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(54) A METHOD OF PRODUCING A MINERAL FIBER-INSULATING WEB AND A PLANT FOR PRODUCING A MINERAL FIBER WEB

VERFAHREN ZUR HERSTELLUNG EINER MINERALFASERBAHN, UND EINE ANLAGE ZUR HERSTELLUNG EINER MINERALFASERBAHN

PROCEDE ET INSTALLATION DE PRODUCTION D'UNE BANDE ISOLANTE EN FIBRES MINERALES

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Description

[0001] The present invention generally relates to the technical field of producing mineral fiber-insulating plates. Mineral fibers generally comprise fibers such as rockwool fibers, glass fibers, etc. More precisely, the present invention relates to a novel technique of producing a mineral fiber-insulating web from which mineral fiber-insulating plates are cut. The mineral fiber-insulating plates produced from the mineral fiber-insulating web produced in accordance with the present invention exhibit advantageous characteristics as to mechanical performance, such as modulus of elasticity and strength, low weight and good thermal-insulating property.

[0002] Mineral fiber-insulating webs are normally hitherto produced as homogeneous webs, i.e. webs in which the mineral fibers of which the mineral fiber-insulating web is composed, are generally orientated in a single predominant orientation which is mostly determined by the orientation of the production line on which the mineral fiber-insulating web is produced and transmitted during the process of producing the mineral fiber-insulating web. The product made from a homogeneous mineral fiber-insulating web exhibits characteristics which are determined by the integrity of the mineral fiber-insulating web and which are predominantly determined by the binding of the mineral fibers within the mineral fiber-insulating plate produced from the mineral fiber-insulating web, and further predominantly determined by the area weight and density of the mineral fibers of the mineral fiber-insulating plate.

[0003] The advantageous characteristics of mineral fiber-insulating plates of a different structure has to some extent already been realized as techniques for the production of mineral fiber-insulating plates in which the mineral fibers are orientated in an overall orientation different from the orientation determined by the production line, has been devised, vide Published International Patent Application, International Application No. PCT/DK91/00383, International Publication No. WO92/10602, US patent No. 4,950,355, and US patent No. 3,493,252. Reference is made to the above patent applications and patents, and the above US patents are hereby incorporated in the present specification by reference.

[0004] From the above published international patent application, International Publication No. WO92/10602, a method of producing an insulating mineral fiber plate composed of interconnected rod-shaped mineral fiber elements is known. The method includes cutting a continuous mineral fiber web in the longitudinal direction thereof in order to form lamellae, cutting the lamellae into desired lengths, turning the lamellae 90° about the longitudinal axis and bonding the lamellae together for forming the plate. The method also includes a step of curing the continuous mineral fiber web, or alternatively the plate composed of the individual lengths of lamellae bonded together for the formation of the plate.

[0005] From US patent No. 3,493,452, a method of producing a fibrous sheet structure including filaments or fibers of a polymeric material such as polyethylene trephtalate or polyhexamethyleaditamide is known. The method includes producing the polymeric material filaments or fibers by means of a carting machine from a supply of filaments or fibers constituted by a porous resilient bat of filaments or fibers, collecting the polymeric material filaments or fibers on a belt for the formation of a continuous web of polymeric material filaments or fibers, compressing the web, cutting the web into a series of parallel fiber strips including polymeric material filaments or fibers and turning the fiber strips 90° about the longitudinal axis and adjoining the strips together as the strips are caused to effect unification solely through the release of a compression effect which has been applied to the strips during the process of turning the strips. The web produced in accordance with the technique described in the above US patent is suitable for manufacturing fabrics such as carpets, blankets, bed spreads, bathrobes etc.

[0006] An object of the present invention is to provide a novel method of producing a mineral fiber-insulating web from which mineral fiber-insulating plates may be cut which method renders it possible in an online production plant to produce mineral fiber-insulating plates which are of a composite and complex structure providing distinct advantages as compared to the prior art homogeneous single direction orientated mineral fiber-containing plates.

[0007] A particular advantage of the present invention relates to the novel mineral fiber-insulating plate according to the present invention and produced in accordance with the method according to the present invention which as compared to prior art mineral fiber-insulating plates contains less mineral fibers and is consequently less costly than the prior art mineral fiber-insulating plates, still exhibiting advantages as compared to the prior art mineral fiber-insulating plates relating to mechanical performance and thermal-insulating properties.

[0008] A further advantage of the present invention relates to the fact that the amount of material wasted by producing mineral fiber-insulating plates in accordance with the method according to the present invention is basically non-existing, or at least reduced to a very low percentage, such as the percentage of 0-2% of the amount of material used for producing the mineral fiber-insulating plate.

[0009] A particular feature of the present invention relates to the fact that the novel mineral fiber-insulating plate according to the present invention and produced in accordance with the method according to the present invention is produceable from less mineral fibers or less material as compared to the prior art mineral fiber-insulating plate still providing the same properties as the prior art mineral fiber-insulating plate regarding mechanical performance and thermal-insulating properties, thus, providing a more lightweight and more compact mineral fiber-insulating plate product as compared to the prior art mineral fiber-insulating plate product reducing transport, storage and handling costs.

[0010] The above object, the above advantage and the above feature together with numerous other objects, advantages and features which will be evident from the below detailed description of present preferred embodiments of the invention are obtained by a method according to the present invention comprising the following steps:

a) producing a first non-woven mineral fiber web defining a first longitudinal direction parallel with the mineral fiber web and a second transversal direction parallel with the first mineral fiber web, the first mineral fiber web containing mineral fibers arranged generally in the second transversal direction and including a first heat-curable bonding agent, the first non-woven mineral fiber web defining a first mineral fiber web height,
b) moving the first mineral fiber web in the first longitudinal direction of the first mineral fiber web,
c) cutting the first mineral fiber web parallel with the first longitudinal direction and perpendicular to the second transversal direction so as to produce a plurality of mutually parallel mineral fiber strips extending in the first longitudinal direction, the mutually parallel mineral fiber strips being of identical width,
d) tilting each of the mutually parallel mineral fiber strips so as to turn the mineral fibers of each of the mutually parallel mineral fiber strips from the arrangement generally in the second transversal direction to the arrangement generally perpendicular to the first longitudinal direction and the second transversal direction,
e) adjoining the tilted mineral fiber strips in abutting relationship so as to produce a second non-woven mineral fiber web defining a second mineral fiber web height identical to the width of the mutually parallel mineral fiber strips, the second mineral fiber web containing mineral fibers arranged generally perpendicular to the first longitudinal direction and the second transversal direction,
f) moving the second mineral fiber web in the first longitudinal direction,
g) producing a third non-woven mineral fiber web defining a third direction parallel with the third mineral fiber web, the third mineral fiber web containing mineral fibers arranged generally in the third direction and including a second heat-curable bonding agent, the third mineral fiber web being a mineral fiber web of a higher compactness as compared to the second mineral fiber web,
h) adjoining the third mineral fiber web to the second mineral fiber web in facial contact therewith for producing a fourth composite mineral fiber web, and
i) curing the first and second curable bonding agents so as to cause the mineral fibers of the fourth composite mineral fiber web to bond to one another, thereby forming the mineral fiber-insulating web.

[0011] The third non-woven mineral fiber web which is adjoined to the second mineral fiber web in step f) may constitute a separate mineral fiber web. Thus, the first and the third mineral fiber webs may be produced by separate production lines which are joined together in step f).

[0012] In accordance with the presently preferred embodiment of the method according to the present invention, the third non-woven mineral fiber web is produced by separating a surface segment layer of the first mineral fiber web therefrom and by compacting the surface segment layer for producing the third mineral fiber web.

[0013] The method according to the present invention preferably further comprises the additional step similar to step g) of producing a fifth non-woven mineral fiber web similar to the third mineral fiber web, and the step of adjoining in step h) the fifth mineral fiber web to the second mineral fiber web in facial contact therewith and so as to sandwich the second mineral fiber web between the third and fifth mineral fiber web in the fourth mineral fiber web. By producing a fifth non-woven mineral fiber web an integral composite mineral fiber structure of the fourth mineral fiber web is accomplished in which structure, the central body originating from the second mineral fiber web is sandwiched between opposite compacted surface layers constituted by the third and the fifth mineral fiber webs. The method according to the present invention further preferably

[0014] comprises the introduction step of producing a first mineral fiber web from a basic non-woven mineral fiber web by arranging the basic mineral fiber web in overlapping layers so as to provide a more homogeneous and compact mineral fiber web as compared to the basic mineral fiber web which additionally contains mineral fibers generally orientated along the longitudinal direction of the basic mineral fiber web. By producing the first mineral fiber web from the basic non-woven mineral fiber web by arranging the basic mineral fiber web in overlapping layers, the general orientation of the mineral fibers of the basic non-woven mineral fiber web is shifted from the longitudinal direction of the basic mineral fiber web to the transversal direction of the first non-woven mineral fiber web. The basic non-woven mineral fiber web is preferably arranged in overlapping relation generally in the second transversal direction.

[0015] In accordance with the technique described in the above-mentioned published international patent application, application No. PCT/DK91/00383, publication No. WO 92/10602, the first and second non-woven mineral fiber webs are preferably exposed to compacting and compression in order to provide more compact and more homogeneous mineral fiber webs. The compacting and compression may include heigt compression, longitudinal compression, transversal compression and combinations thereof. Thus, the method according to the present invention preferably further comprises the additional step of height-compressing the first non-woven mineral fiber web produced in step a) and preferably produced from the basic non-woven mineral fiber web as described above.

