regulates, and controls physical data on process operation;
- it directs and controls data on work-order comprising a size and type of particular product undergoing the process;
- regulates data on traceability of material built-into the product which is especially important in proving the conformity of built-into materials with tested product in order to obtain certificates necessary and/or licenses to sell the products;
- records the evidence of errors during process and pinpoints their origin as well as performs statistical analysis of errors by help of data acquisition and management.

It is self evident that the above described invention can be also used in other particular form not changing the substance of the invention.

CLAIMS

1. Light building panel, **characterized in that** it comprises at least one of the following:

- (a) shielding means for protection against environment;
- (b) formative means for giving form and strength;
- (c) a filling of mineral wool and/or glass wool and/or a combination of insulation materials;
- (d) connecting means for connecting shielding and/or formative means with filling.

2. An apparatus for continuous manufacturing of light building panels with mineral filling with mineral filling as an insulation whereby said panels are manufactured by cutting of continuous band of the light building panel, **characterized in that** it comprises decoiling means for decoiling of shielding and/or formative means, profiling means for profiling of said shielding and/or formative means, insertion means for insertion of ribs of mineral filling, preheating means for heating of elements of the band of light building panel, application means for application of connecting means, a double band device (11), cutting means, cutting and arranging means for cutting and sorting of lamellas (26) into a band of lamellas (89) and/or unloading transporting means for loading of the light building panels on the pads (51) and elements of the light building panels comprising shielding means, formative means and/or filling of mineral wool and/or combinations of insulation materials connected thereto.

3. A process for continuous manufacturing of light building panels with mineral filling with mineral filling as an insulation whereby said panels are manufactured by cutting of

continuous band of the light building panel, **characterized in that** it comprises assembling of a continuous band of the light building panel comprised of elements of the light building panel comprising shielding means, formative means and/or filling of mineral wool and/or combinations of insulation materials using processes comprising of decoiling of shielding and/or formative means, cutting and arranging of lamellas (26) into a band of lamellas (89), inserting ribs of mineral filling, heating of elements of the band of the light building panel, application of connecting means on the elements of the band of the light building panel;

connecting of the elements of the band of the light building panel within a double band device (11);

cutting of the band of the light building panel into the light building panels of predetermined length;

loading of finished light building panels on pads (51).

4. A process for continuous manufacturing of light building panels with mineral filling with mineral filling as an insulation whereby said panels are manufactured by cutting of continuous band of the light building panel, **characterized in that** it enables manufacturing of fireproof light building panels, light building panels of modulus ranging from 200 mm to 1200 mm, light building panels using mineral wool fillings with various characteristics, light building panels for essentially flat roofs with flexible material bands and condensate shielding coating.

5. An invention according to the claims 2 and/or 3 and/or 4, **characterized in that** it

comprises:

- (a) decoiling with at least one decoiler (2) of upper shielding and/or formative means;
- (b) decoiling with at least one decoiler (1) of lower shielding and/or formative means;
- (c) changing of sheets with a double carriage at reduced velocities of the band of lamellas (89);
- (d) positioning of tools on cassettes enabling fast and simple changing of tools.

6. An invention according to any of the previous claims, or combination thereof, **characterized in that** it comprises at least one of the following characteristics:

- (a) at least one surface of the light building panel is equipped with at least one protrusion and/or at least one rib in longitudinal direction;
- (b) the upper and the lower shielding and/or formative means are symmetrical with regard to longitudinal axis of the light building panel;
- (c) the shielding and/or formative means feature endings and/or protrusions to facilitate interconnecting between adjacent light building panels during mounting and/or overlapping with adjacent light building panels during mounting;
- (d) interconnection between adjacent building panels is facilitated using sealing means.

7. An invention according to any of the previous claims, or combination thereof, **characterized in that** the protrusions and/or the ribs on shielding and/or formative means feature trapezoidal cross sections with a width of narrower of both base sides of the trapezoid ranging from 20 mm to 30 mm, an inner angle of the trapezoid between 23° and 33°, and distance between both base, parallel, sides ranging from 33 mm to 40 mm.

8. An invention according to any of the previous claims, or combination thereof, **characterized in that** the mineral wool, glass wool, and/or other insulation material comprises one of the following densities:

- (a) between 115 kg/m³ and 135 kg/m³ for fireproof light building panels with appropriate mechanical characteristics;
- (b) between 135 kg/m³ and 165 kg/m³ for light building panels used for walkable essentially flat roofs or for those panels which should withstand usual loading during exploitation and/or local pressure load.

9. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** it comprises:

- (a) cutting of mineral filling panels (81) with a set of at least two circular saws (33) into lamellas (26);
- (b) change of direction from essentially perpendicular to the longitudinal lamella (26) axis to essentially parallel to the longitudinal lamella (26) axis;
- (c) separation into individual lamellas (26) or groups thereof using sorting feeder (84) and turning of individual lamellas (26) or groups thereof for essentially right angle around center of turning table (85);
- (d) transport of individual lamellas (26) to sorting feeder (84) with velocity which exceeds accommodating velocity of sorting feeder (84) thereby ensuring longitudinal contact between individual lamellas.

10. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** it

comprises:

(a) formation of a set of lamellas (86) comprising at least two one from another separated yet sidelong aligned lamellas by means of separators whereby said set of lamellas (86) is transported:

- during a start-up until it reaches a rearranging device (87) whereby parquet-like assembly is assembled by rearranging of lamellas;

- during normal operation until it reaches previously assembled set of lamellas; resulting in sidelong shifted set of lamellas (86);

(b) establishment of continuous band of lamellas (89) comprising at least two adjacent and sidelong connected lamellas (26) whereby said band (89) is driven by at least one side guiding belt (88) which exerts side force and whereby the band of lamellas (89) features parquet-like appearance when observed from above;

(c) establishment of longitudinal force via means of the side guiding belt (88) velocity which exceeds velocity of the band of lamellas (89).

11. An invention according to the claims 2, 3, 4, and/or 5, **characterized by** insertion of a corrective lamella (26) to remedy corrupted parquet-like order.

12. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** a set of at least two circular saws (33) performs simultaneous cutting of mineral filling panel (81) into individual lamellas (26) of predetermined thickness.

13. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the

trimming and milling process applied to the band of lamellas (89) comprises at least one of the following:

- (a) trimming using at least one circular saw (35) in longitudinal direction;
- (b) simultaneous trimming using at least two coaxially positioned circular saws (35), said saws (35) distanced for a width of the band of lamellas (89);
- (c) breaking of trimmed-off edges;
- (d) milling of at least one edge of the band of lamellas (89) with at least one milling tool (37).

14. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the trimming is followed by suction of remnants from the surface of mineral filling using suction means.

15. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** an application of connecting means is performed in a thin layer whereby essentially uniformly applied quantity of connecting means does not exceed 500 g/m².

16. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the application of connecting means is performed essentially uniformly in a film or droplets over essentially whole width of the band of lamellas (89) whereby the adhesive application device (9) applies a coating of the connecting means on upper and/or lower side of the band of lamellas (89) by periodic or oscillatory moves essentially perpendicular to the movement of the band of lamellas (89).

17. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the connecting means is an adhesive, and:

(a) a quantity of applied adhesive ranges between 90 to 110 , or, alternatively

(b) the use of adhesive ranges between 0.1 to 0.5 kg/m² and further the use of water is up to 45 % (weight) of adhesive;

whereby the recited values are valid for individual layer of adhesive on one of the base surfaces of the band of lamellas (89) and whereby the adhesive features the following characteristics: viscosity up to 2 Pas; density up to 1500 kg/m³, reaction time in the laboratory: open time 15-20s, or, alternatively, open time over 64 s; developing in a double band device (11) at temperature of up to 50°C for up to 3 minutes.

18. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the double band device (11) is comprised of two parallel bands of shielding and/or formative means supported and/or guided by supporting means and the band of lamellas (89) guided into between said parallel bands from the side whereby an angle formed by a projection of one of longitudinal edges of band of lamellas (89) onto a surface of the lower of two parallel bands and one of edges of one of both parallel bands ranges between 7° to 13° and whereby the band of lamellas (89) is unsupported at the bottom prior to entering said double band device (11).

19. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the band of lamellas (89) before entering the double band device (89) performs a double bending and whereby consequences of said double bending on individual lamellas (26) comprising the

band of lamellas (89) are mitigated by use of at least one of the following elements: longitudinal pushing force realized by velocity difference between transporting means and the band of lamellas (89); side pushing force realized by side pressing means along the length of the double bending; at least one alignment roller (91) positioned in a plane parallel to the band of lamellas (89) surface plane whereby a centerline of said alignment roller (91) is perpendicular to the direction of the band of lamellas (89) movement and whereby said alignment roller (91) limits vertical shift of two adjacent lamellas (26) comprising the band of lamellas (89); vertical force exerted by the double band device (11) on the band of lamellas (89) which causes vertical deformation of individual lamellas (26) forming the band of lamellas (89) and/or squeezing of the adhesive into the band of lamellas (89).

20. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** at least two simultaneously operated side chains whereby a contacting element of an upper chain conforms to and by virtue of its shape limits and further via friction transmits own momentum on at least one upper edge of upper shielding and/or formative means which are comprised by the light building panel band, and a contacting element of a lower chain conforms to and by virtue of its shape limits and further via friction transmits own momentum on at least one lower edge of lower shielding and/or formative means which are comprised by the light building panel band.

21. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the upper shielding and/or formative mean (21) is guided using the contacting elements of at least two upper side chains (13, 14) both of which can be adjusted in height to accommodate different

thicknesses of particular fireproof light building panel and can be adjusted in width to accommodate different widths of particular light building panel, and the lower shielding and/or formative mean (23, 24, 25) is guided using the contacting elements of at least two lower side chains (16, 17) both of which can be adjusted in width to accommodate different widths of particular light building panel whereby said contacting elements (13, 14, 16, 17) are simplified negatives of respective profiles of edges of shielding and/or formative means they are in contact with.

22. An invention according to the claims 2, 3, 4, and/or 5, **characterized by** attaching side protective means along the length of side surfaces of the band of lamellas (89) for protection of the double band device (11) against fouling and the finished light building panel against humidity.

23. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the upper shielding and/or formative means comprise at least one of the following: natron paper, aluminum sheet, sheet of plastics, and/or bitumen band.

24. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the upper shielding and/or formative means of flexible material (45) band are heated with hot air or other gas of temperature ranging between 100°C and 200°C whereby the band is between 1 mm and 5 mm thick and feeding velocity is between 3 m/min and 9 m/min resulting in the band temperature ranging between 40°C and 75°C, and whereby the band (45) is heated in detachable chamber (46) which features a suction system (47) for suction and/or regeneration

of said air and/or other gas, and whereby a coating is applied to the band (45), said coating comprising at least one of the following:

(a) 0.1 to 0.5 kg/m² of adhesive for each individual layer;

(b) up to 1.5 kg/m² of polyurethane coating;

whereby said coating is applied to the preheated band (45) surface with temperature ranging from 40°C to 50°C.

25. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** it comprises at least one of the following:

(a) cutting of the band of the light building panel into the light building panels of predetermined length whereby the cutting is performed by at least one bandsaw (12) with the direction of cutting from the lower shielding and/or formative means toward upper shielding and/or formative means,

(b) production of eaves by circular saw by previously applying separation means for prevention of the mineral filling and shielding and/or formative means attachment.

26. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** a supporting of packages comprised of vertically stacked light building panels on at least two pads (51) performing padding and/or supporting function comprises at least one of the following characteristics:

the pad (51) at the very end of the lowest panel acting as the bottom surface of the package is distanced 5 mm to 25 mm from the edge of said lowest panel;

a distance between adjacent pads (51) is computed using the following formula:

$$L_{SVE} = ((L_{pak} + 2 * T_{pak}) - (N * L_{pod})) / (N - 1)$$

whereby

L_{SVE} is a net distance between the pads (51)

L_{pak} is a length of the panels including predetermined tolerance of loading of at least two light building panels

L_{pod} is a pad (51) length

N is a number of pads (51) in the package

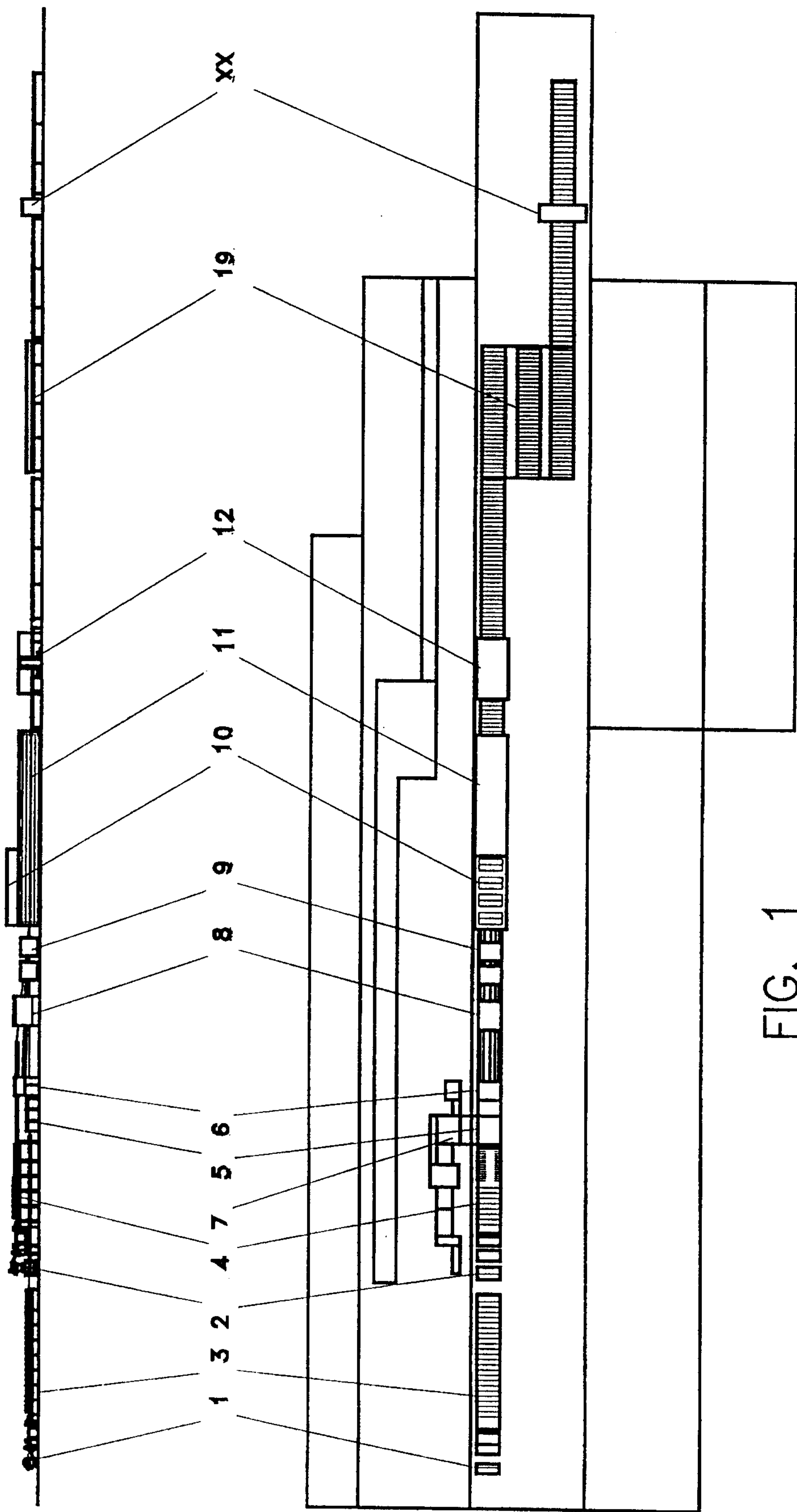
T_{pak} is a distance of an edge of the pad from an edge of the panel;

whereby an operator of said apparatus chooses L_{pak} according to the thickness dd of the panels and density r of the mineral filling.

27. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** the process of manufacturing of the light building panels is controlled using microprocessor regulating means and comprises: reading, regulating, and controlling of physical data on process operation; directing and controlling data on work-order comprising a size and type of particular product undergoing said process; regulating data on traceability of material built-into the product; recording the evidence of errors during said process.

28. An invention according to the claims 2, 3, 4, and/or 5, **characterized in that** a condensate shielding coating of thickness ranging from 2 mm to 10 mm is applied to the lower outer layer of the building panel by expansion of the adhesive between the upper band of flexible material (45) and the lower outer layer of the light building panel.

29. An invention according to any of the previous claims, or combination thereof, **characterized in that** the combination of the insulating materials is performed in at least two layers.



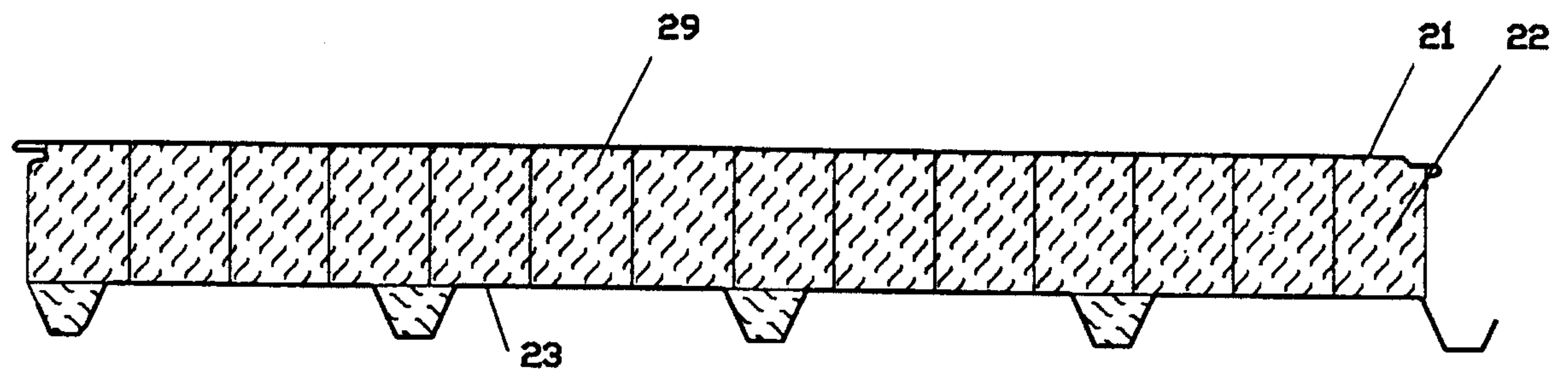


FIG. 2

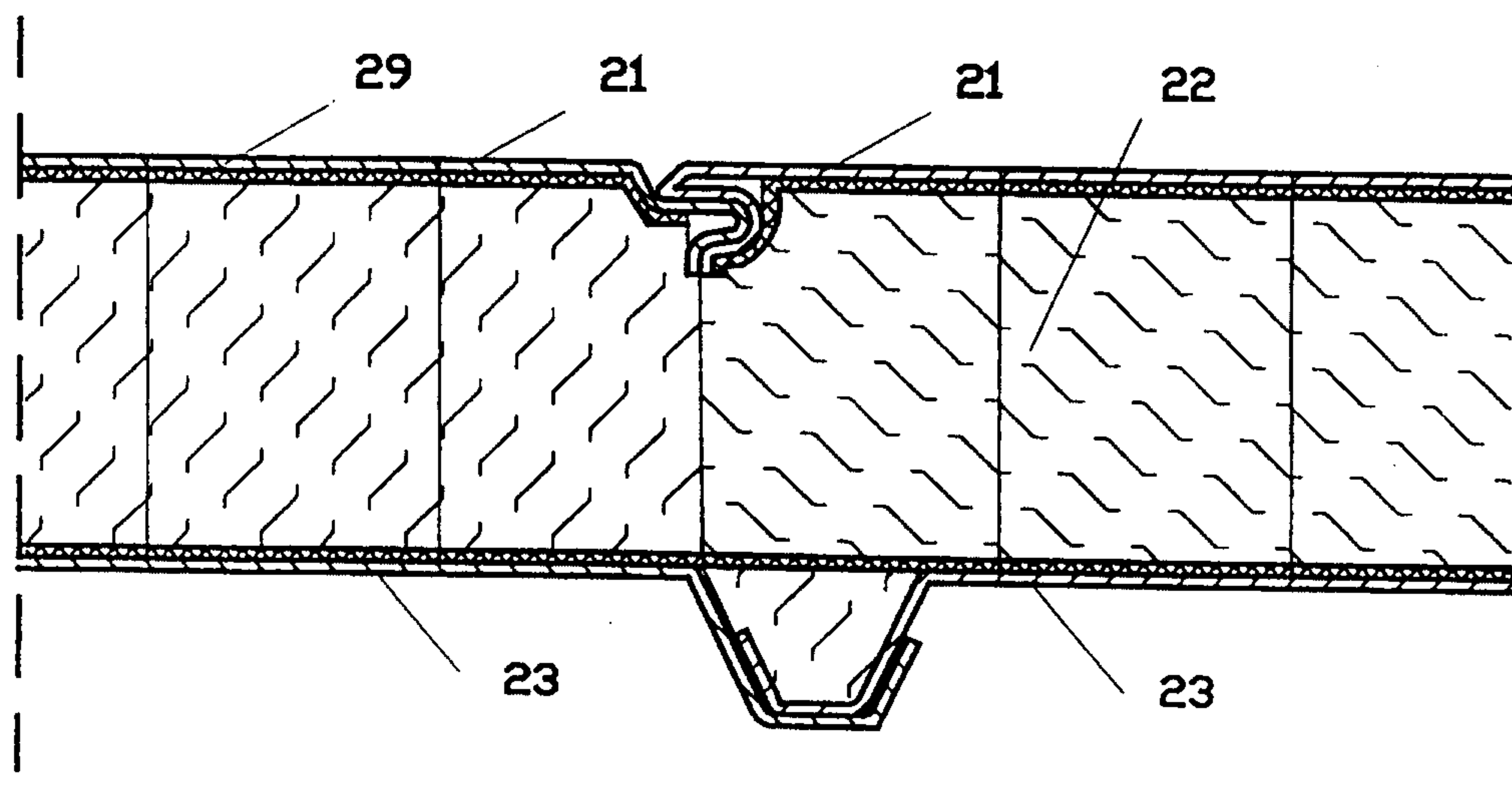
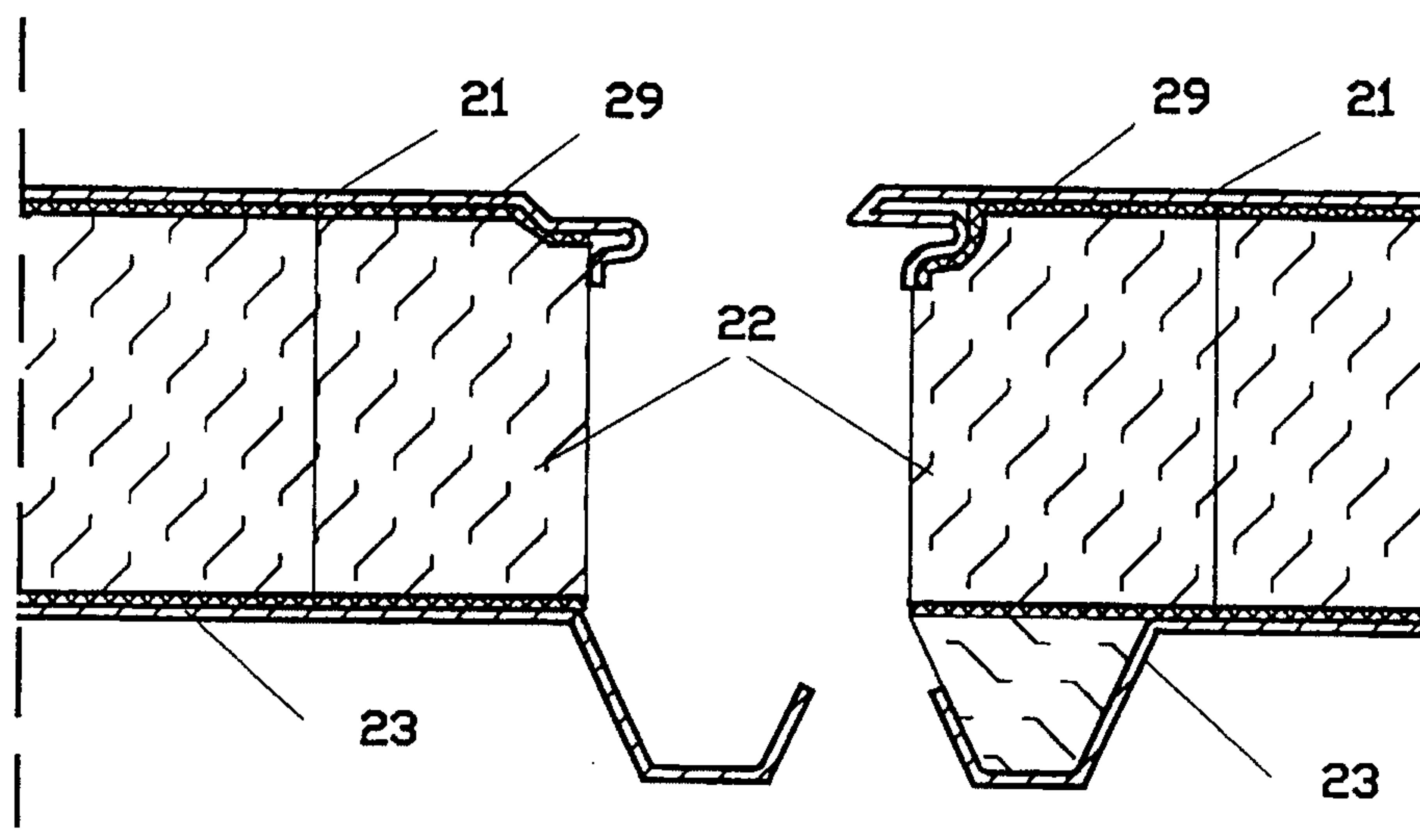