[0016] Further preferably, the method according to the present invention may comprise the additional step of longitudinally compressing the first non-woven mineral fiber web produced in step a) and additionally or alternatively the additional step of longitudinally compressing the second non-woven mineral fiber web produced in step e). By performing a longitudinal compression, the mineral fiber web exposed to the longitudinal compression is made more homogeneous, resulting In an overall improvement of the mechanical performance and, in most instances, the thermal-insulating property of the longitudinally compressed mineral fiber web as compared to a non-longitudinally compressed mineral fiber web.

[0017] As will be evident from the detailed description below of presently preferred embodiments of the present invention, the mineral fiber-insulating plates produced in accordance with the method according to the present invention exhibit surprisingly improved mechanical properties and mechanical performance, provided the second non-woven mineral fiber web produced in step e) is exposed to transversal compression, producing a homogenization of the mineral fiber structure of the second non-woven mineral fiber web. The transversal compression of the second non-woven mineral fiber web results in a remarkable improvement of the mechanical properties and performance of the final mineral fiber-insulating plates produced from the second non-woven mineral fiber web, which improvement is believed to originate from a mechanical repositioning of the mineral fibers of the second non-woven mineral fiber web, as the second non-woven mineral fiber web is exposed to the transversal compression, by which repositioning the mineral fibers of the second non-woven mineral fiber web are evenly distributed throughout the uncured mineral fiber web.

[0018] The method according to the present invention may further preferably and advantageously comprise the step of applying a foil to a side surface of both side surfaces of the first non-woven mineral fiber web and/or applying a foil to a side surface or both side surfaces of the second non-woven mineral fiber web. The foil may be a foil of a plastics material, such as a continuous foil, a woven or non-woven mesh, or alternatively a foil of a non-plastics material, such as a paper or cloth material. The mineral fiber-insulating web produced in accordance with the method according to the present invention may, as discussed above, be provided with two oppositely arranged mineral fiber webs sandwiching a central body of the composite mineral fiber-insulating web. Provided the mineral fiber-insulating web is produced as a three-layer assembly, one or both outer side surfaces may be provided with similar or identical surface coverings.

[0019] The method according to the present invention may further comprise the additional step of compressing the fourth composite mineral fiber web prior to introducing the fourth composite mineral fiber web into the curing oven. The compressing of the fourth composite mineral fiber web may comprise height compression, longitudinal compression and/or transversal compression. By compressing the fourth composite mineral fiber web, the homogenity of the final product is believed to be improved as the compressing of the fourth composite mineral fiber web produces a homogenizing effect on the central body of the fourth composite mineral fiber web, which central body is constituted by the central body of the second non-woven mineral fiber web.

[0020] The step i) of curing the first curable bonding agent and optionally the second and third curable bonding agents as well may, dependent on the nature of the curable bonding agent or bonding agents, be carried out in numerous diffent ways, e.g. by simply exposing the curable bonding agent or bonding agents to a curing gas or a curing atmosphere, such as the atmosphere, by exposing the curable bonding agent or bonding agents to radiation, such as UV radiation or IR radiation. Provided the curable bonding agent or bonding agents are a heat-curable bonding agents, such as conventional resin-based bonding agents normally used within the mineral fiber industry, the process of curing the curable bonding agent or bonding agents includes the step of introducing the mineral fiber web to be cured into a curing oven. Consequently, the curing process is performed by means of a curing oven. Further alternative curing appliances may comprise IR radiators, microwave radiators, etc.

[0021] From the cured mineral fiber-insulating web produced in step i), plate segments are preferably cut by cutting the cured fourth composite mineral fiber web into plate segment in a separate production step.

[0022] The above object, the above advantage and the above features together with numerous other objects, advantages and features is furthermore obtained by means of a plant for producing a mineral fiber-insulating web, comprising:

a) first means for producing a first non-woven mineral fiber web defining a first longitudinal direction parallel with the mineral fiber web and a second transversal direction parallel with the first mineral fiber web, the first mineral fiber web being produced containing mineral fibers arranged generally in the second transversal direction and including a first heat-curable bonding agent, the first non-woven mineral fiber web being produced defining a first mineral fiber web height,
b) second means for moving the first mineral fiber web in the first longitudinal direction of the first mineral fiber web,
c) third means for cutting the first mineral fiber web parallel with the first longitudinal direction and perpendicular to the second transversal direction so as to produce a plurality of mutually parallel mineral fiber strips extending in the first longitudinal direction, the mutually parallel mineral fiber strips being of identical width,
d) fourth means for tilting each of the mutually parallel mineral fiber strips so as to turn the mineral fibers of each of the mutually parallel mineral fiber strips from the arrangement generally in the second transversal direction to the arrangement generally perpendicular to the first longitudinal direction and the second transversal direction,
e) fifth means for adjoining the tilted mineral fiber strips in abutting relationship so as to produce a second non-

woven mineral fiber web defining a second mineral fiber web height identical to the width of each of the mutually parallel mineral fiber strips, the second mineral fiber web being produced containing mineral fibers arranged generally perpendicular to the first longitudinal direction and the second transversal direction,

f) sixth means for moving the second mineral fiber web in the first longitudinal direction,

g) seventh means for producing a third non-woven mineral fiber web defining a third direction parallel with the third mineral fiber web, the third mineral fiber web being produced containing mineral fibers arranged generally in the third direction and including a second heat-curable bonding agent, the third mineral fiber web being a mineral fiber web of a higher compactness as compared to the second mineral fiber web,

h) eight means for adjoining the third mineral fiber web to the second mineral fiber web in facial contact therewith for producing a fourth composite mineral fiber web, and

i) ninth means for curing the first and second curable bonding agents so as to cause the mineral fibers of the fourth composite mineral fiber web to bond to one another, thereby forming the mineral fiber-insulating web.

[0023] The plant according to the present invention may additionally advantageously comprise any of the above features of the method according to the present invention.

[0024] From US 3,230,995, a structural panel is known which structural panel is produced from lamellae including mineral fibers and being linked together by means of reinforcing strips which are adhered to the lamellae by means of adhesives which are cured in a separate or further curing process. According to the technique disclosed in US 3,230,995, two separate heat curing processes are utilized, a first heat curing process being used for curing the bonding agent bonding the mineral fibers of an integral mineral fiber web together from which integral and bonded mineral fiber web the lamellae are cut, and a second heat curing process in which the reinforcing elements are bonded to the previously cured mineral fiber containing lamellae.

[0025] The above object, the above advantage and the above features together with numerous other objects, advantages and features is furthermore obtained by means of a mineral fiber-insulating plate according to the present invention, which mineral fiber-insulating plate defines a longitudinal direction and comprises:

a central body containing mineral fibers,

a surface layer containing mineral fibers, the central body and the surface layer being adjoined in facial contact with one another,

the mineral fibers of the central body being arranged generally perpendicularly to the longitudinal direction and perpendicularly to the surface layer,

the mineral fibers of the surface layer being arranged generally in a direction parallel with the longitudinal direction, the surface layer being of a higher compactness as compared to the central body, and

the mineral fibers of the central body and the mineral fibers of the surface layer being bonded together in an integral structure solely through cured bonding agents cured in a single curing process and initially present in non-woven mineral fiber webs from which the central body and the surface layer are produced.

[0026] The mineral fiber-insulating plate according to the present invention preferably comprises opposite surface layers of similar structure sandwiching the central body in the integral structure of the mineral fiber-insulating plate.

[0027] The present invention will now be further described with reference to the drawings, in which

Fig. 1 is a schematic and perspective view illustrating a first production step of producing a mineral fiber-insulating web from a mineral fiber forming melt,

Fig. 2 is a schematic and perspective view illustrating a production step of compacting a mineral fiber-insulating web,

Fig. 3 is a schematic and perspective view illustrating a production step of separating a surface layer of the mineral fiber-insulating web produced in accordance with the production steps shown in Fig. 1 and optionally compacted in accordance with the production step shown in Fig. 2

Fig. 4a is a schematic and perspective view illustrating a production step of cutting a mineral fiber-insulating web into longitudinally extending strips and of turning the strips 90° and furthermore illustrating a production step of adjoining the strips,

Fig. 4b is a schematic and perspective view illustrating a production step of transversely compacting the strips out, turned and adjoined in the production step shown in Fig. 4a,

Fig 4c is a schematic and perspective view illustrating a production step of simultaneously transversally compressing, height-compressing and longitudinally compressing a mineral fiber-insulating web,

Fig. 5 is a schematic and perspective view illustrating the production step of adjoining a surface layer, preferably a compacted surface layer to a mineral fiber-insulating web produced in accordance with the production steps shown in Figs. 3, 4a and 4b, and of curing the mineral fiber-insulating web and furthermore illustrating a production step of separating the cured mineral fiber-insulating web into plate segments,

Fig. 6a is a schematic and perspective view illustrating a first embodiment of a mineral fiber-insulating plate segment produced in accordance with the techniques disclosed in Figs. 1-5,

Fig. 6b is a schematic and perspective view illustrating a second embodiment of a mineral fiber-insulating plate segment produced in accordance with the techniques disclosed in Figs. 1-5,

Figs. 7 and 8 are diagrammatic views illustrating production parameters of an online production plant producing general building-insulating plates from a mineral fiber-insulating web produced in accordance with the teachings of the present invention, and

Figs. 9 and 10 are diagrammatic views similar to the views of Figs. 7 and 8, respectively, illustrating production parameters of an online production plant producing mineral fiber heat-insulating roofing plates from a mineral fiber-insulating web produced in accordance with the teachings of the present invention.

[0028] In Fig. 1, a first step of producing a mineral fiber-insulating web is disclosed. The first step involve the formation of mineral fibers from a mineral fiber forming melt which is produced in a furnace 30 and which is supplied from a spout 32 of the furnace 30 to a total of four rapidly rotating spinning-wheels 34 to which the mineral fiber forming melt is supplied as a mineral fiber forming melt stream 36. As the mineral fiber forming melt stream 36 is supplied to the spinning-wheels 34 in a radial direction relative thereto, a cooling gas stream is simultaneously supplied to the rapidly rotating spinning-wheels 34 in the axial direction thereof causing the formation of individual mineral fibers which are expelled or sprayed from the rapidly rotating spinning-wheels 34 as indicated by the reference numeral 38. The mineral fiber spray 38 is collected on a continuously operated first conveyer belt 42 forming a primary mineral fiber-insulating web 40. A heat-curable bonding agent is also added to the primary mineral fiber-insulating web 40 either directly to the primary mineral fiber-insulating web 40 or at the stage of expelling the mineral fibers from the spinning-wheels 34, i.e. at the stage of forming the individual mineral fibers. The first conveyer belt 42 is, as is evident from Fig. 1, composed of two conveyer belt sections. A first conveyer belt section which is sloping relative to the horizontal direction and relative to a second substantially horizontal conveyer belt section. The first section constitutes a collector section, whereas the second section constitutes a transport section by means of which the primary mineral fiber-insulating web 40 is transferred to a second and a third continuously operated conveyer belt designated the reference numeral 44 and 46, respectively, which are operated in synchronism with the first conveyer belt 42 sandwiching the primary mineral fiber-insulating web 40 between two adjacent surfaces of the second and third conveyer belts 44 and 46, respectively.

[0029] The second and third conveyer belts 44 and 46, respectively, communicate with a fourth conveyer belt 48 which constitutes a collector conveyer belt on which a secondary mineral fiber-insulating web 50 is collected as the second and third conveyer belts 44 and 46, respectively, are swung across the upper surface of the fourth conveyer belt 48 in the transversal direction relative to the fourth conveyer belt 48. The secondary mineral fiber-insulating web 50 is consequently produced by arranging the primary mineral fiber-insulating web 40 in overlapping relation generally in the transversal direction of the fourth conveyer belt 48.

[0030] By producing the secondary mineral fiber-insulating web 50 from the primary mineral fiber-insulating web 40 as disclosed in Fig. 1, a more homogeneous secondary mineral fiber-insulating web 50 is produced as compared to the less homogeneous primary mineral fiber-insulating web 40.

[0031] It is to be realized that the overall orientation of the mineral fibers of the primary mineral fiber-insulating web 40 is parallel with the longitudinal direction of the web 40 and the direction of transportation of the first conveyer belt 42. Contrary to the primary mineral fiber-insulating web 40 the overall orientation of the mineral fibers of the secondary mineral fiber-insulating web 50 is substantially perpendicular and transversal relative to the longitudinal direction of the secondary mineral fiber-insulating web 50 and the direction of transportation of the fourth conveyer belt 48.

[0032] In Fig. 2, a station for compacting and homogenizing an input mineral fiber-insulating web 50' is shown, which station serves the purpose of compacting and homogenizing the input mineral fiber-insulating web 50' for producing an output mineral fiber-insulating web 50'', which output mineral fiber-insulating web 50'' is more compact and more homogeneous as compared to the input mineral fiber-insulating web 50'. The input mineral fiber-insulating web 50' may constitute the secondary mineral fiber-insulating web 50 produced in the station shown in Fig. 1.

[0033] The compacting station comprises two sections. The first section comprises two conveyer belts 52'' and 54'', which are arranged at the upper side surface and the lower side surface, respectively, of the mineral fiber web 50'. The first section basically constitutes a section in which the mineral fiber web 50' input to the section is exposed to a height compression, causing a reduction of the overall height of the mineral fiber web and a compacting of the mineral fiber web. The conveyer belts 52'' and 54'' are consequently arranged in a manner, in which they slope from an input end at the left-hand side of Fig. 2, at which input end the mineral fiber web 50' is input to the first section, towards an output end, from which the height-compressed mineral fiber web is delivered to the second section of the compacting station.

[0034] The second section of the compacting station comprises three sets of rollers 56' and 58', 56'' and 58'', and 56''' and 58'''. The rollers 56', 56'' and 56''' are arranged at the upper side surface of the mineral fiber web, whereas the rollers 58', 58'' and 58''' are arranged at the lower side surface of the mineral fiber web. The second section of the compacting station provides a longitudinal compression of the mineral fiber web, which longitudinal compression produces a homogenization of the mineral fiber web, as the mineral fibers of the mineral fiber web are caused to be rearranged as compared to the initial structure into a more homogeneous structure. The three sets of rollers 56' and 58', 56'' and 58'', and 56''' and 58''' of the second section are rotated at the same rotational speed, which is, however, lower than the rotational speed of the conveyer belts 52'' and 54'' of the first section, causing the longitudinal compression of the mineral fiber web. The height-compressed and longitudinally compressed mineral fiber web is output from the compacting station shown in Fig. 2, designated the reference numeral 50''.

[0035] It is to be realized that the combined height-and-longitudinal-compression compacting station shown in Fig. 2 may be modified by the omission of one of the two sections, i.e. the first section constituting the height-compression section, or alternatively the second section constituting the longitudinal-compression section. By the omission of one of the two sections of the compacting station shown in Fig. 2, a compacting section performing a single compacting or compression operation is provided, such as a height-compressing station or alternatively a longitudinally-compressing station. Although the height-compressing section has been described including conveyer belts, and the longitudinally-compressing section has been described including rollers, both sections may be implemented by means of belts or rollers. Also, the height-compressing section may be implemented by means of rollers, and the longitudinally-compressing section may be implemented by means of conveyer belts.

[0036] In Fig. 3, a further production station is shown, in which station a surface layer 24 is separated from the mineral fiber-insulating web 50'', providing a remaining part of the mineral fiber-insulating web 50'', the remaining part being designated the reference numeral 50'''. The mineral fiber-insulating web 50'' may constitute the output mineral fiber-insulating web 50'' shown in Fig. 2, or alternatively the mineral fiber-insulating web 50 produced in the station shown in Fig. 1. The separation of the surface layer 24 from the remaining part 50''' of the mineral fiber-insulating web is accomplished by mans of a cutting tool 72 as the remaining part 50''' of the mineral fiber-insulating web 50'' is supported and transported by mans of a conveyer belt 70. The cutting tool 72 may be constituted by a stationary cutting tool or knife or alternatively be constituted by a transversely reciprocating cutting tool. The surface layer 24 separated from the mineral fiber-insulating web is derived from the path of travel of the remaining part 50''' of the mineral fiber-insulating web by means of a conveyer belt 74 and is transferred from the conveyer belt 74 to three sets of rollers comprising a first set of rollers 76' and 78', a second set of rollers 76'' and 78'', and a third set of rollers 76''' and 78''', which three sets of rollers together constitute a compacting or compressing section similar to the second section of the compacting station described above with reference to Fig. 2.

[0037] In Fig. 4a, a production station is illustrated, which involves four separate productions steps, a first production step involving applying a continuous foil to an upper side surface of a mineral fiber-insulating web, a second step involving cutting the mineral fiber-insulating web into longitudinally extending strips, a third step involving turning the longitudinally extending strips 90° and adjoining the turned, longitudinally extending strips together, and a fourth step involving applying a surface covering constituted by a woven, mesh foil to an upper side surface of the adjoined and turned, longitudinally extending strips.

[0038] In the left-hand part of Fig. 4a, the mineral fiber-insulating web is shown. The mineral fiber-insulating web 50''' shown in Fig. 4a may constitute the remaining part 50 ''' of the mineral fiber-insulating web 50'', or may constitute the mineral fiber-insulating web 50'' output from the compacting station shown in Fig. 2, or may alternatively constitute the mineral fiber-insulating web 50 produced in the station shown in Fig. 1. The mineral fiber-insulating web to be processed in the station shown in Fig. 4a, however, preferably constitutes the remaining part 50''' of the mineral fiber-insulating web 50'' shown in Fig. 3. In a first substation shown in Fig. 4a, the mineral fiber-insulating web 50''' is brought into contact with a pressing roller 68, by means of which a continuous foil 67 of a thermoplastic material is applied to the upper side surface of the mineral fiber-insulating web 50'''. The continuous foil of the thermoplastic material is supplied from a roll 66. After the continuous foil 67 has been applied to the upper side surface of the mineral fiber-insulating web 50''', the mineral fiber-insulating web 50''' and the continuous foil 67 applied thereto are brought into contact with a total of seven mutually parallel, rotatable cutting knives, one of which is designated the reference numeral 60.

[0039] The knives 60 are arranged equidistantly spaced apart and cut the mineral fiber-insulating web 50''', the upper side surface of which is provided with the continuous foil 67, into a total of eight mutually parallel, longitudinally extending strips, each having a surface foil strip. The longitudinally extending strips are thereupon brought into contact with a total of eight turning plates 62 which serve the purpose of turning the mutually parallel strips 90° relative to the longitudinal direction of the mineral fiber-insulating web 50'''. One of the mutually parallel strips is designated the reference numeral 64, and one of the foil strips is designated the reference numeral 69.