FIG. 3

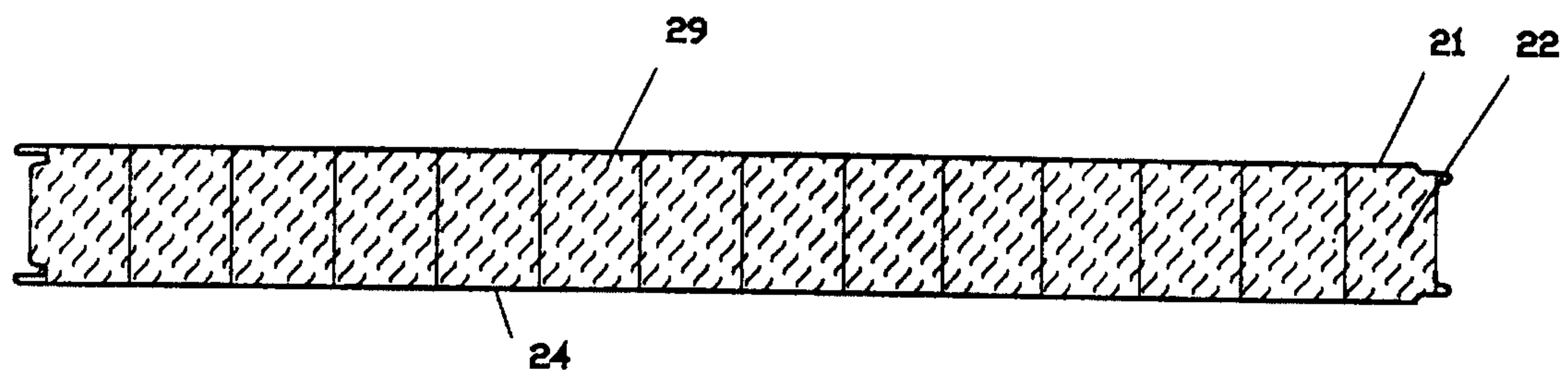


FIG. 4

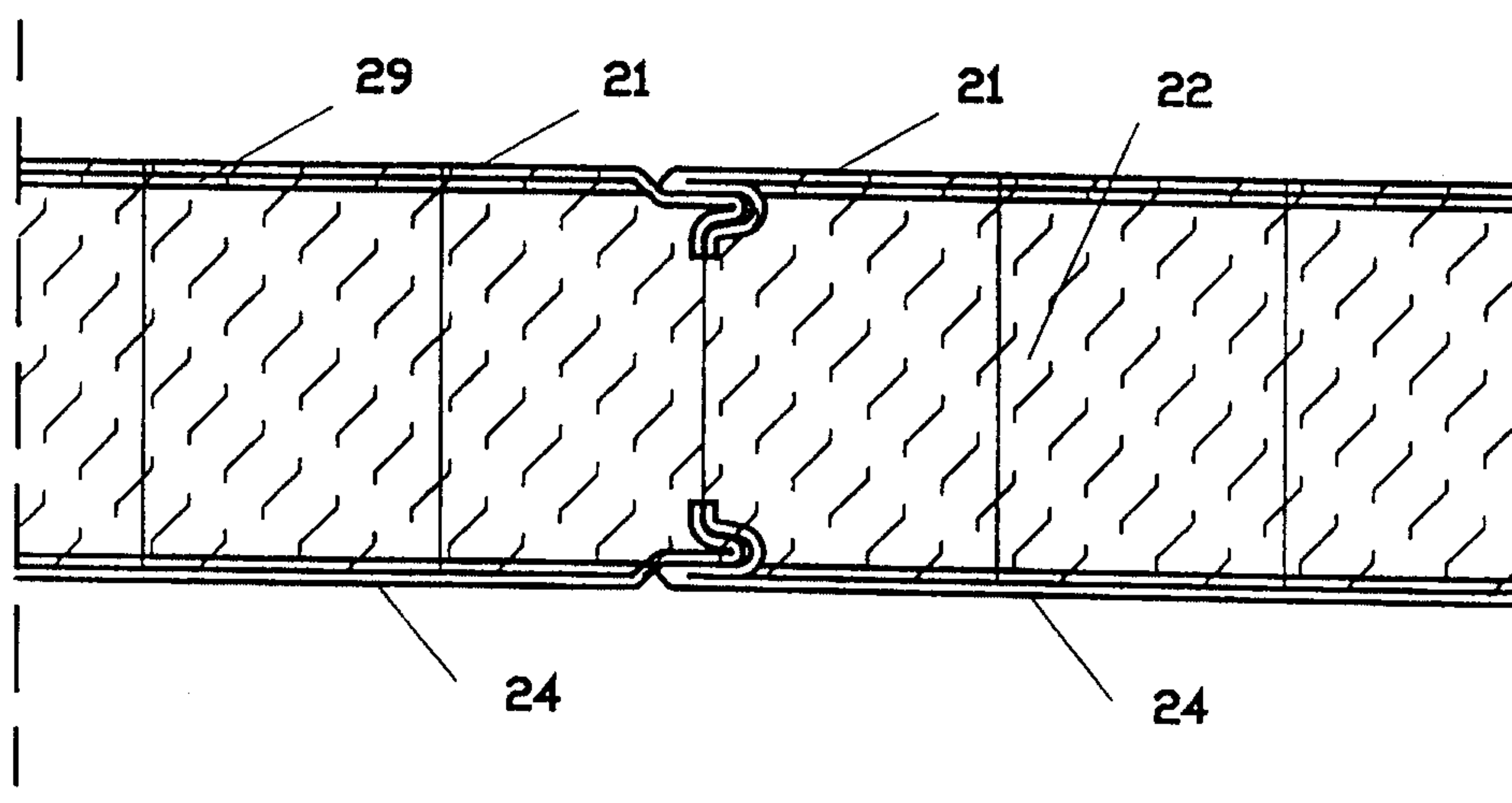
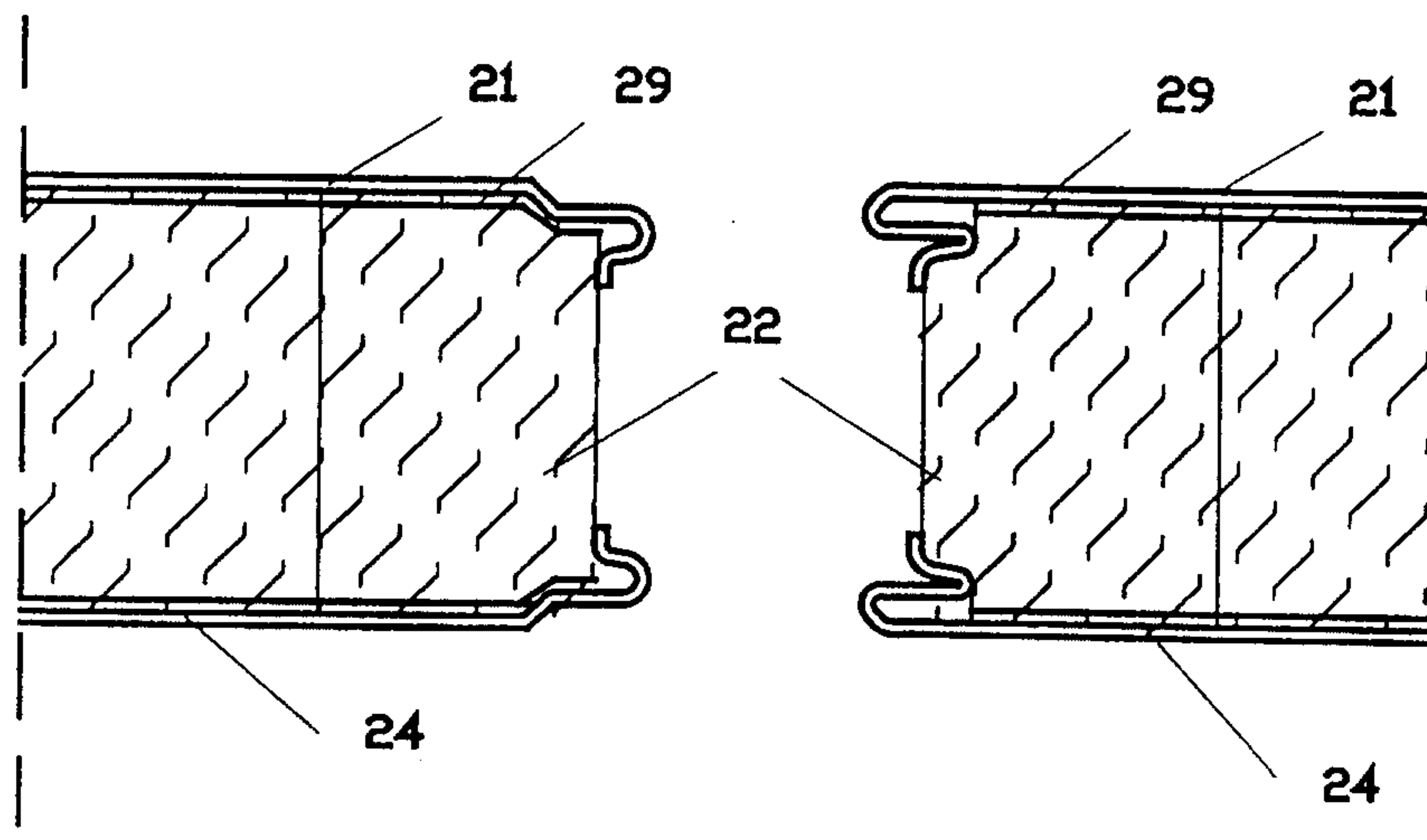


FIG. 5

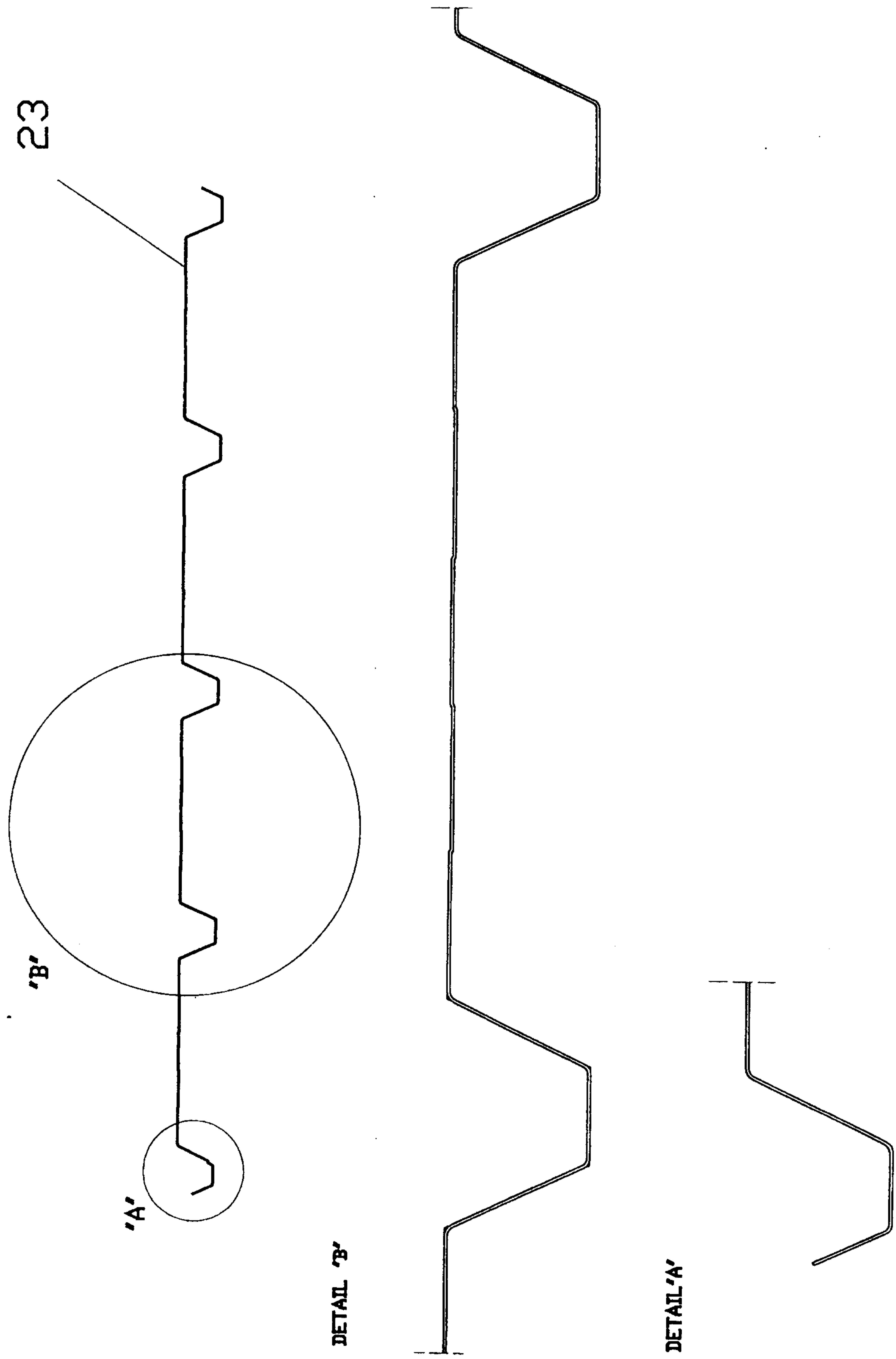
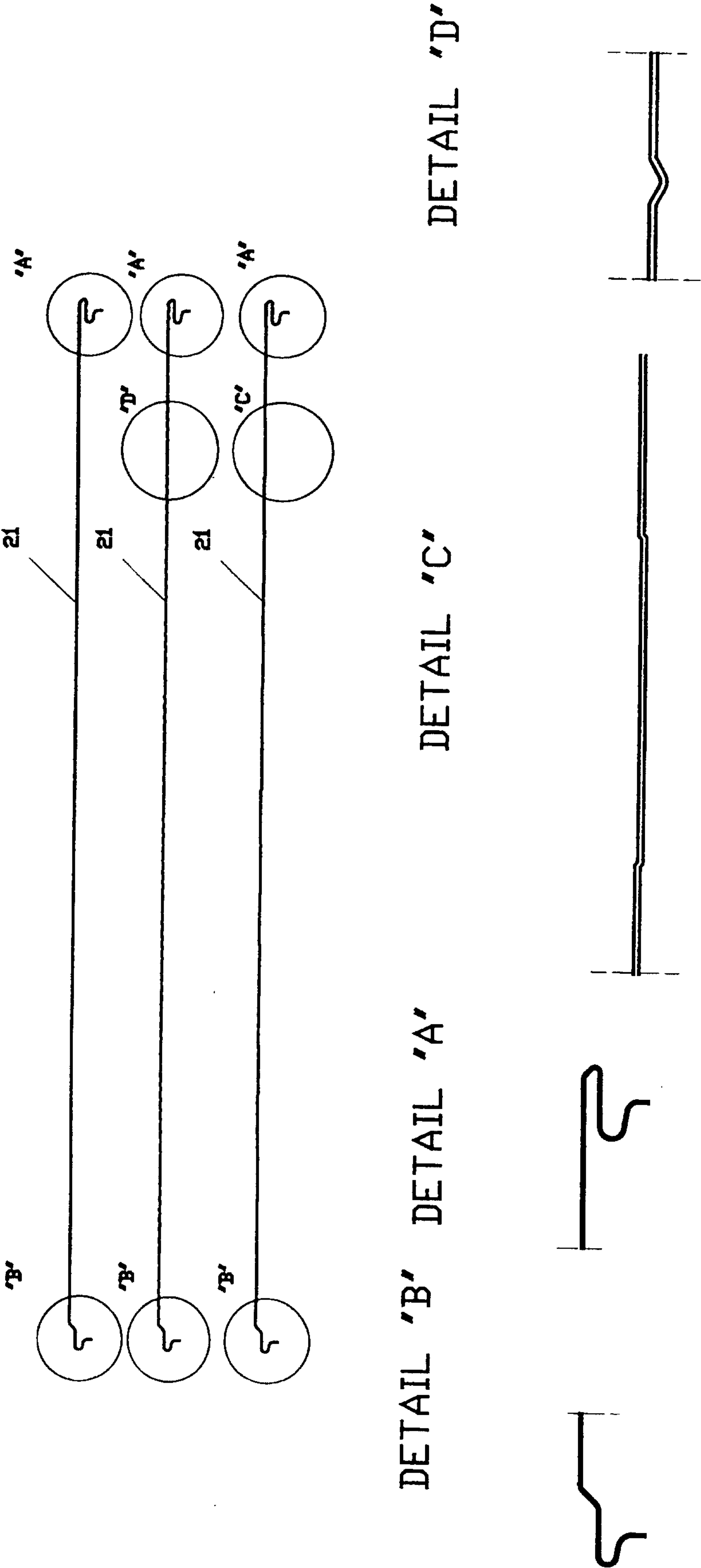