[0040] The mineral fiber-insulating web 50''' shown in Fig. 3 is produced from the mineral fiber-insulating web 50 shown in Fig. 1. Consequently, the mineral fibers of the mineral fiber-insulating 50''' shown in Fig. 3 are generally orientated along the transversal direction of the mineral fiber-insulating web 50'''. As the strips 64 of the mineral fiber-insulating web 50''', which strips are cut by means of the knives 60, are turned 90° relative to the longitudinal direction of the mineral fiber-insulating web 50''', the mineral fibers of the strips 64 are turned 90°.

[0041] As the strips 64 of the mineral fiber-insulating web 50''' are turned 90 relative to the longitudinal direction of the mineral fiber-insulating web 50''', the foil strips 69 are also turned 90° and except for the outermost surface foil strip embedded between two adjacent strips 64 of the mineral fiber-insulating web 50'''. Consequently, the mineral fibers of the strips 64 which are adjoined one another through the foil strips 69 for the formation of an integral mineral fiber-insulating web 50'''' are generally orientated perpendicular to the longitudinal direction of the mineral fiber-insulating web and also perpendicular to the transversal direction of the mineral fiber-insulating web. Consequently, the mineral fibers of mineral fiber-insulating web 50'''' composed of the strips 64 are generally orientated perpendicular to the outer surfaces of the mineral fiber-insulating web 50'''' constituted by the adjoined strips 64.

[0042] After the integral mineral fiber-insulating web 50'''' has been produced, in which mineral fiber-insulating web the foil strips 69 are embedded within the strips 64, the mineral fiber-insulating web 50'''' is moved to a further foil application station, in which a woven mesh foil 99, which is supplied from a roll 98, is applied to one of the side surfaces, the upper side surface of the mineral fiber-insulating web 50'''' by means of a press roller 97. The woven mesh foil 99 may be applied to the upper side surface of the mineral fiber-insulating web 50'''' and fixated relative thereto by means of an adhesive layer, such as a glue layer, or simply be pressed against the mineral fiber top surface of the mineral fiber-insulating web.

[0043] Similarly, the continuous foil 67 may be applied to the upper side surface of the mineral fiber-insulating web 50''' and adhered thereto by means of an adhesive layer constituted by e.g. a glue layer, in a manner well-known in the art per se.

[0044] It is to be realized that, in accordance with a preferred, alternative embodiment, the contiuous foil 67 and the woven mesh foil 99 are omitted, as the mineral fiber-insulating web 50'''' is simply produced from the mineral fiber strips 64, which are produced by means of the knives 60 from the mineral fiber-insulating web 50''' and turned by means of the plates 62 and thereupon adjoined one another, producing a mineral fiber-insulating web including mineral fibers, and the heat-curable bonding agent exclusively.

[0045] In Fig. 4b, a transversally-compressing station is shown, which is designated the reference numeral 80 in its entirety. In the station 80, the mineral fiber-insulating web 50'''' produced in accordance with the above-described, preferred, alternative embodiment, comprising mineral fibers and the heat-curable bonding agent exclusively, is brought into contact with two conveyer belts 85 and 86, which define a constriction in which the mineral fiber-insulating web is caused to be transversally compressed and into contact with a total of four surface-agitating rollers 89a, 89b, 89c and 89d, which together with similar rollers, not shown in the drawing, arranged opposite to the rollers 89a, 89b, 89c and 89d serve the purpose of assisting in providing a transversal compression of the web 50''''. The conveyer belts 85 and 86 are journalled on rollers 81, 83 and 82, 84, respectively.

[0046] From the transversally-compressing station 80, a transversally compressed and compacted mineral fiber-insulating web 50''''' is supplied. As the mineral fiber-insulating web 50'''' is transmitted through the transversally-compressing station 80 and transformed into the transversally compressed mineral fiber-insulating web 50''''', the web is supported on rollers constituted by an input roller 87 and an output roller 88.

[0047] Although the mineral fiber-insulating web 50'''' input to the transversally-compressing station 80 is preferably constituted by the above-described, preferred and alternative embodiment, the mineral fiber-insulating web 50'''' may alternatively comprise integral foil strips similar to the foil strips 69 discussed above.

[0048] Provided the mineral fiber-insulating web 50'''' to be transversally compressed within the station 80 is provided with a top surface layer, such as the woven mesh foil 99 described above with reference to Fig. 4a, the foil has to be of a structure compatible with the transversal compression of the web and foil assembly. Thus, the foil applied to the upper side surface of the mineral fiber-insulating web 50'''' has to be compressable and adaptable to the reduced width of the mineral fiber-insulating web 50''''' output from the transversally-compressing station 80.

[0049] In Fig. 4c, an alternative technique of compressing the mineral fiber-insulating web 50'''' is shown. According to the technique disclosed in Fig. 4c, a station 60'''' is employed, which station constitutes a combined height-compressing, longitudinally-compressing and transversally compressing station. Thus, the station 60'''' comprises a total of six sets of rollers, three sets of which are constituted by the three sets of rollers 56', 58'; 56'', 58''; and 56''', 58''' discussed above with reference to Fig. 2, and constitutes an alternative to the combination of the stations discussed above with reference to Figs. 2 and 4b.

[0050] The station 60'''' shown in Fig. 4c further comprises three sets of rollers, a first set of which is constituted by two rollers 152' and 154', a second set of which is constituted by two rollers 152'' and 154'', and third set of which is constituted by two rollers 152''' and 154'''. The rollers 152', 152'' and 152''' are arranged at the upper side surface of the mineral fiber-insulating web 50'' like the rollers 56', 56'' and 56'''. The three rollers 154', 154'' and 154''' are arranged at the lower side surface of the mineral fiber-insulating web 50'' like the rollers 58', 58'' and 58'''. The three sets of rollers 152', 154'; 152'', 154''; and 152''', 154''' serve the same purpose as the belt assemblies 52'', 54'' discussed above with reference to Fig. 2, viz. the purpose of height compressing the mineral fiber-insulating web 50'' input to the station 60''''.

[0051] The three sets of height-compressing rollers 152', 154'; 152'', 154''; and 152''', 154''' are like the above-described belt assemblies 52'', 54'' operated at a rotational speed identical to the velocity of the mineral fiber-insulating web 50'''' input to the height-compressing section of the station 60''''. The three sets of rollers constituting the longitudinally-compressing section, i.e. the rollers 56', 58'; 56'', 58''; and 56''', 58''', are operated at a reduced rotational speed determining the longitudinal compression ratio.

[0052] For generating the transversal compression of the mineral fiber-insulating web 50'''' input to the station 60'''', shown in Fig. 4c, four crankshaft assemblies designated the reference numerals 160', 160'', 160''', and 160'''' are provided. The crankshaft assemblies are of identical structures, and in the below description a single crankshaft assembly, the crankshaft assembly 160'', is described, as the crankshaft assemblies 160', 160''' and 160'''' are identical to the crankshaft assembly 160'' and comprise elements identical to the elements of the crankshaft assembly 160'', however, designated the same reference numerals added a single, a double and a triple mark, respectively.

[0053] The crankshaft assembly 160'' includes a motor 162'', which drives a gear assembly 164'', from which an output shaft 166'' extends. A total of six gearwheels 168'' of identical configurations are mounted on the output shaft 166''. Each of the gearwheels 168'' meshes with a corresponding gearwheel 170''. Each of the gearwheels 170'' constitutes a drivewheel of a crankshaft lever system further comprising an idler wheel 172'' and a crankshaft lever 174''. The crankshaft levers 174'' are arranged so as to be lifted from a retracted position to an elevated position between two adjacent rollers at the righ-hand, lower side of the mineral fiber-insulating web 50'''' input to the station 60'''' and are adapted to cooperate with crankshaft levers of the crankshaft lever system 160' positioned at the right-hand, upper side of the mineral fiber-insulating web 50'''' input to the station 60''''.

[0054] Similarly, the crankshaft levers of the crankshaft lever systems 160''' and 160'''', arranged at the left-hand, upper and lower side, respectively, of the mineral fiber-insulating web 50'''' input to the station 60'''', are adapted to cooperated in a manner to be described below.

[0055] As is evident from Fig. 4c, a first set of crankshaft levers 174', 174'', 114''', 174'''' of the crankshaft lever systems 160', 160'', 160''' and 160'''' are positioned between the first and second sets of rollers 152', 154' and 152'', 154''. Similarly, a second set of crankshaft levers are positioned between the second and third sets of rollers 152'', 154'' and 152''', 154'''.

[0056] The crankshaft levers of each of the total of six crankshaft lever sets are of identical widths. Within each of the crankshaft lever systems 160', 160'', 160''' and 160'''', the first crankshaft lever is the widest crankshaft lever, and the width of the crankshaft lever within each crankshaft lever system is reduced from the first crankshaft lever to the sixth crankshaft lever positioned behind the sixth set of rollers 56''', 58'''.

[0057] By means of the motors of the crankshaft assemblies 160', 160'', 160''' and 160'''', the crankshaft levers of a specific crankshaft set are rotated in synchronism with the remaining three crankshaft levers of the crankshaft lever set in question. The crankshaft levers of all six sets of crankshaft levers are moreover operated in synchronism and in synchronism with the velocity of the mineral fiber-insulating web 50'''' input to the station 60''''. The widest or first set of crankshaft levers is adapted to initiate the transversal compression of the mineral fiber-insulating web 50'''', as the crankshaft levers 174'' and 174'''' of the crankshaft lever systems 160'' and 160'''', respectively, are raised from positions below the lower side surface of the mineral fiber-insulating web 50'''' and are brought into contact with the lower side surface of the mineral fiber-insulating web 50'''', and as the crankshaft levers 174' and 174''' of the crankshaft lever systems 160' and 160''', respectively, are simultaneously lowered from positions above the upper side surface of the mineral fiber-insulating web 50'''' and brought into contact with the upper side surface of the mineral fiber-insulating web 50''''.

[0058] Further rotation of the output shafts 166', 166'', 166''' and 166'''' causes the crankshaft levers of the first set of crankshaft levers to be moved towards the center of the mineral fiber-insulating web 50'''', providing a transversal compression of a central area of the mineral fiber-insulating web 50''''. As the crankshaft levers of the first set of crankshaft levers reach the central position, the crankshaft levers of the crankshaft lever systems 160' and 160''' are raised, whereas the crankshaft levers of the crankshaft lever systems 160'' and 160'''' are lowered and consequently brought out of contact with the upper and lower side surface, respectively, of the mineral fiber-insulating web 50''''.

[0059] As the mineral fiber-insulating web 50'' is moved further through the station 60'''', the next or second set of crankshaft levers provides an additional transversal compression of areas of the mineral fiber-insulating web 50'''', which areas are positioned at opposite sides of the above-mentioned central area, whereupon the third, the fourth, the fifth, and the sixth sets of crankshaft levers provide additional transversal compression of the mineral fiber-insulating web, producing an overall, homogeneous, transversal compression of the mineral fiber-insulating web.

[0060] The width of the crankshaft levers of each set of crankshaft levers, the gear ratio of the gear assemblies 164', 164'', 164''' and 164'''', the gear ratio of the gearwheels 168 and 170, and the velocity of the mineral fiber-insulating web 50'''' input to the station 60'''' are adapted to one another and further to the rotational speed of the height compression and the longitudinally-compressing sections of the station for producing the height-, longitudinally-compressed and transversally-compressed mineral fiber-insulating web 50''''.

[0061] The integration of the height-compressing section, the longitudinally-compressing section and the transversally compressing section into a single station, as described above with reference to Fig. 4c, is, by no means, mandatory to the operation of the crankshaft systems described above with reference to Fig. 4c. Thus, the height-compressing section, the longitudinally-compressing section and the transversally-compressing sections may be separated, however, the integration of all three functions reduces the overall size of the production plant. The station described above with reference to Fig. 4c may preferably be completed by an additional longitudinally-compressing section similar to the longitudinally-compressing section described above with reference to Fig. 2. The additional longitudinally-compressing section may constitute an additional or second longitudinally-compressing section or an alternative longitudinally-compressing section, provided the station described above with reference to Fig. 4c constitutes a height-compressing section and a transversally-compressing section exclusively. Additionally or alternatively, the height-compressing section of the station described above with reference to Fig. 4c may be substituted by a separate height-compressing section, such as a height-compressing section similar to the height-compressing section described above with reference to Fig. 2.

[0062] As the mineral fiber-insulating web 50''''' has been produced as described above with reference to Figs. 4a and 4b or 4c, and as the surface layer 24 has been compacted as described above with reference to Fig. 3, the compacted surface layer 24 is returned to the mineral fiber-insulating web 50''''' and adjoined in facial contact with the upper surface of the mineral fiber-insulating web 50'''''.

[0063] In Fig. 5, a set of rollers comprising a roller 79' and a roller 79'' arranged at the upper and lower side surface of the surface layer 24, respectively, constitutes a set of rollers by means of which a surface foil 99' supplied from a roll 98' is applied to the upper side surface of the compacted surface layer 24. From the rollers 79' and 79'', the surface layer 24 which constitutes an integral mineral fiber-insulating web of higher compactness as compared to the mineral fiber-insulating web 50''''', is shifted towards the upper side surface of the mineral fiber-insulating web 50''''' by means of two rollers 77' and 77''. The roller 77'' is positioned below the surface layer 24 and constitutes a turning roller, whereas the roller 77', which is positioned above the upper side surface of the surface layer 24, serves the purpose of pressing the compacted surface layer 24 into facial contact with the upper side surface of the mineral fiber-insulating web 50''''', which is supported and transported by means of the conveyer belt 70 also shown in Fig. 3. After the compacted surface layer 24 has been arranged in facial contact with the upper side surface of the mineral fiber-insulating web 50''''', a mineral fiber-insulating web assembly is provided, which assembly is designated the reference numeral 90 in its entirety.

[0064] In Fig. 5, a further foil 99'' is shown in dotted line. This foil is supplied from a roll 98''. The foil 99'' may constitute a continuous foil or alternatively a mesh foil, i.e. a foil similar to the foil 67 and the foil 99, respectively, described above with reference to Fig. 4a. It is, however, to be emphasized that the foils 67, 99, 99' and 99'' constitute optional features which may be omitted, provided an integral mineral fiber web structure is to be produced. Alternatively, one or more of the above-listed foils, or all foils, may be provided in various embodiments of the mineral fiber-insulating web produced in accordance with the teachings of the present invention.

[0065] It is to be realized that the compacted surface layer 24 which is separated from the mineral fiber-insulating web 50'' as shown in Fig. 3, may alternatively be provided from a separate production line as the production station shown in Fig. 1 is communicating directly with the production station shown in Fig. 4a, optionally through the production station shown in Fig. 2, thus, eliminating the production station shown in Fig. 3. Preferably, the production station shown in Fig. 3 is adapted to separate two surface layers from the mineral fiber-insulating web 50'' for producing two separated surface layers separated from opposite side surfaces of the mineral fiber-insulating web 50'', which surface layers are processed in accordance with the technique described above with reference to Fig. 3 for the formation of two high compactness surface layers which in accordance with the technique described above with reference to Fig. 5 are adjoined with the mineral fiber-insulating web 50''''' at opposite side surfaces thereof producing a sandwiching of the mineral fiber-insulating web 50''''' between two opposite surface layers similar to the surface layer 24 shown in Fig. 5.

[0066] In Fig. 5, the mineral fiber-insulating web assembly 90 is finally moved through a curing station constituting a curing oven or curing furnace comprising oppositely arranged curing oven sections 92 and 94, which generate heat for heating the mineral fiber-insulating web assembly 50 to an elevated temperature so as to cause the heat-curable bonding agent of the mineral fiber-insulating web assembly to cure and cause the mineral fibers of the central core or the body of the assembly and the mineral fibers of the compacted surface layer or surface layers to be bonded together so as to form an integral bonded mineral fiber-insulating web which is cut into plate-like segments by means of a knife 96. Provided the foil strips 67, and optionally the continuous foil 99'', are provided, the thermoplastic material of the foil strip 67 and the continuous foil 99'' is also melted, providing an additional bonding of the mineral fibers of the mineral fiber-insulating web.

[0067] In Fig. 5, a single plate-like segment 10' is shown comprising a central core 12 and a top layer 14. The top layer 14 is made from the compacted surface layer 24, whereas the core 12 is made from the mineral fiber-insulating web 50''''' shown in Fig. 5.

[0068] In Fig. 6a, a fragmentary and perspective view of a first embodiment of a plate segment of a mineral fiber-insulating web according to the present invention is shown, designated the reference numeral 10 in its entirety. The plate segment 10 comprises the central core 12 and the top layer 14 and further a bottom layer 16 made from a surface layer of the mineral fiber-insulating web 50''. The reference numeral 18 designates a segment of the core 12 of the plate segment 10 which segment 18 is made from one of the strips 64 of the mineral fiber-insulating web 50''''.

[0069] In Fig. 6b, a fragmentary and perspective view of a second embodiment of a plate segment of a mineral fiber-insulating web according to the present invention is shown, designated the reference numeral 10' in its entirety. Like the plate segment 10, described above with reference to Fig. 6a, the plate segment 10' comprises the central core 12, the top layer 14 and the bottom layer 16. Moreover, a top surface covering 15 is provided, which is constituted by the foil 99' described above with reference to Fig. 5. The top surface covering 15 may constitute a web of a plastics material, a woven or non-woven plastic foil, or alternatively a covering made from a non-plastics material, such as a paper material serving design and architectural purposes exclusively. The top surface layer 15 may alternatively be applied to the mineral fiber-insulating web after the curing of the heat-curable bonding agent, i.e. after the exposure of the mineral fiber-insulating web 90 to heat generated by the oven sections 92 and 94 shown in Fig. 5.

Example 1

[0070] A central core or body of a heat-insulating plate made from a mineral fiber-insulating web produced in accordance with the method according to the present invention as described above with reference to Figs. 1-5, is produced in accordance with the specifications listed below:

[0071] The method comprises a sequence of steps similar to the steps described above with reference to Figs. 2, 4a, 4c, 2 and the right-hand part of Fig. 5. The production output of the plant is 5000 kg/h. The area weight of the primary web is 0.5 kg/m^2, and the width of the primary web is 2850 mm. The rate of the first longitudinal compression produced in the station dis-closed in Fig. 2 is 1:1.5; the rate of transversal compression produced in the station disclosed in Fig. 4c is also 1:1.5, and the rate of the second longitudinal compression produced in the station disclosed in Fig. 2 is 1:1.5. The mineral fiber strips produced in the station dis-closed in Fig. 4a are of a quadratic cross-sectional configuration measuring 50 mm x 50 mm. The density of the final plate disclosed in Fig. 5 is 110 kg/m^3. The width of the final mineral fiber-insulating web is 1800 mm.