FIG. 6



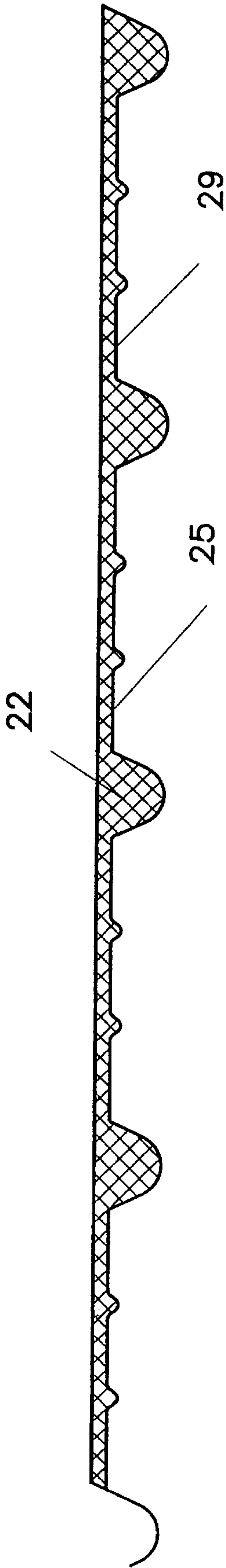


FIG. 8

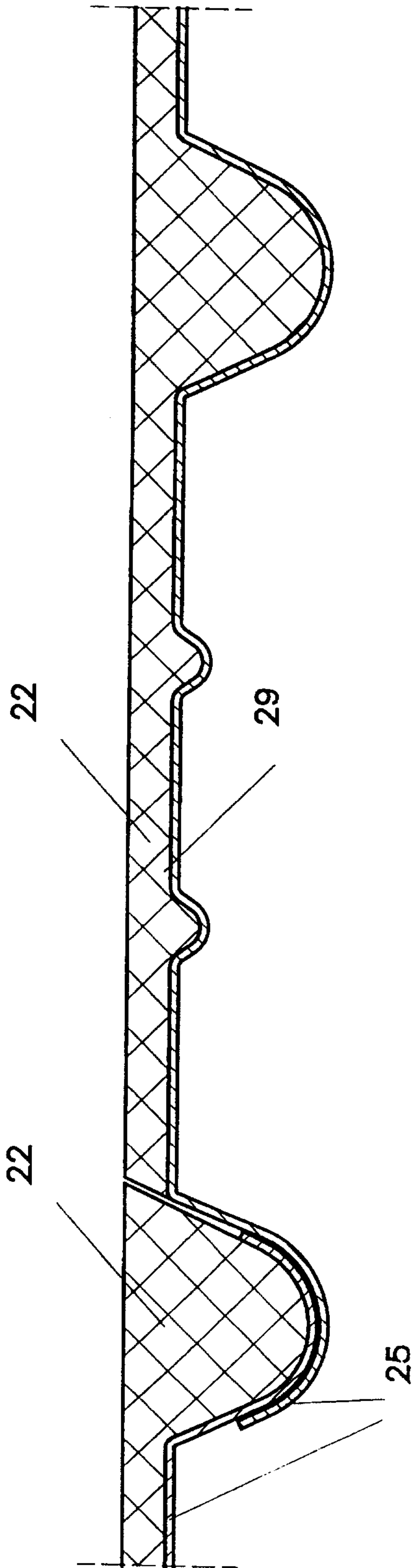


FIG. 9

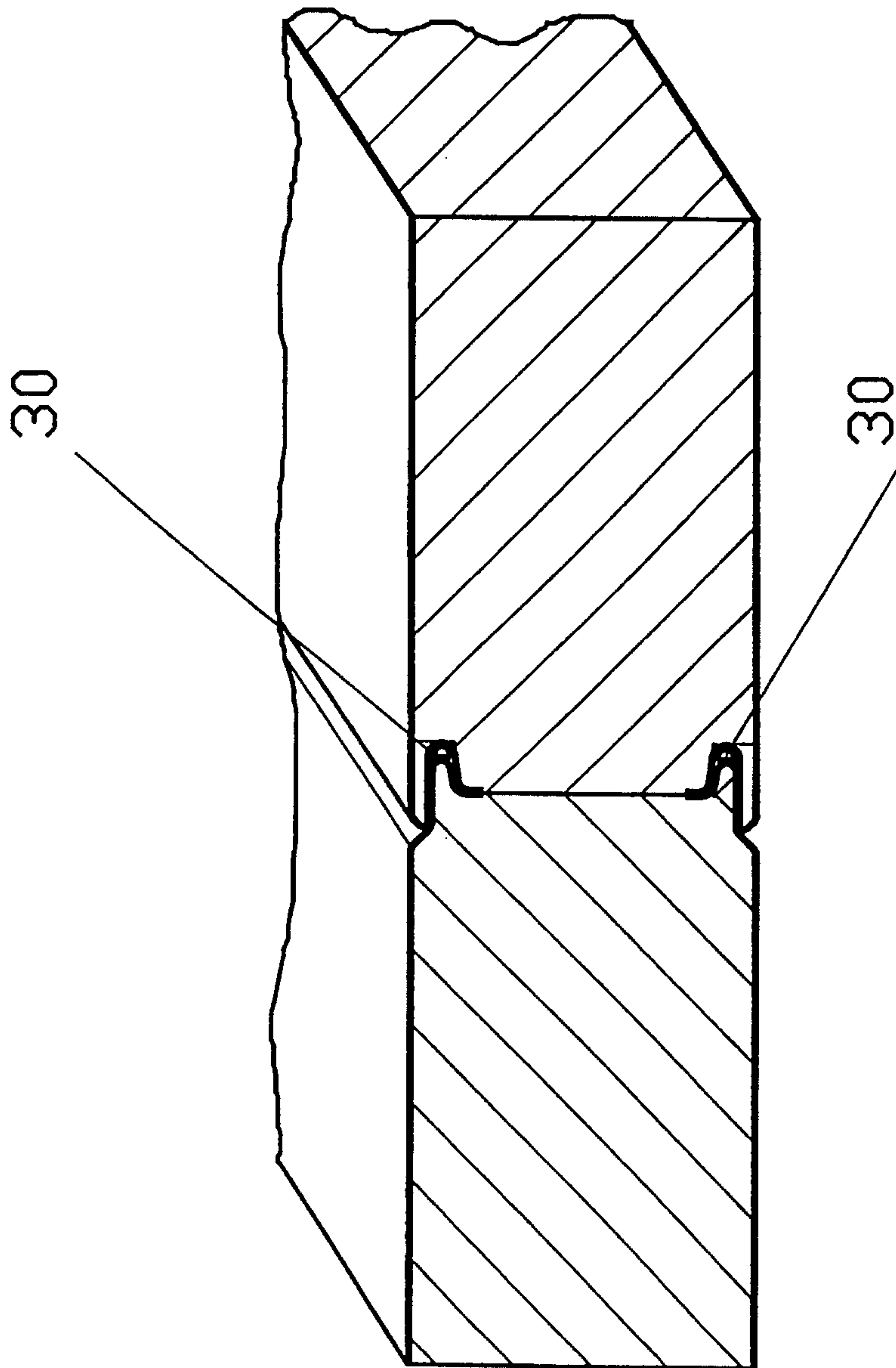


FIG. 10

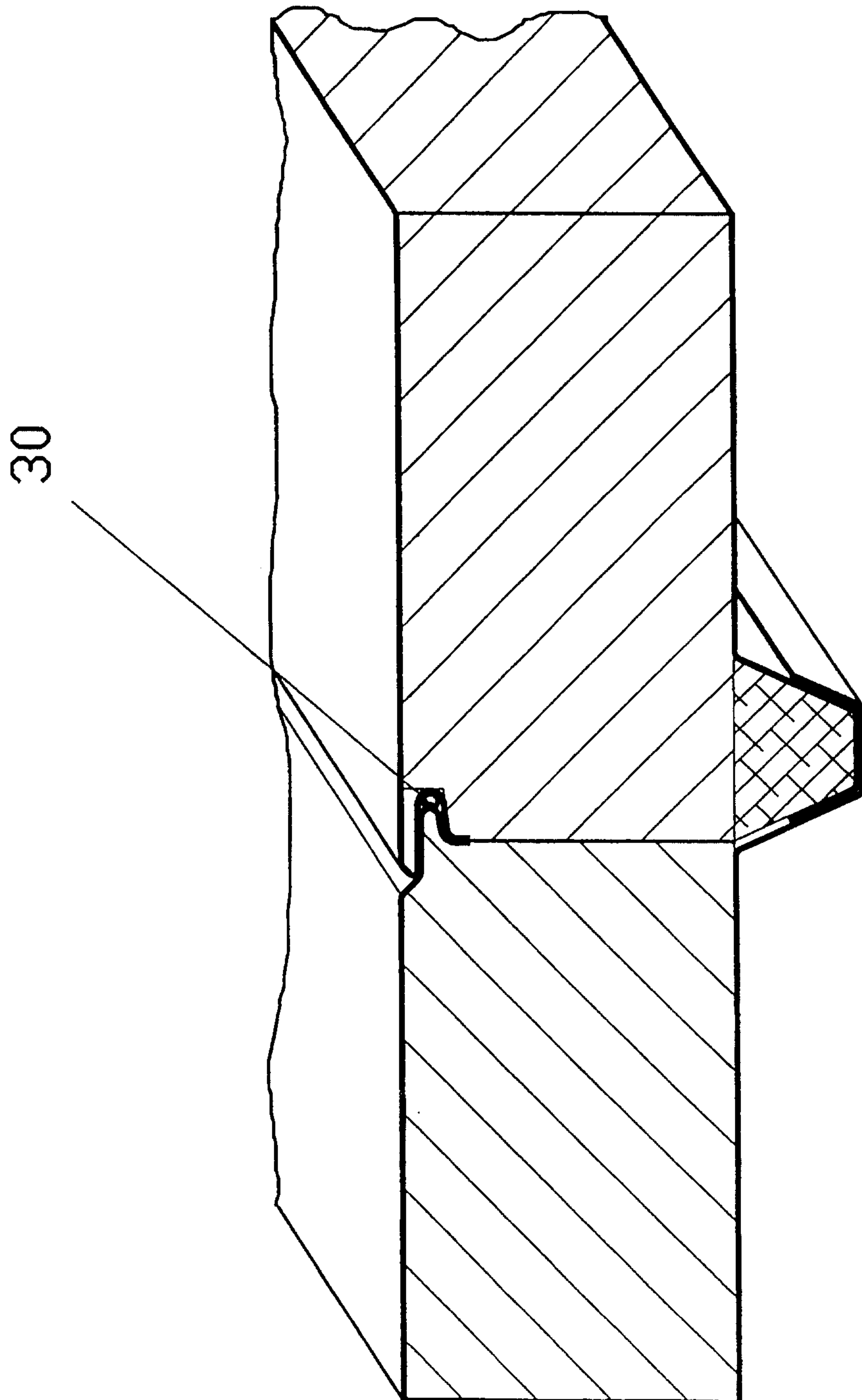


FIG.11

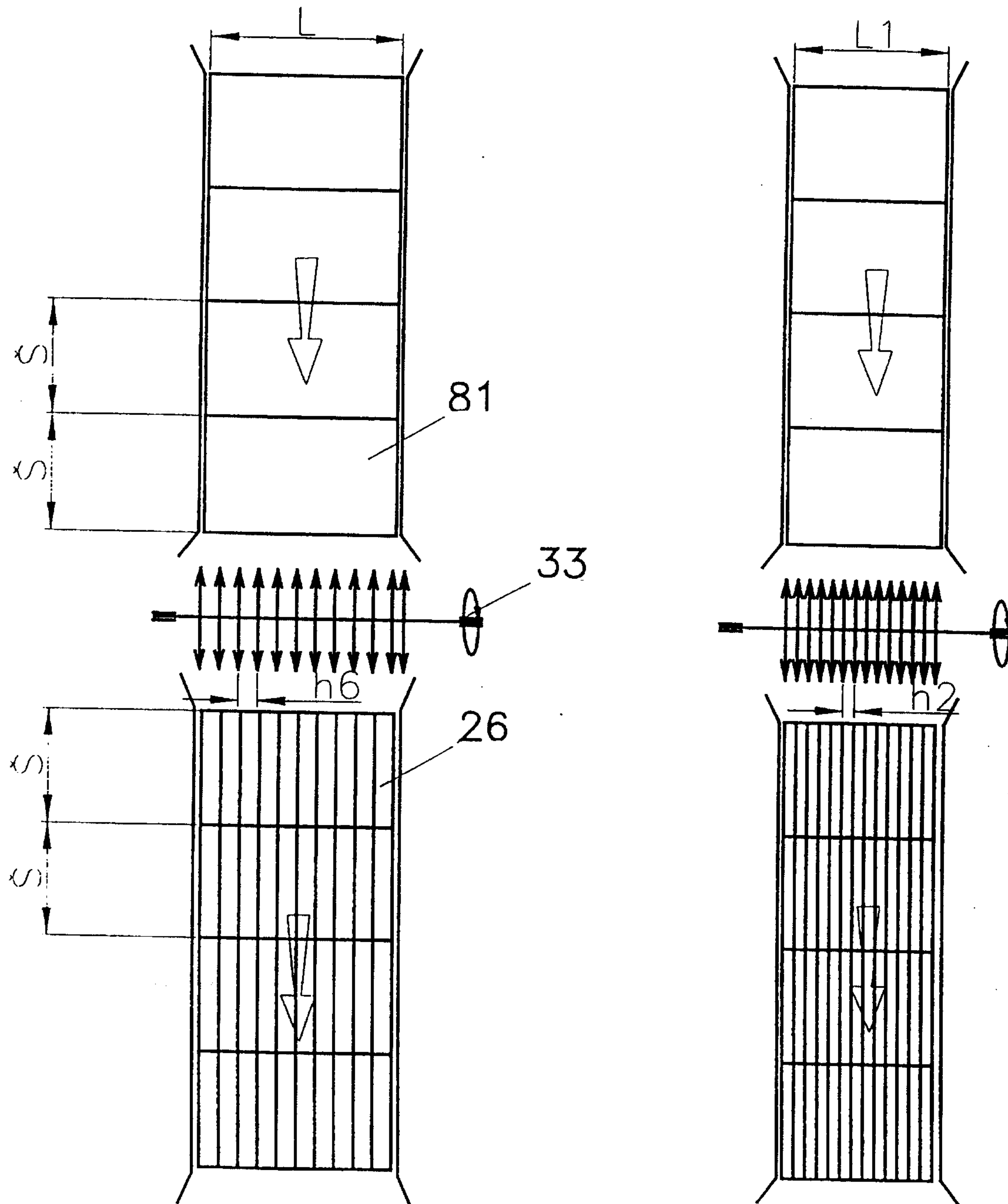


FIG.12

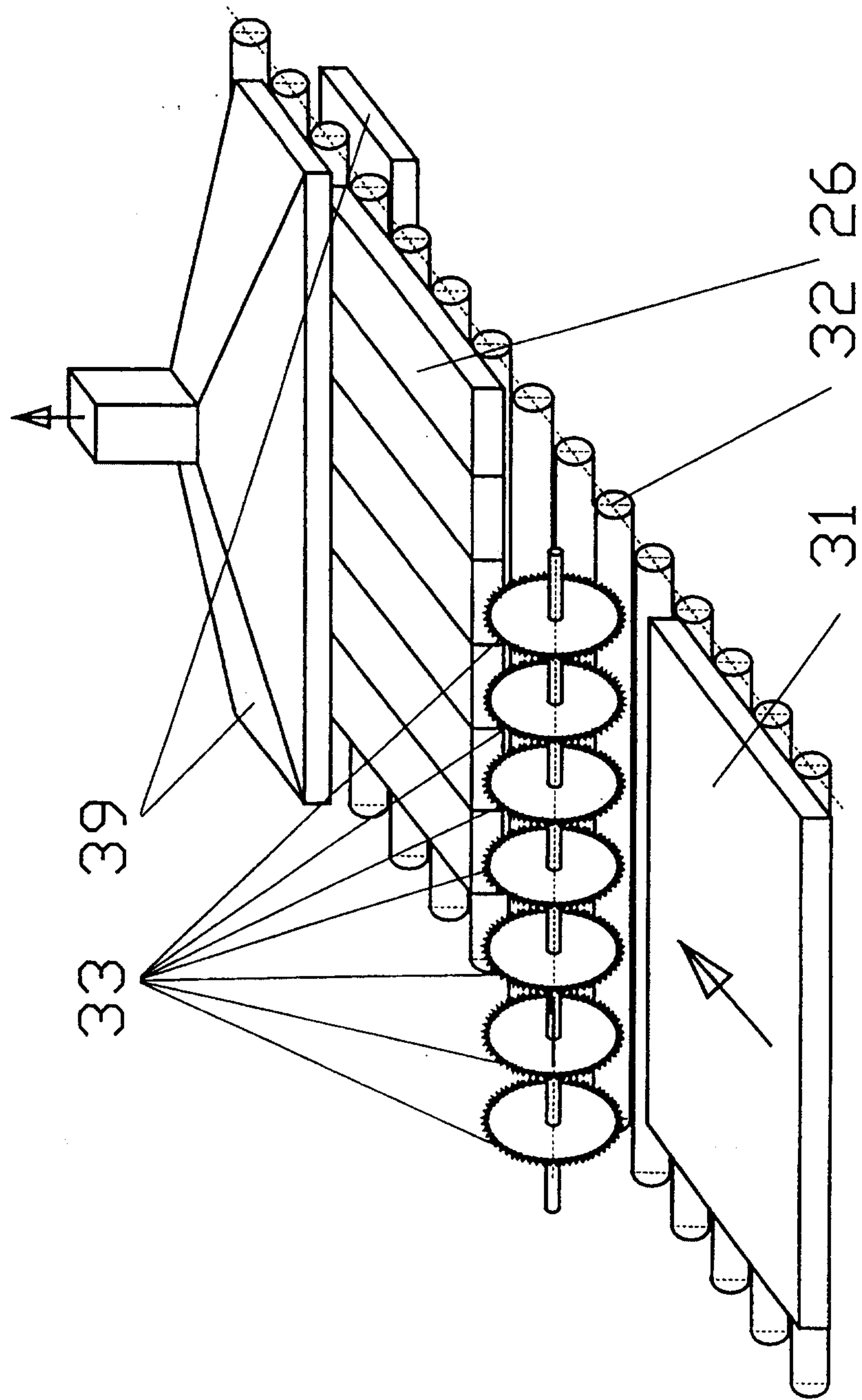


FIG.13

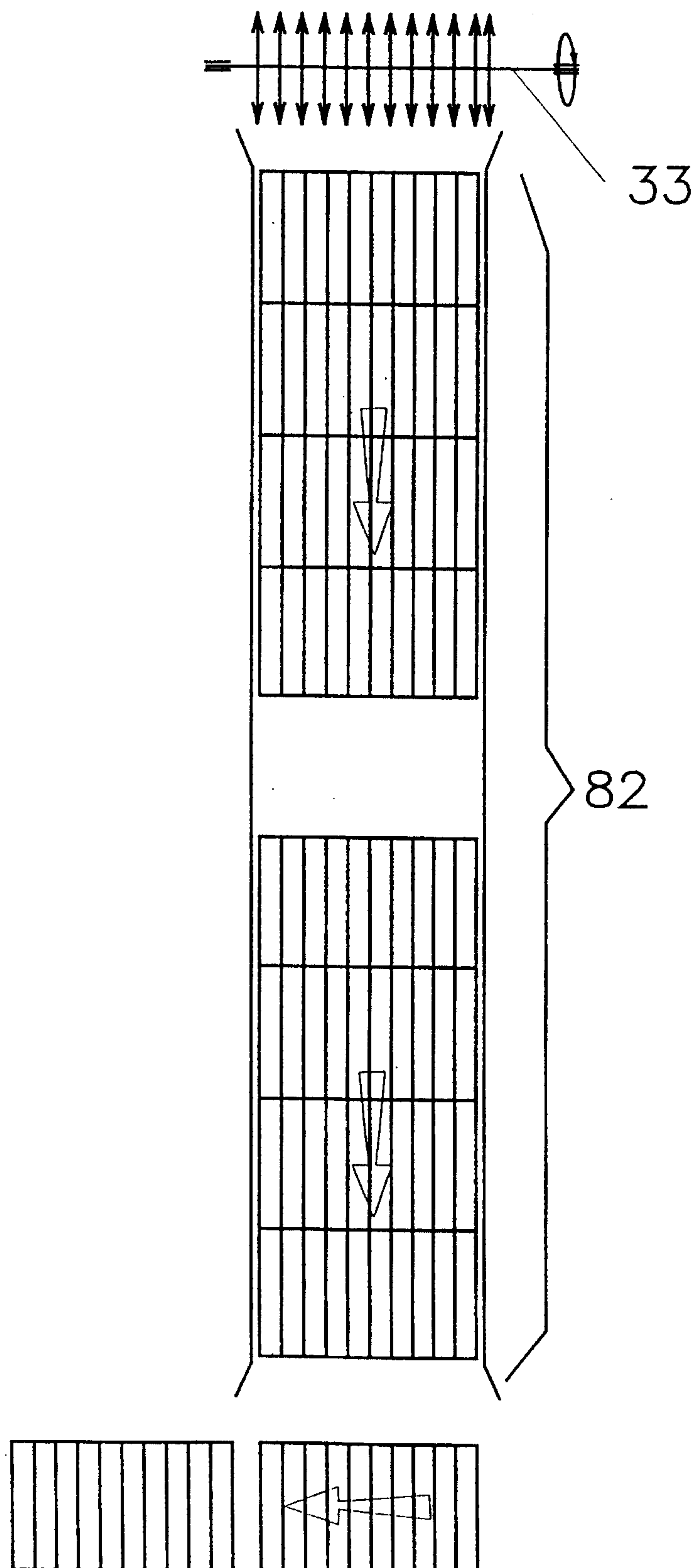


FIG. 14

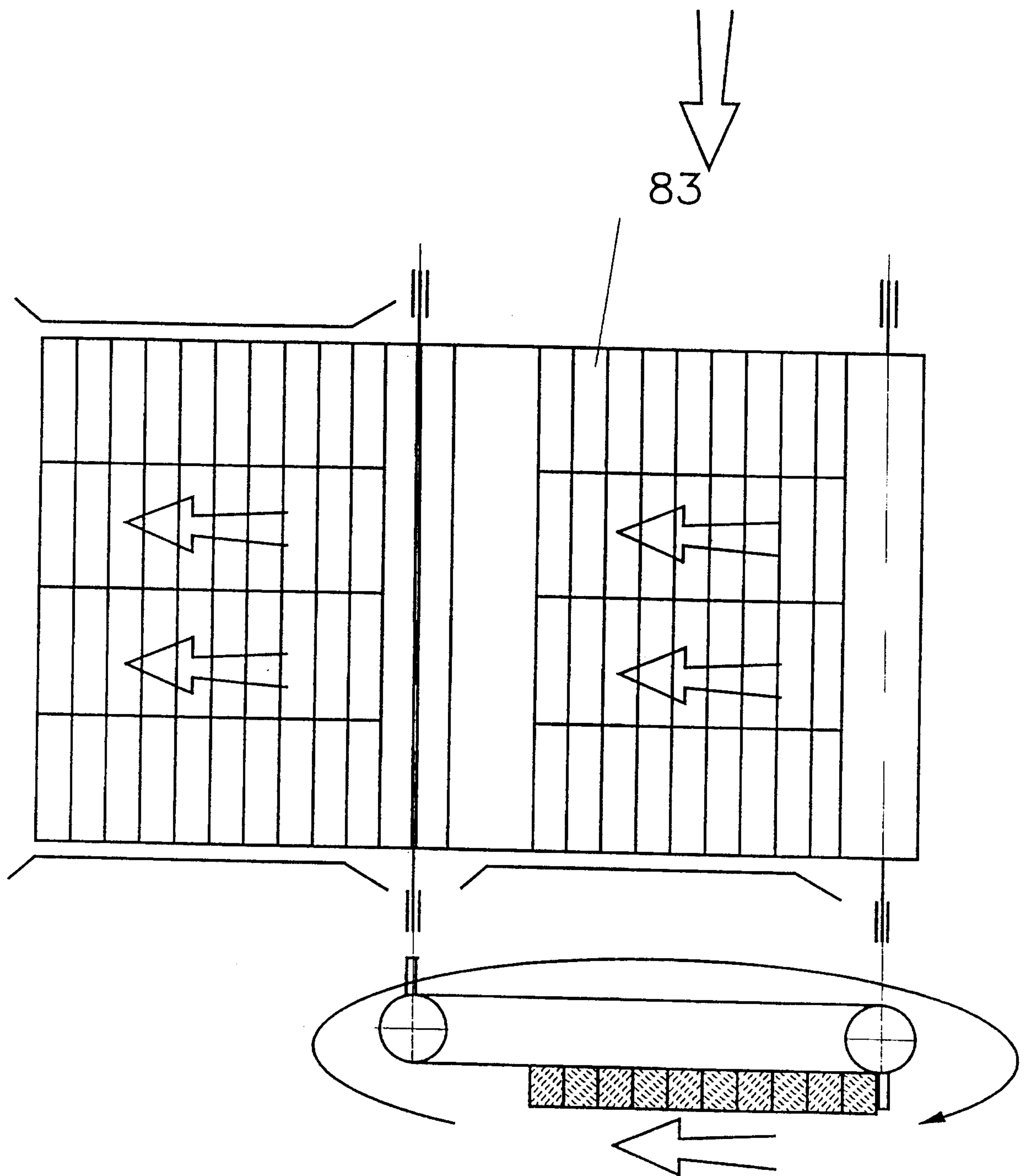


FIG.15