[0072] The production parameters used are listed in tables A and B below:

Table A

Total thickness mm	A m/min x 10	B m/min	C m/min	D m/min	E m/min
50	9.26	28.41	18.94	12.63	8.42
75	9.26	18.94	12.63	8.42	5.61
100	9.26	14.20	9.47	6.31	4.21
125	9.26	11.36	7.58	5.05	3.37
150	9.26	9.47	6.31	4.21	2.81
175	9.26	8.12	5.41	3.61	2.41
200	9.26	7.10	4.73	3.16	2.10
225	9.26	6.31	4.21	2.81	1.87
250	9.26	5.68	3.79	2.53	1.68
275	9.26	5.17	3.44	2.30	1.53

A = Velocity of belt 42
B = Velocity of belt 48
C = Velocity of belt 70 after first longitudinal compression (Fig. 2)
D = Velocity of belt 70 after transversal compression (Fig. 4c)
E = Velocity of belt 70 after second longitudinal compression and before curing oven (Fig. 5)

Table B

Total thickness mm	F kg/m^2	G kg/m^2	H kg/m^2	I kg/m^2	J kg/m^2	K %
50	1.63	2.44	3.67	3.67	5.50	5.56
75	2.44	3.67	5.50	5.50	8.25	6.94
100	3.26	4.89	7.33	7.33	11.00	8.33
125	4.07	6.11	9.17	9.17	13.75	6.94
150	4.89	7.33	11.00	11.00	16.50	11.11
175	5.70	8.56	12.83	12.83	19.25	9.72
200	6.52	9.78	14.67	14.67	22.00	13.89
225	7.33	11.00	16.50	16.50	24.75	15.28
250	8.15	12.22	18.33	18.33	27.50	13.89
275	8.96	13.44	20.17	20.17	30.25	9.72

F = Area weight of mineral fiber-insulating web on belt 48
G = Area weight of mineral fiber-insulating web after first longitudinal compression (Fig. 2)
H = Area weight of mineral fiber-insulating web after transversal compression (Fig. 4c)
I = Area weight of mineral fiber-insulating web before second longitudinal compression (Fig. 2)
J = Area weight of mineral fiber-insulating web after second longitudinal compression (Fig. 2)
K = Amount of material recycled

In Fig. 7, a diagramme is shown, illustrating the correspondence between the parameters listed in Table A. The reference signs used in Fig. 7 refer to the parameters listed in Table A. In Fig. 8, a diagramme is shown, illustrating the correspondence between the parameters listed in Table B. The reference signs used in Fig. 8 refer to the parameters listed in Table B.

Example 2

[0073] A central core or body of a roofing plate, made from a mineral fiber-insulating web produced in accordance with the method according to the present invention as described above with reference to Figs. 1-5, is produced in accordance with the specifications listed below:

[0074] The method comprises a sequence of steps similar to the steps described above with reference to Figs. 2, 4a, 4c, 2 and the right-hand part of Fig. 5. The production output of the plant is 5000 kg/h. The area weight of the primary web is 0.5 kg/m^2, and the width of the primary web is 2850 mm. The rate of the first longitudinal compression produced in the station disclosed in Fig. 2 is 1:1.5; the rate of transversal compression produced in the station disclosed in Fig. 4c is also 1:1.5, and the rate of the second longitudinal compression produced in the station disclosed in Fig. 2 is 1:2. The mineral fiber strips produced in the station disclosed in Fig. 4a are of a quadratic cross-sectional configuration measuring 50 mm x 50 mm. The density of the final plate disclosed in Fig. 5 is 200 kg/m^3. The width of the final mineral fiber-insulating web is 1800 mm.

[0075] The production parameters used are listed in tables C and D below:

Table C

Total thickness mm	A m/min x 10	B m/min	C m/min	D m/min	E m/min
50	9.26	20.83	13.89	9.26	4.63
75	9.26	13.89	9.26	6.17	3.09
100	9.26	10.42	6.94	4.63	2.31
125	9.26	8.33	5.56	3.70	1.85

Table C (continued)

Total thickness mm	A m/min x 10	B m/min	C m/min	D m/min	E m/min
150	9.26	6.94	4.63	3.09	1.54
175	9.26	5.95	3.97	2.65	1.32
200	9.26	5.21	3.47	2.31	1.16
225	9.26	4.63	3.09	2.06	1.03
250	9.26	4.17	2.78	1.85	0.93
275	9.26	3.79	2.53	1.68	0.84

A = Velocity of belt 42
B = Velocity of belt 48
C = Velocity of belt 70 after first longitudinal compression (Fig. 2)
D = Velocity of belt 70 after transversal compression (Fig. 4c)
E = Velocity of belt 70 after second longitudinal compression and before curing oven (Fig. 5)

[0076] In Fig. 9, a diagramme similar to the diagramme of Fig. 7 is shown, illustrating the correspondance between the parameters listed above in table C.

Table D

Total thickness mm	F kg/m^2	G kg/m^2	H kg/m^2	I kg/m^2	J kg/m^2	K %
50	2.22	3.33	5.00	5.00	10.00	5.56
75	3.33	5.00	7.50	7.50	15.00	6.94
100	4.44	6.67	10.00	10.00	20.00	8.33
125	5.56	8.33	12.50	12.50	25.00	6.94
150	6.67	10.00	15.00	15.00	30.00	11.11
175	7.78	11.67	17.50	17.50	35.00	9.72
200	8.89	13.33	20.00	20.00	40.00	13.89
225	10.00	15.00	22.50	22.50	45.00	15.28
250	11.11	16.67	25.00	25.00	50.00	13.89
275	12.22	18.33	27.50	27.50	55.00	9.72

F = Area weight of mineral fiber-insulating web on belt 48
G = Area weight of mineral fiber-insulating web after first longitudinal compression (Fig. 2)
H = Area weight of mineral fiber-insulating web after transversal compression (Fig. 4c)
I = Area weight of mineral fiber-insulating web before second longitudinal compression (Fig.2)
J = Area weight of mineral fiber-insulating web after second longitudinal compression (Fig. 2)
K = Amount of material recycled

[0077] In Fig. 10, a diagramme similar to the diagramme of Fig. 8 is shown, illustrating the correspondance between the parameters listed above in table D.

Example 3

[0078] A central core or body of a heat-insulating plate made from a mineral fiber-insulating web produced in accordance with the method according to the present invention as described above with reference to Figs. 1-5, is produced in accordance with the specifications listed below:

[0079] The method comprises a sequence of steps similar to the steps described above with reference to Figs. 2, 4a, 4c, 2 and the right-hand part of Fig. 5. The production output of the plant is 5000 kg/h. The area weight of the primary web is 0.4 kg/m^2, and the width of the primary web is 2280 mm. The rate of the first longitudinal compression produced in the station disclosed in Fig. 2 is 1:1.1; the rate of transversal compression produced in the station disclosed in Fig. 4c is also 1:1.2, and the rate of the second longitudinal compression produced in the station disclosed in Fig. 2 is 1:1.2. The mineral fiber strips produced in the station disclosed in Fig. 4a are of a quadratic cross-sectional configuration measuring 50 mm x 50 mm. The density of the final plate disclosed in Fig. 5 is 20 kg/m^3. The width of the final mineral fiber-insulating web is 1800 mm.

[0080] The production parameters used are listed in tables A and B below:

Table E

Total thickness mm	A m/min x 10	B m/min	C m/min	D m/min	E m/min
50	11.57	73.33	66.67	55.56	46.30
75	11.57	48.89	44.44	37.04	30.86
100	11.57	36.67	33.33	27.78	23.15
125	11.57	29.33	26.67	22.22	18.52
150	11.57	24.44	22.22	18.52	15.43
175	11.57	20.95	19.05	15.87	13.23
200	11.57	18.33	16.67	13.89	11.57
225	11.57	16.30	14.81	12.35	10.29
250	11.57	14.67	13.33	11.11	9.26
275	11.57	13.33	12.12	10.10	8.42

A = Velocity of belt 42
B = Velocity of belt 48
C = Velocity of belt 70 after first longitudinal compression (Fig. 2)
D = Velocity of belt 70 after transversal compression (Fig. 4c)
E = Velocity of belt 70 after second longitudinal compression and before curing oven (Fig. 5)

[0081] In Fig. 11, a diagramme similar to the diagramme of Fig. 7 is shown, illustrating the correspondance between the parameters listed above in table E.