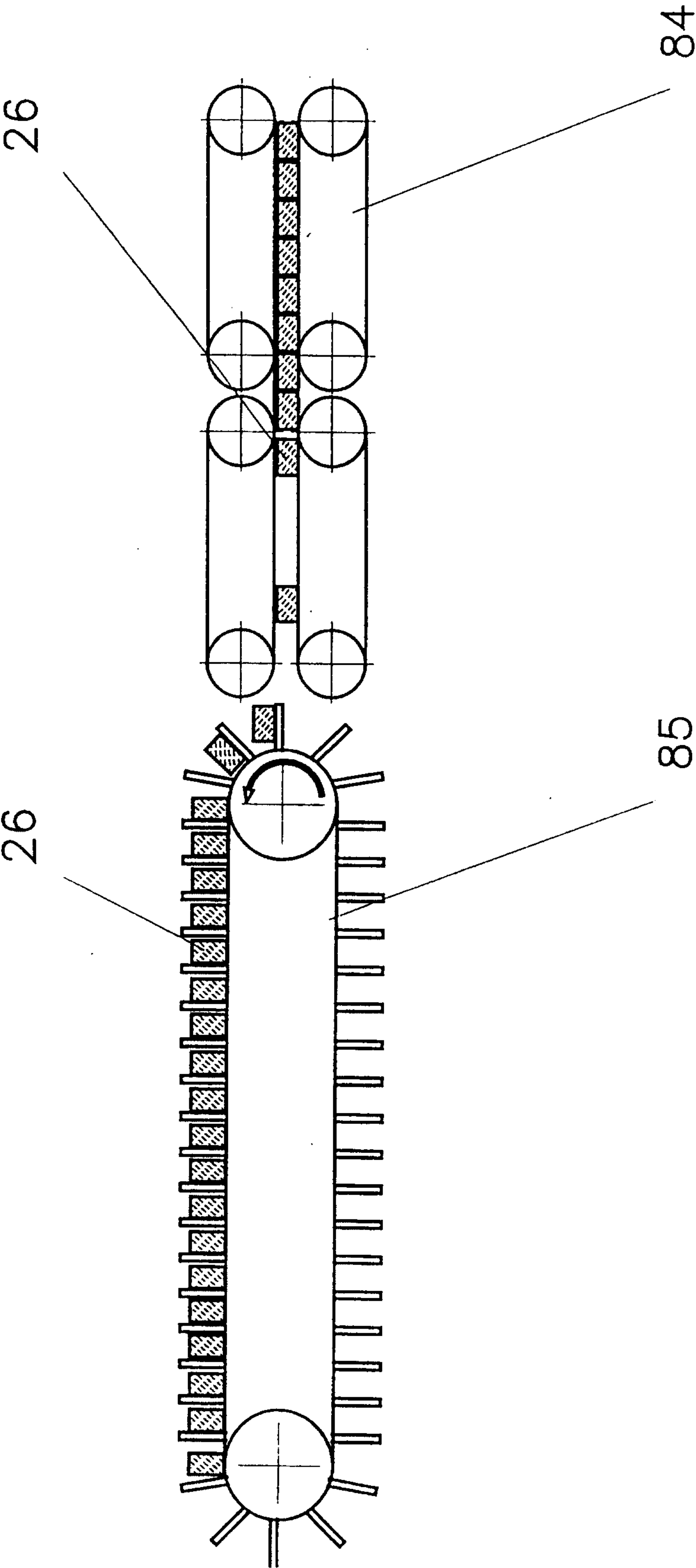


FIG.16

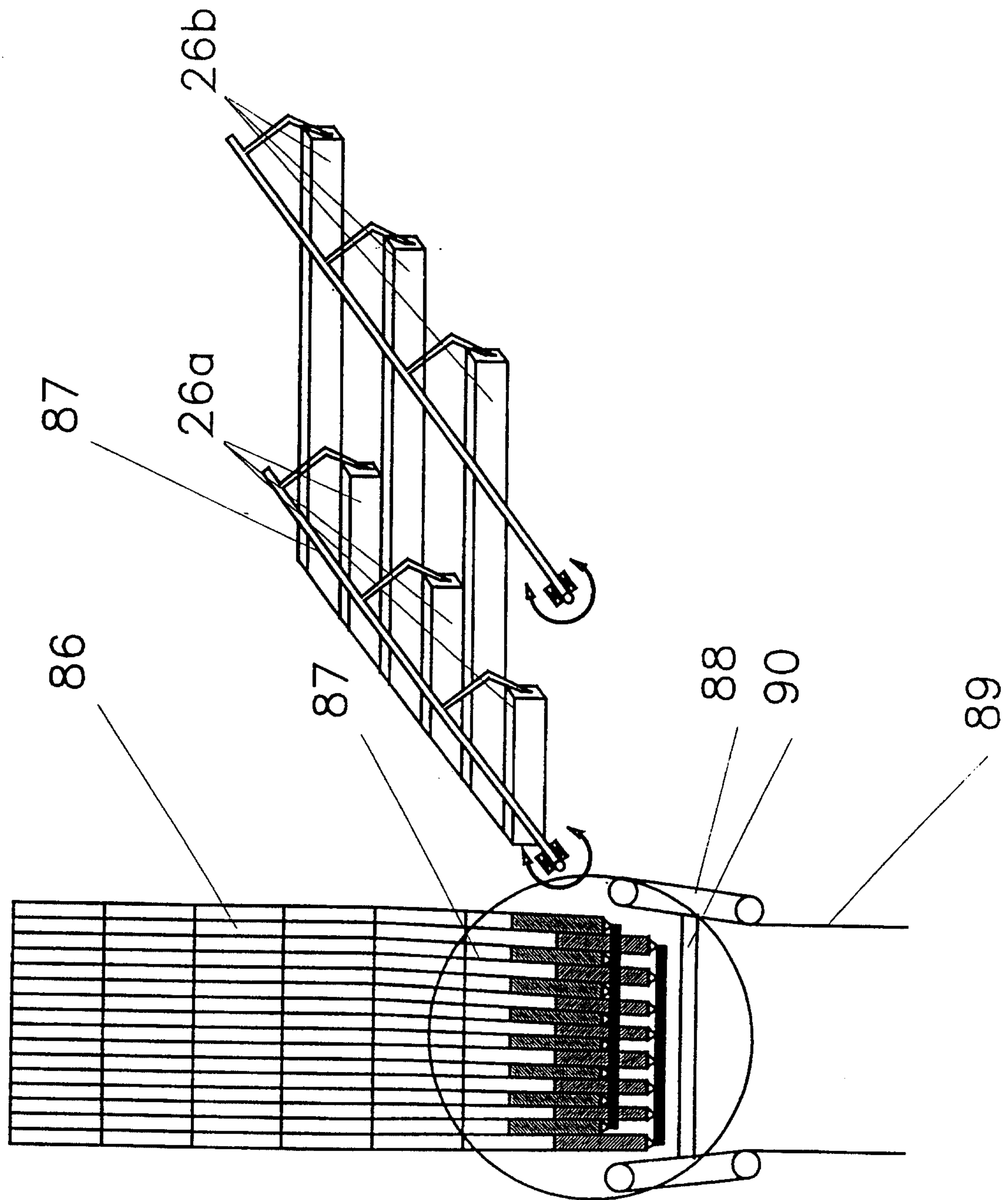


FIG.17

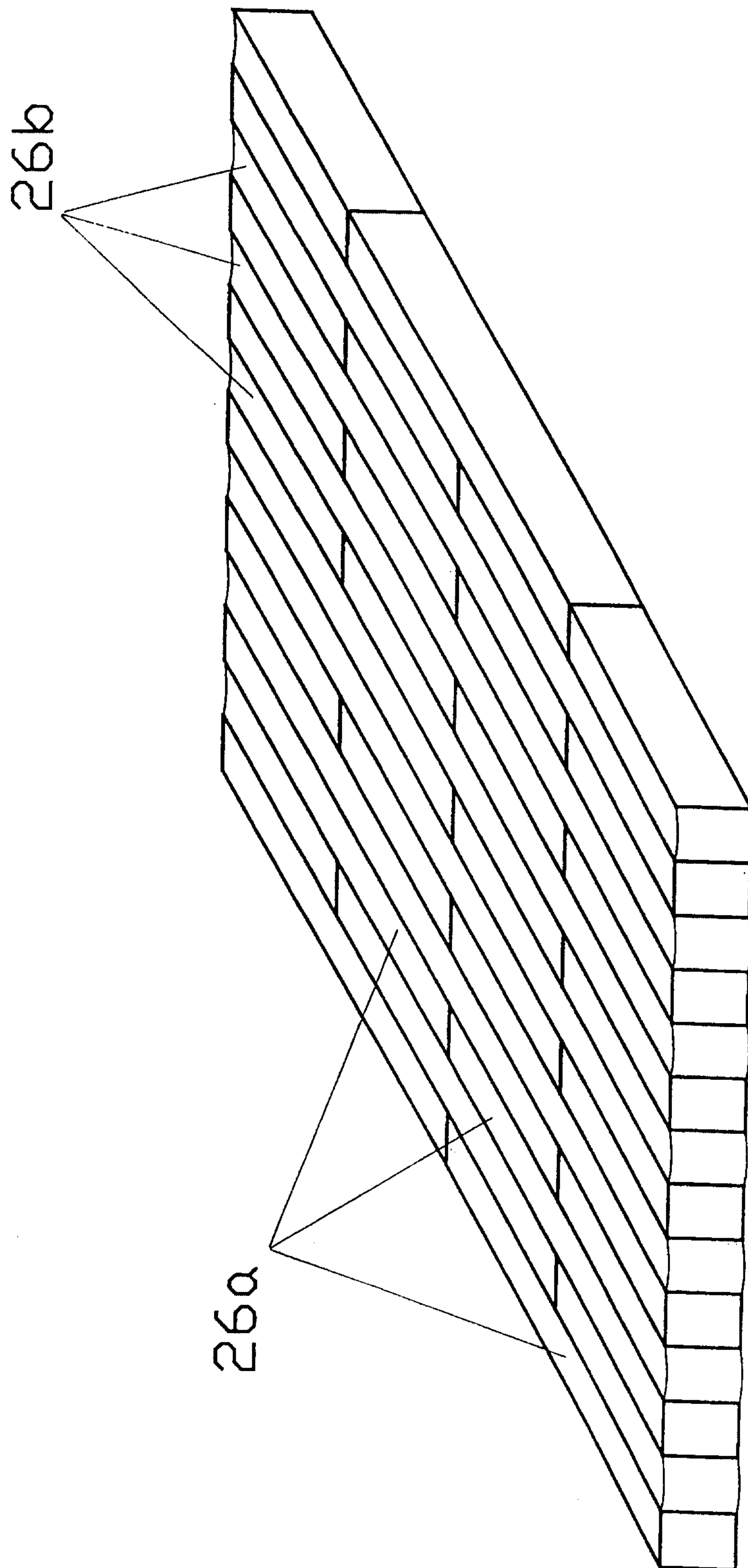


FIG. 18

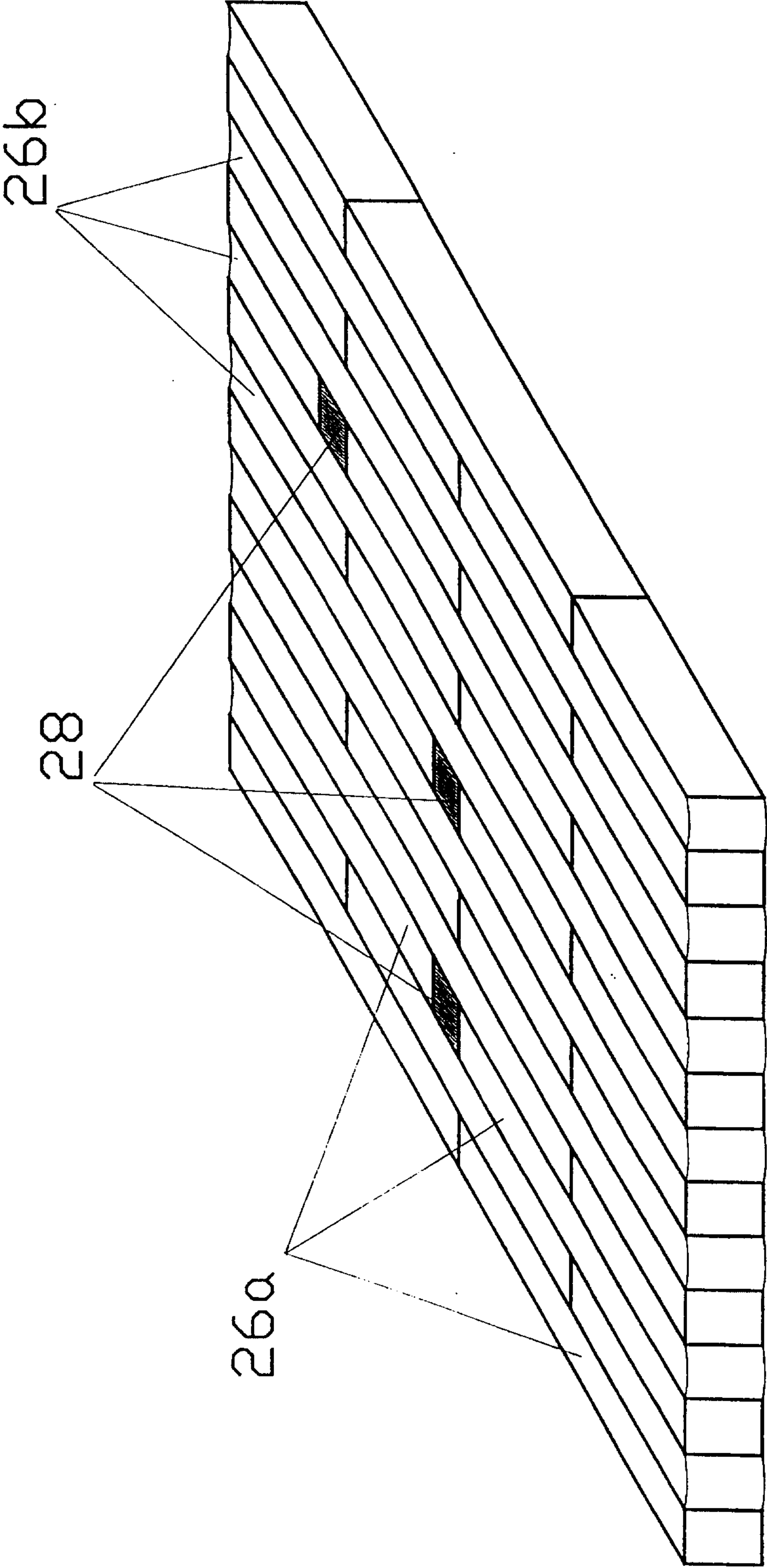


FIG.19

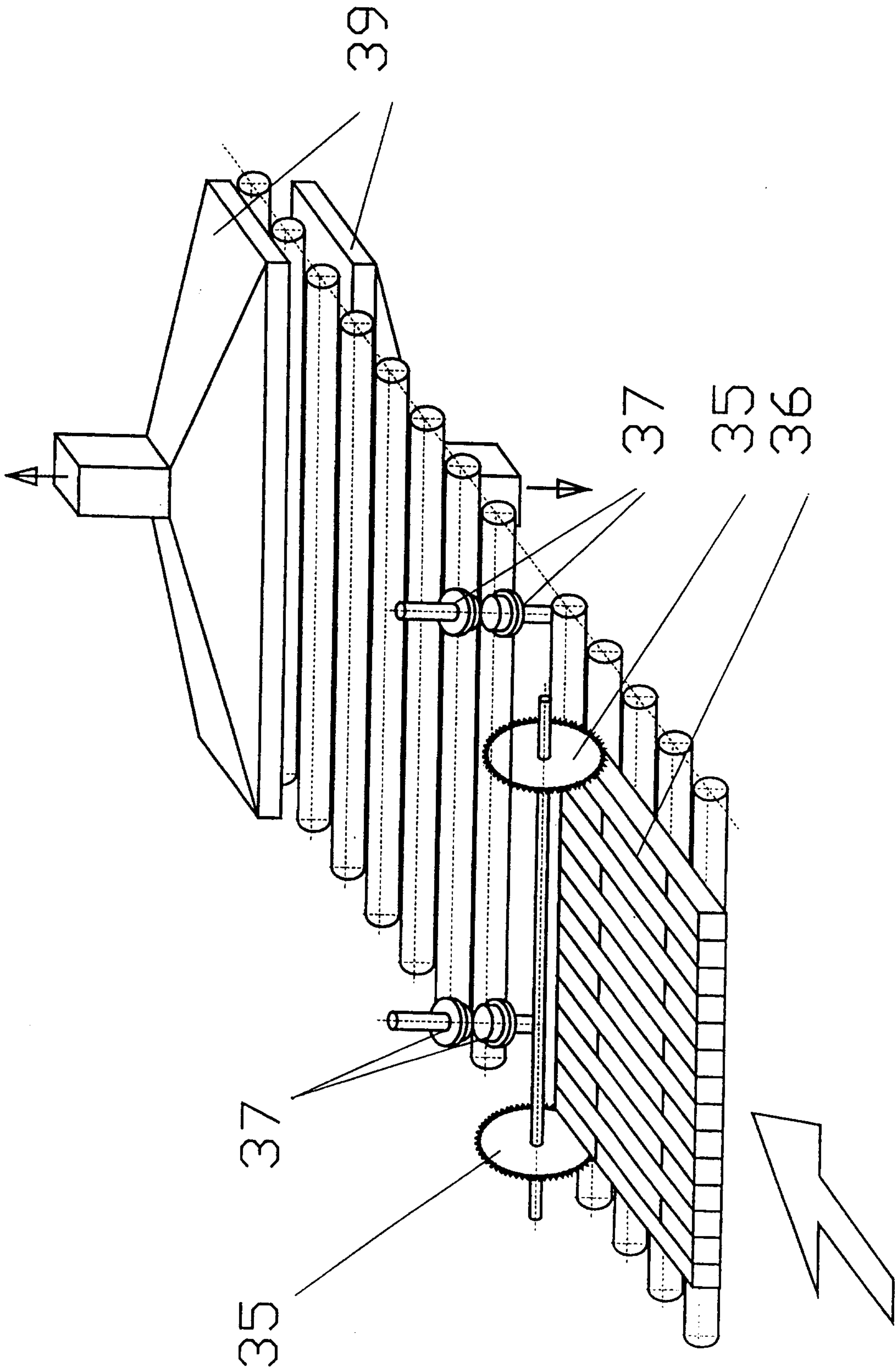


FIG. 20

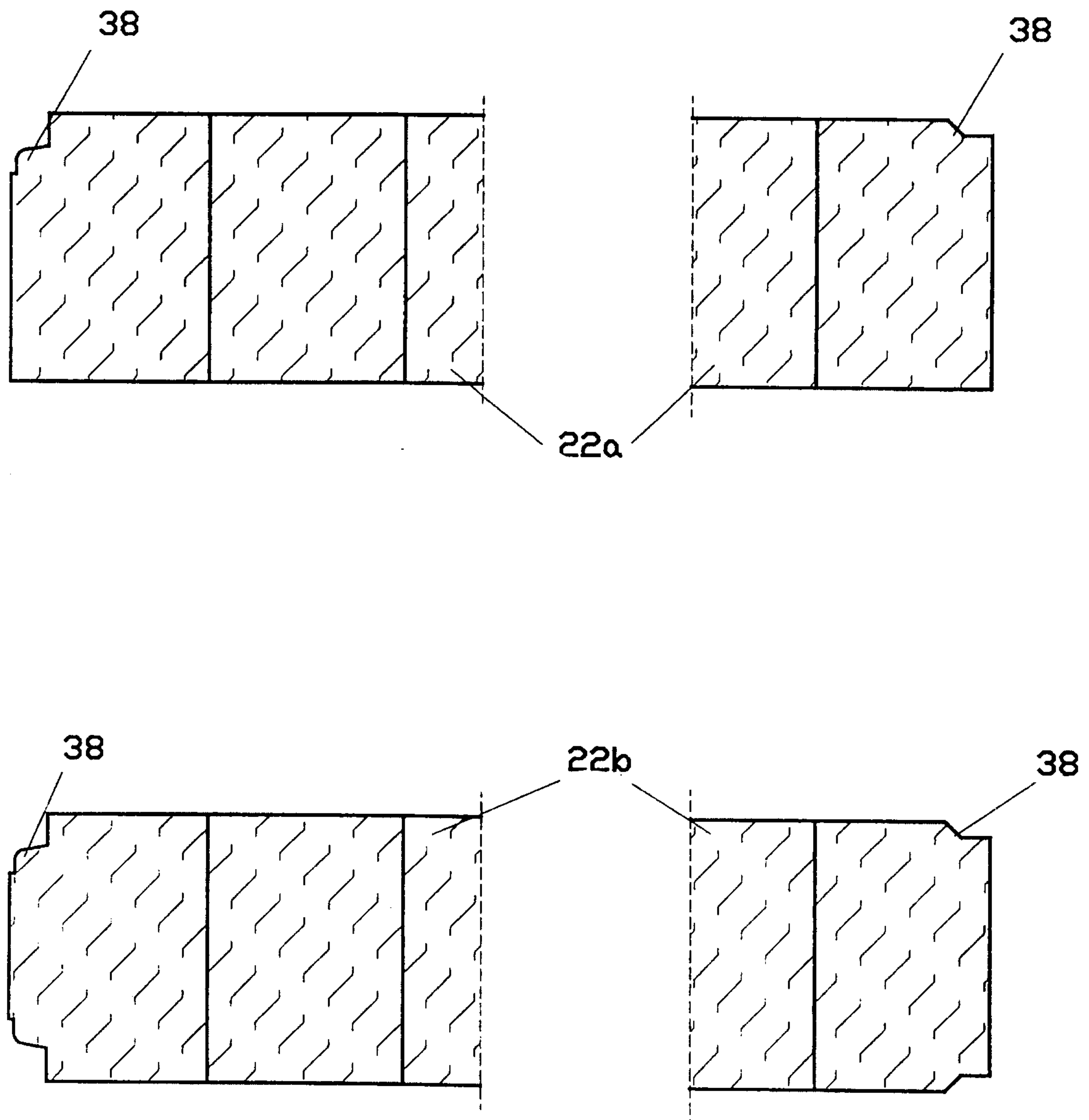


FIG. 21

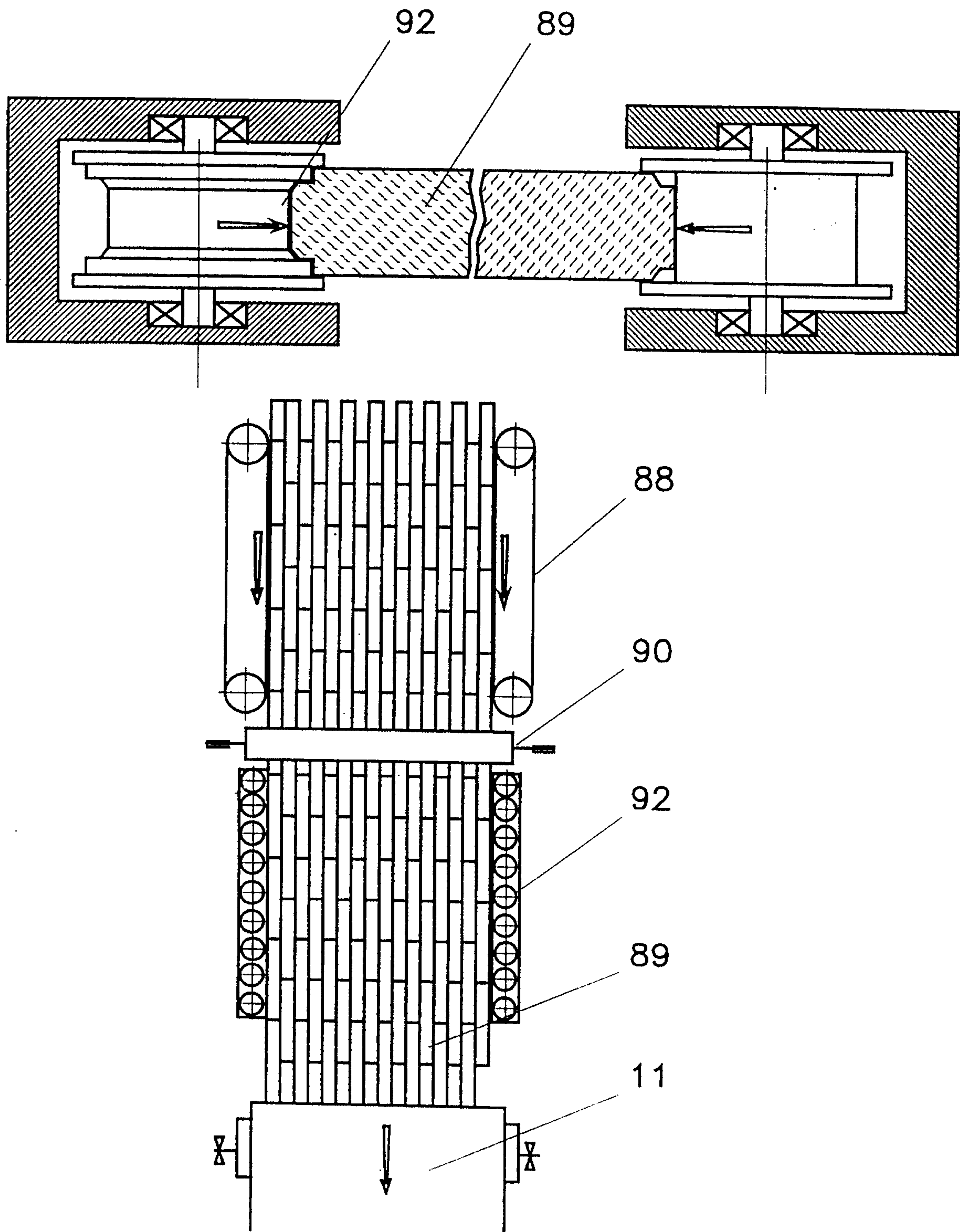


FIG.22

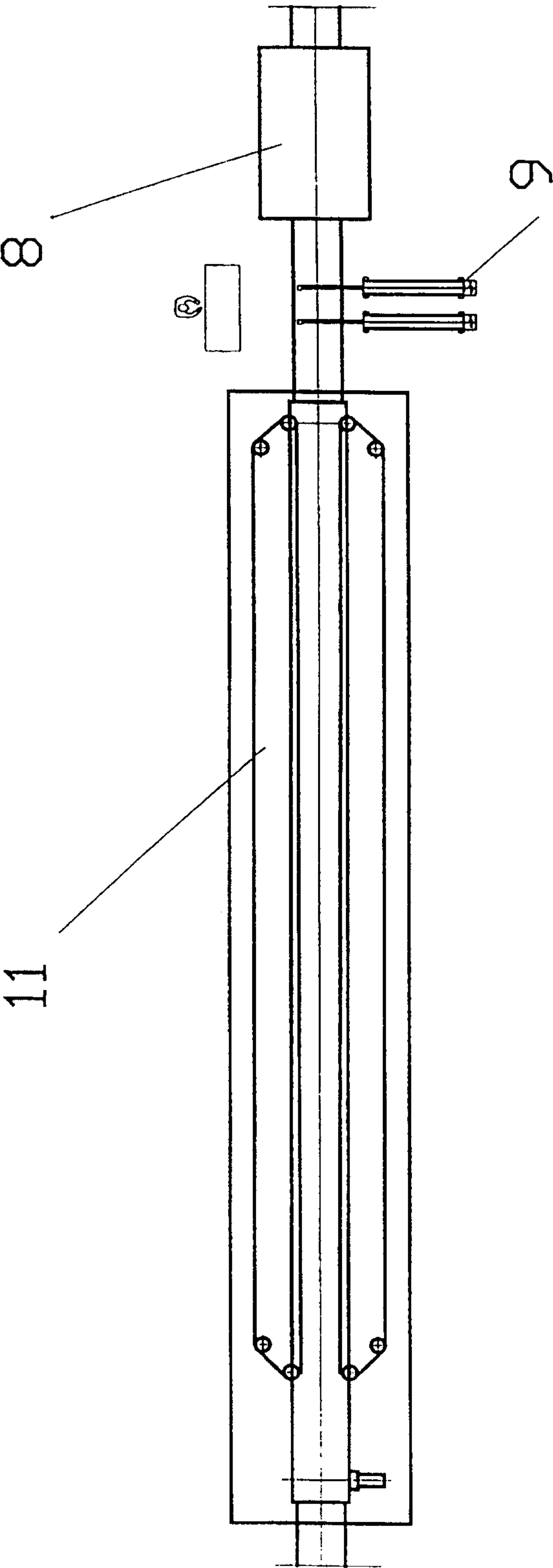
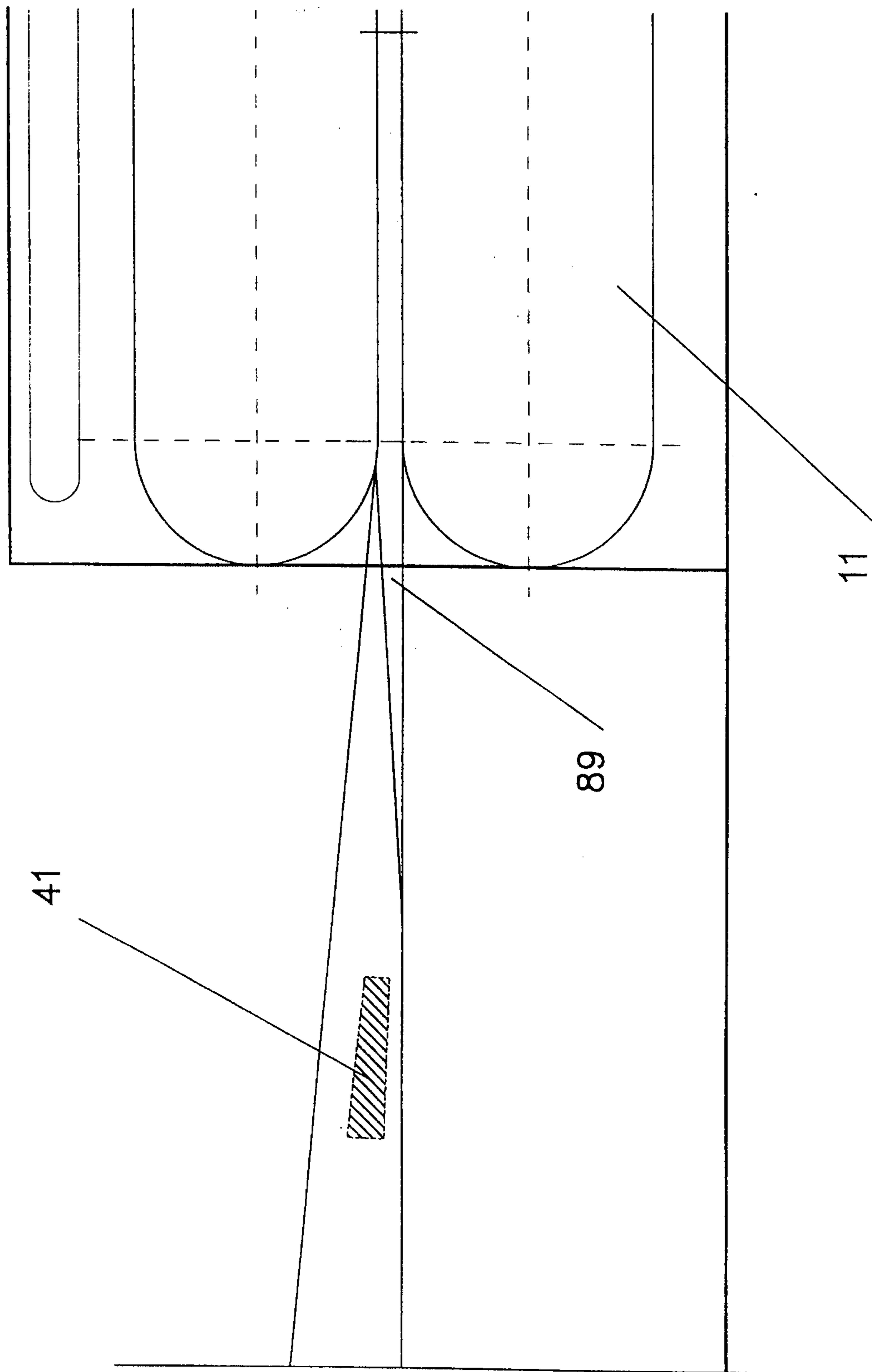