Table F

Total thickness mm	F kg/m^2	G kg/m^2	H kg/m^2	I kg/m^2	J kg/m^2	K %
50	0.63	0.69	0.83	0.83	1.00	5.56
75	0.95	1.04	1.25	1.25	1.50	6.94
100	1.26	1.39	1.67	1.67	2.00	8.33
125	1.58	1.74	2.08	2.08	2.50	6.94
150	1.89	2.08	2.50	2.50	3.00	11.11
175	2.21	2.43	2.92	2.92	3.50	9.72
200	2.53	2.78	3.33	3.33	4.00	13.89
225	2.84	3.13	3.75	3.75	4.50	15.28
250	3.16	3.47	4.17	4.17	5.00	13.89

Table F (continued)

Total thickness mm	F kg/m²	G kg/m²	H kg/m²	I kg/m²	J kg/m²	K %
275	3.47	3.82	4.58	4.58	5.50	9.72
F = Area weight of mineral fiber-insulating web on belt 48 G = Area weight of mineral fiber-insulating web after first longitudinal compression (Fig. 2) H = Area weight of mineral fiber-insulating web after transversal compression (Fig. 4c) I = Area weight of mineral fiber-insulating web before second longitudinal compression (Fig. 2) J = Area weight of mineral fiber-insulating web after second longitudinal compression (Fig. 2) K = Amount of material recycled						

In Fig. 12, a diagramme similar to the diagramme of Fig. 8 is shown, illustrating the correspondance between the parameters listed above in table F. Example 4 The importance of exposing the mineral fiber-insulating web to a longitudinal and transversal compression is illustrated in the data in table G given below:

Table G

	Conventional mineral fiber-insulating plates		Mineral fiber-insulating plates according to the present invention, not being exposed to longitudinal/transversal compression				Mineral fiber-insulating plates according to the present invention being exposed to longitudinal/transversal compression			
Heat-insulating plate of a density of 30 kg/m^3	Pressure strength:	2 kPa	-	-	-	7 kPa	-	-	-	9 kPa
	Modulus of elasticity:	15 kPa	-	-	-	125 kPa	-	-	-	150 kPa
Roofing plate of a density of 150 kg/m^3	Pressure strength:	70 kPa	-	-	-	180 kPa	-	-	-	210 kPa
	Modulus of elasticity:	600 kPa	-	-	-	3300 kPa	-	-	-	4000 kPa

[0082] The mineral fiber-insulating plates according to the present invention clearly demonstrate increased pressure strength and modulus of elasticity as compared to a conventional heat-insulating plate. The mechanical performance of the mineral fiber-insulating plates according to the present invention, is, however, further increased by exposing the mineral-insulating web, from which the insulating plates are produces, to longitudinal and transversal compression as discussed above with reference to Fig. 2 and Fig. 4b.

Claims

1. A method of producing a mineral fiber-insulating web comprising the following steps:

   a) producing a first non-woven mineral fiber web (50''') defining a first longitudinal direction parallel with said first mineral fiber web (50''') and a second transversal direction parallel with said first mineral fiber web (50'''), said first mineral fiber web (50''') containing mineral fibers arranged generally in said second transversal direction and including a first heat-curable bonding agent, said first non-woven mineral fiber web (50''') defining a first mineral fiber web (50''') height,

b) moving said first mineral fiber web (50''') in said first longitudinal direction of said first mineral fiber web (50'''),

c) cutting said first mineral fiber web (50''') parallel with said first longitudinal direction and perpendicular to said second transversal direction so as to produce a plurality of mutually parallel mineral fiber strips (64) extending in said first longitudinal direction, said mutually parallel mineral fiber strips (64) being of identical width,

d) tilting each of said mutually parallel mineral fiber strips (64) so as to turn said mineral fibers of each of said mutually parallel mineral fiber strips (64) from the arrangement generally in said second transversal direction to the arrangement generally perpendicular to said first longitudinal direction and said second transversal direction,

e) adjoining said tilted mineral fiber strips (64) in abutting relationship so as to produce a second non-woven mineral fiber web (50'''') defining a second mineral fiber web height identical to said width of each of said mutually parallel mineral fiber strips (64), said second mineral fiber web (50'''') containing mineral fibers arranged generally perpendicular to said first longitudinal direction and said second transversal direction,

f) moving said second mineral fiber web (50'''') in said first longitudinal direction,

g) producing a third non-woven mineral fiber web (24) defining a third direction parallel with said third mineral fiber web (24), said third mineral fiber web (24) containing mineral fibers arranged generally in said third direction and including a second heat-curable bonding agent, said third mineral fiber web (24) being a mineral fiber web of a higher compactness as compared to said second mineral fiber web (50''''),

h) adjoining said third mineral fiber web (64) to said second mineral fiber web (50'''') in facial contact therewith for producing a fourth composite mineral fiber web (90), and

i) curing said first and second curable bonding agents so as to cause said mineral fibers of said fourth composite mineral fiber web (90) to bond to one another, thereby forming said mineral fiber-insulating web.

2. The method according to Claim 1, said third non-woven mineral fiber web (24) being produced by separating a surface segment layer of said first mineral fiber web (50''') therefrom and by compacting said surface segment layer for producing said third mineral fiber web (24).

3. The method according to any of the Claims 1 or 2, comprising the additional step similar to the step g) of producing a fifth non-woven mineral fiber web similar to said third mineral fiber web (24), and the step of adjoining in step h) said fifth mineral fiber web to said second mineral fiber web (50'''') in facial contact therewith and so as to sandwich said second mineral fiber web (50'''') between said third (24) and fifth mineral fiber webs in said fourth mineral fiber web (90).

4. The method according to any of the Claims 1-3, comprising the introductory step of producing said first mineral fiber web (50''') from a basic non-woven mineral fiber web (40) by arranging said basic mineral fiber web (40) in overlapping layers.

5. The method according to Claim 4, said basic non-woven mineral fiber web (40) being arranged in overlapping relation generally in said second transversal direction.

6. The method according to any of the claims 1-5, further comprising the additional step of height compressing said first non-woven mineral fiber web (50''') produced in step a).

7. The method according to any of the claims 1-6, further comprising the additional step of longitudinally compressing said first non-woven mineral fiber web (50''') produced in step a), and additionally or alternatively the additional step of longitudinally compressing said second non-woven mineral fiber web (50'''') produced in step e).

8. The method according to any of the claims 1-7, further comprising the additional step of transversally compressing said second non-woven mineral fiber web produced (50'''') in step e).

9. The method according to any of the claims 1-8, comprising the addtional step of compressing said fourth composite mineral fiber web (90) prior to introducing in step i) said fourth composite mineral fiber web into a curing oven (92, 94).

10. The method according to any of the claims 1-9, further comprising the step of applying a foil (67) to a side surface or both side surfaces of said first non-woven mineral fiber web (50''') and/or applying a foil (99) to a side surface or both side surfaces of said second non-woven mineral fiber web (50'''').

11. The method according to any of the claims 1-10, further comprising the step of cutting said cured fourth composite mineral fiber web (90) into plate segments (10').

12. A plant for producing a mineral fiber-insulating web comprising:

a) first means (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') for producing a first non-woven mineral fiber web (50''') defining a first longitudinal direction parallel with said first mineral fiber web (50''') and a second transversal direction parallel with said first mineral fiber web (50'''), said first mineral fiber web (50''') being produced containing mineral fibers arranged generally in said second transversal direction and including a first heat-curable bonding agent, said first non-woven mineral fiber web (50''') being produced defining a first mineral fiber web height,
b) second means (70) for moving said first mineral fiber web (50''') in said first longitudinal direction of said first mineral fiber web (50'''),
c) third means (60) for cutting said first mineral fiber web (50''') parallel with said first longitudinal direction and perpendicular to said second transversal direction so as to produce a plurality of mutually parallel mineral fiber strips (64) extending in said first longitudinal direction, said mutually parallel mineral fiber strips (64) being of identical width,
d) fourth means (62) for tilting each of said mutually parallel mineral fiber strips (64) so as to turn said mineral fibers of each of said mutually parallel mineral fiber strips (64) from the arrangement generally in said second transversal direction to the arrangement generally perpendicular to said first longitudinal direction and said second transversal direction,
e) fifth means (80) for adjoining said tilted mineral fiber strips (64) in abutting relationship so as to produce a second non-woven mineral fiber web (50'''') defining a second mineral fiber web height identical to said width of each of said mutually parallel mineral fiber strips (64), said second mineral fiber web (50'''') being produced containing mineral fibers arranged generally perpendicular to said first longitudinal direction and said second transversal direction,
f) sixth means (70) for moving said second mineral fiber web (50'''') in said first longitudinal direction,
g) seventh means (72, 76', 76'', 76''', 78', 78'', 78''') for producing a third non-woven mineral fiber web (24) defining a third direction parallel with said third mineral fiber web (24), said third mineral fiber web (24) being produced containing mineral fibers arranged generally in said third direction and including a second heat-curable bonding agent, said third mineral fiber web (24) being a mineral fiber web of a higher compactness as compared to said second mineral fiber web (50''''),
h) eight means (77') for adjoining said third mineral fiber web (24) to said second mineral fiber web (50'''') in facial contact therewith for producing a fourth composite mineral fiber web (90), and
i) ninth means (92, 94) for curing said first and second curable bonding agents so as to cause said mineral fibers of said fourth composite mineral fiber web (90) to bond to one another, thereby forming said mineral fiber-insulating web.

13. The plant according to Claim 12, said seventh means (72, 76', 76'', 76''', 78', 78'', 78''') being adapted to produce said third non-woven mineral fiber web (24) by separating a surface segment layer (24) of said first mineral fiber web (50''') therefrom and by compacting said surface segment layer (24) for producing said third mineral fiber web (24).

14. The plant according to any of the Claims 12 or 13, further comprising tenth means similar to said seventh means (72, 76', 76'', 76''', 78', 78'', 78''') for producing a fifth non-woven mineral fiber web similar to said third mineral fiber web (24), and eleventh means for adjoining said fifth mineral fiber web to said second mineral fiber web (50'''') in facial contact therewith and so as to sandwich said second mineral fiber web (50'''') between said third (24) and fifth mineral fiber webs in said fourth mineral fiber web (90).

15. The plant according to any of the Claims 12-14, said first means (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') being adapted to produce said first mineral fiber web (50''') from a basic non-woven mineral fiber web (40) by arranging said basic mineral fiber web (40) in overlapping layers.

16. The plant according to Claim 15, said first means (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') being adapted to arrange said basic non-woven mineral fiber web (40) in overlapping relation generally in said second transversal direction.

17. The plant according to any of the claims 12-16, further comprising twelfth means (52', 52'', 52''', 54', 54'', 54''') for height compressing said first non-woven mineral fiber web (50''') produced by said first means (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''').