FIG.23



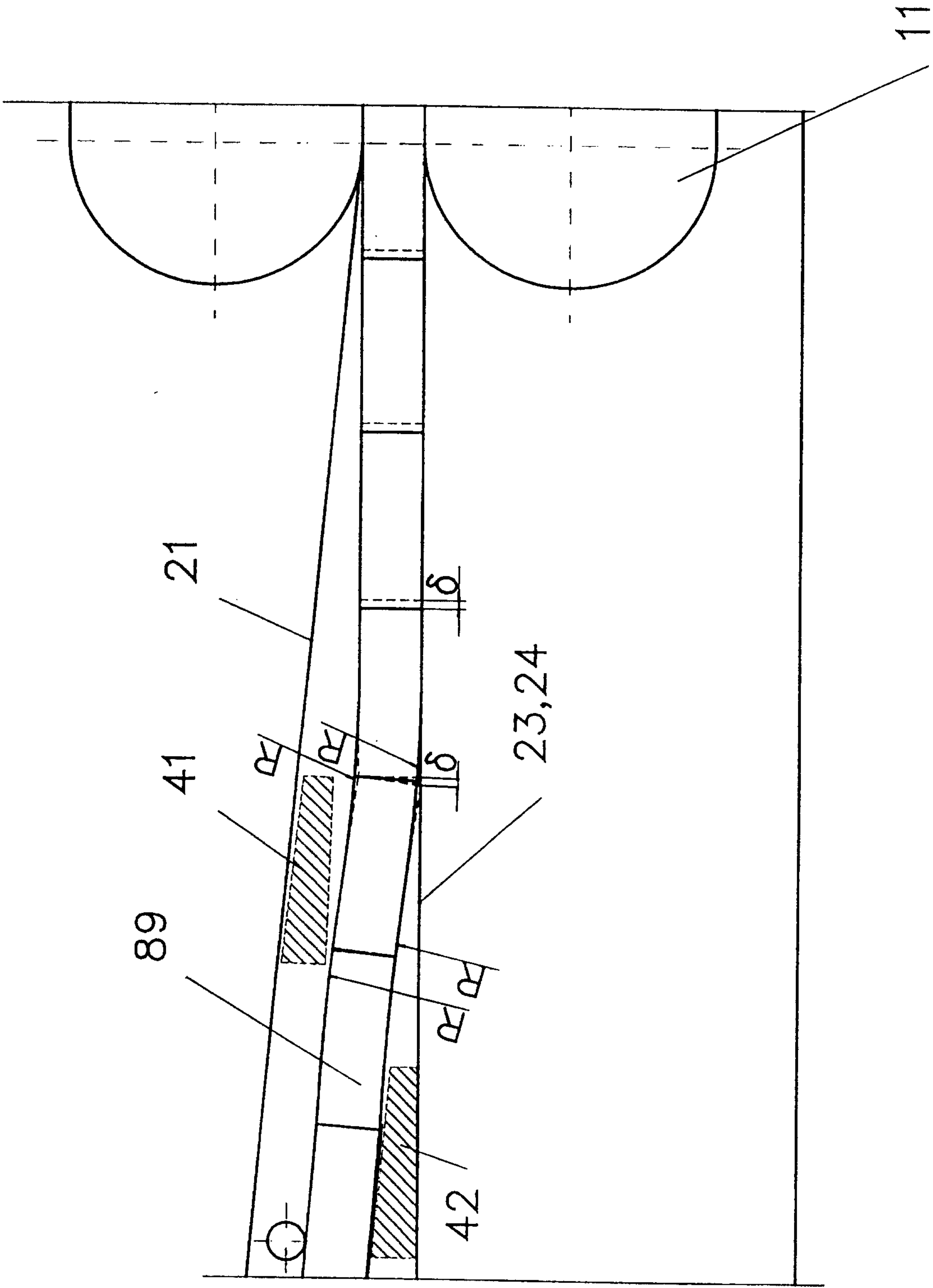


FIG.25

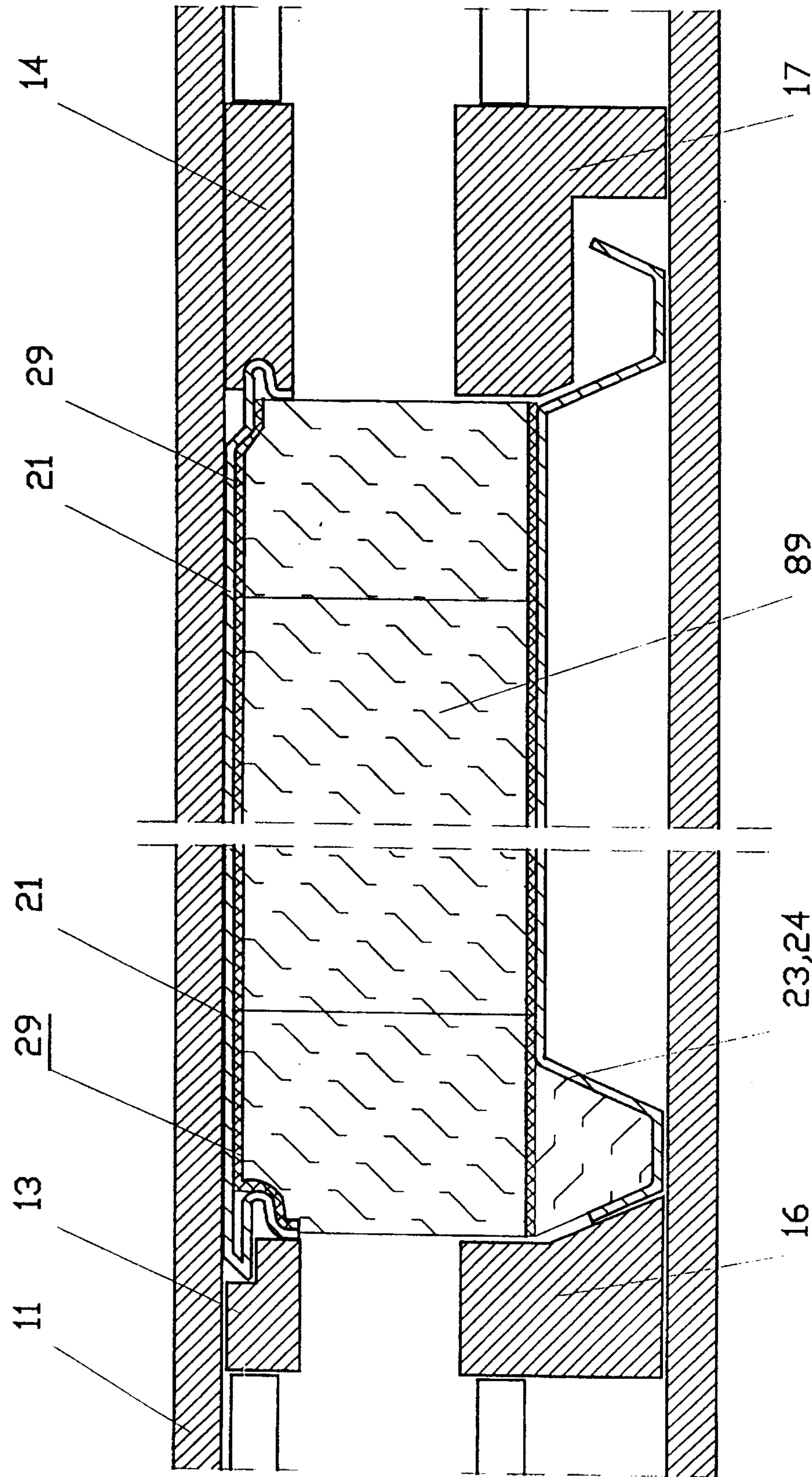


FIG. 26

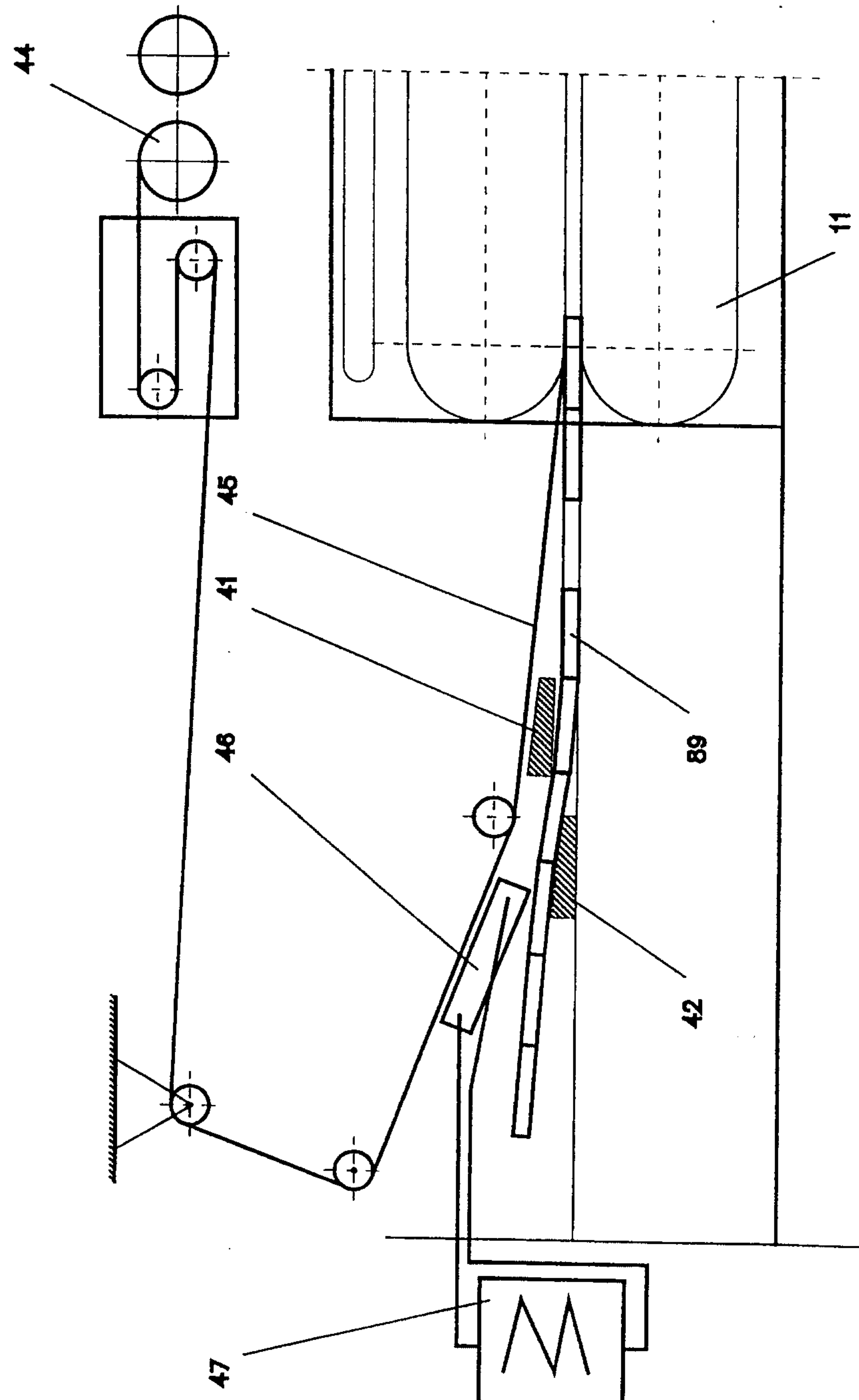


FIG. 27

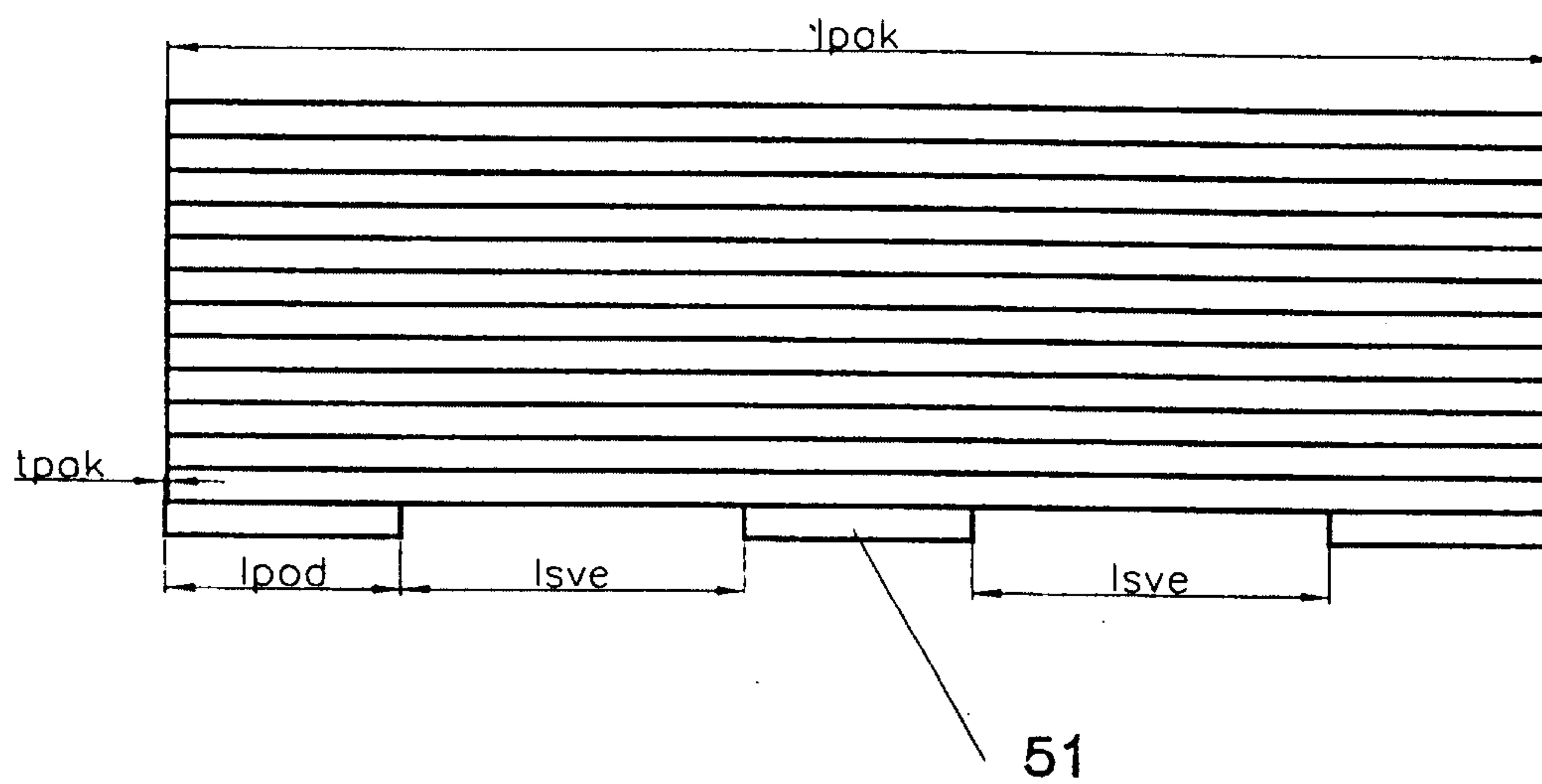


FIG.28