18. The plant according to any of the claims 12-17, further comprising thirteenth means (56', 56'', 56''', 58', 58'', 58''') for longitudinally compressing said first non-woven mineral fiber web (50''') produced by said first means (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58'''), and additionally or alternatively fourteenth means (60'''') for longitudinally compressing said second non-woven mineral fiber web (50'''') produced by said fifth means (80).

19. The plant according to any of the claims 12-18, further comprising fifteenth means (60'''', 80) for transversally compressing said second non-woven mineral fiber web produced by said fifth means.

20. The plant according to any of the claims 12-19, comprising sixteenth means (60'''', 80) for compressing said fourth composite mineral fiber web prior to curing said fourth composite mineral fiber web (90) by means of said ninth means (92, 94).

21. The plant according to any of the claims 12-20, further comprising seventeenth means (168, 97) for applying a foil (67) to a side surface or both side surfaces of said first non-woven mineral fiber web (50''') and/or applying a foil (99) to a side surface or both side surfaces of said second non-woven mineral fiber web (50'''').

22. The plant according to any of the claims 12-21, further comprising eighteenth means (96) for cutting said cured fourth composite mineral fiber web (90) into plate segments (10').

Patentansprüche

1. Verfahren zum Herstellen einer Mineralfaserisolierbahn, umfassend die folgenden Schritte:

a) Herstellen einer ersten Vliesstoff-Mineralfaserbahn (50'''), welche eine erste Längsrichtung definiert, die parallel zur ersten Mineralfaserbahn (50''') ist, und eine zweite Querrichtung, welche parallel zur ersten Mineralfaserbahn (50''') ist, wobei die erste Mineralfaserbahn (50''') Mineralfasern enthält, welche im allgemeinen in der zweiten Querrichtung angeordnet sind, und ein erstes wärmehärtbares Bindemittel umfaßt, wobei die erste Vliesstoff-Mineralfaserbahn (50''') eine erste Höhe einer Mineralfaserbahn (50''') definiert,

b) Bewegen der ersten Mineralfaserbahn (50''') in die erste Längsrichtung der ersten Mineralfaserbahn (50'''),

c) Schneiden der ersten Mineralfaserbahn (50''') parallel zur ersten Längsrichtung und senkrecht zur zweiten Querrichtung, um eine Mehrzahl zueinander paralleler Mineralfaserstreifen (64) herzustellen, welche sich in der ersten Längsrichtung erstrecken, wobei die zueinander parallelen Mineralfaserstreifen (64) von identischen Breite sind,

d) Schwenken jedes der zueinander parallelen Mineralfaserstreifen (64), um die Mineralfasern jedes der zueinander parallelen Mineralfaserstreifen (64) aus der im allgemeinen in der zweiten Querrichtung verlaufenden Anordnung in die auf die erste Längsrichtung und die zweite Querrichtung im allgemeinen senkrecht verlaufende Anordnung zu drehen,

e) Anfügen der geschwenkten Mineralfaserstreifen (64) in einer angrenzenden Beziehung, um eine zweite Vliesstoff-Mineralfaserbahn (50'''') herzustellen, welche eine zweite Mineralfaserbahnhöhe definiert, die mit der Breite jedes der zueinander parallelen Mineralfaserstreifen (64) identisch ist, wobei die zweite Mineralfaserbahn (50'''') Mineralfasern enthält, welche im allgemeinen senkrecht auf die erste Längsrichtung und die zweite Querrichtung verlaufen,

f) Bewegen der zweiten Mineralfaserbahn (50'''') in die erste Längsrichtung,

g) Herstellen einer dritten Vliesstoff-Mineralfaserbahn (24), welche eine dritte Richtung definiert, die parallel zur dritten Mineralfaserbahn (24) ist, wobei die dritte Mineralfaserbahn (24) Mineralfasern enthält, welche im allgemeinen in der dritten Richtung angeordnet sind, und ein zweites wärmehärtbares Bindemittel umfaßt, wobei die dritte Mineralfaserbahn (24) eine, verglichen mit der zweiten Mineralfaserbahn (50''''), größere Kompaktheit aufweist,

h) Anfügen der dritten Mineralfaserbahn (24) an die zweite Mineralfaserbahn (50'''') in Flächenkontakt damit zum Herstellen einer vierten Verbund-Mineralfaserbahn (90), und

i) Härten des ersten und des zweiten härtbaren Bindemittels, um zu bewirken, daß sich die Mineralfasern der vierten Verbund-Mineralfaserbahn (90) aneinanderbinden und dadurch die Mineralfaserisolierbahn bilden.

2. Verfahren nach Anspruch 1, wobei die dritte Vliesstoff-Mineralfaserbahn (24) durch Trennen einer Oberflächensegmentschicht der ersten Mineralfaserbahn (50''') davon und durch Kompaktieren der Oberflächensegmentschicht zum Herstellen der dritten Mineralfaserbahn (24) hergestellt wird.

3. Verfahren nach einem beliebigen der Ansprüche 1 oder 2, umfassend den zusätzlichen, dem Schritt g) ähnlichen Schritt des Herstellens einer fünften Vliesstoff-Mineralfaserbahn, die der dritten Mineralfaserbahn (24) ähnlich ist, und den Schritt des Anfügens aus Schritt h) der fünften Mineralfaserbahn an die zweite Mineralfaserbahn (50'''') in Flächenkontakt damit und um in der vierten Mineralfaserbahn (90) die zweite Mineralfaserbahn (50'''') zwischen die dritte (24) und die fünfte Mineralfaserbahn einzulagern.

4. Verfahren nach einem beliebigen der Ansprüche 1 - 3, umfassend den einleitenden Schritt des Herstellens der ersten Mineralfaserbahn (50''') aus einer Ausgangs-Vliesstoff-Mineralfaserbahn (40) durch Anordnen der Ausgangsmineralfaserbahn (40) in einander überlappenden Schichten.

5. Verfahren nach Anspruch 4, wobei die Ausgangs-Vliesstoff-Mineralfaserbahn (40) im allgemeinen in der zweiten Querrichtung in einer sich überlappenden Beziehung angeordnet ist.

6. Verfahren nach einem beliebigen der Ansprüche 1 - 5, des weiteren umfassend den zusätzlichen Schritt des Höhenkomprimierens der ersten, in Schritt a) hergestellten Vliesstoff-Mineralfaserbahn (50''').

7. Verfahren nach einem beliebigen der Ansprüche 1 - 6, des weiteren umfassend den zusätzlichen Schritt des Längskomprimierens der ersten, in Schritt a) hergestellten Vliesstoff-Mineralfaserbahn (50''') und zusätzlich oder alternativ dazu den zusätzlichen Schritt des Längskomprimierens der zweiten, in Schritt e) hergestellten Vliesstoff-Mineralfaserbahn (50'''').

8. Verfahren nach einem beliebigen der Ansprüche 1 - 7, des weiteren umfassend den zusätzlichen Schritt des Querkomprimierens der zweiten, in Schritt e) hergestellten Vliesstoff-Mineralfaserbahn (50'''').

9. Verfahren nach einem beliebigen der Ansprüche 1 - 8, umfassend den zusätzlichen Schritt des Komprimierens der vierten Verbund-Mineralfaserbahn (90) vor dem Hineinführen der vierten Verbund-Mineralfaserbahn in Schritt i) in einen Härteofen (92, 94).

10. Verfahren nach einem beliebigen der Ansprüche 1 - 9, des weiteren umfassend den Schritt des Aufbringens einer Folie (67) auf einer Seitenoberfläche oder beiden Seitenoberflächen der ersten Vliesstoff-Mineralfaserbahn (50''') und/oder des Aufbringens einer Folie (99) auf einer Seitenoberfläche oder beiden Seitenoberflächen der zweiten Vliesstoff-Mineralfaserbahn (50'''').

11. Verfahren nach einem beliebigen der Ansprüche 1 - 10, des weiteren umfassend den Schritt des Schneidens der gehärteten vierten Verbund-Mineralfaserbahn (90) in Plattensegmente (10').

12. Anlage zum Herstellen einer Mineralfaserisolierbahn, umfassend:

a) Erste Mittel (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') zum Herstellen einer ersten Vliesstoff-Mineralfaserbahn (50'''), welche eine erste Längsrichtung definiert, die parallel zur ersten Mineralfaserbahn (50''') ist, und eine zweite Querrichtung, welche parallel zur ersten Mineralfaserbahn (50''') ist, wobei die hergestellt werdende erste Mineralfaserbahn (50''') Mineralfasern enthält, welche im allgemeinen in der zweiten Querrichtung angeordnet sind, und ein erstes wärmehärtbares Bindemittel umfaßt, wobei die erzeugt werdende erste Vliesstoff-Mineralfaserbahn (50''') eine erste Mineralfaserbahnhöhe definiert,

b) zweite Mittel (70) zum Bewegen der ersten Mineralfaserbahn (50''') in die erste Längsrichtung der ersten Mineralfaserbahn (50'''),

c) dritte Mittel (60) zum Schneiden der ersten Mineralfaserbahn (50''') parallel zur ersten Längsrichtung und senkrecht zur zweiten Querrichtung, um eine Mehrzahl zueinander paralleler Mineralfaserstreifen (64) herzustellen, welche sich in der ersten Längsrichtung erstrecken, wobei die zueinander parallelen Mineralfaserstreifen (64) von identischen Breite sind,

d) vierte Mittel (62) zum Schwenken jedes der zueinander parallelen Mineralfaserstreifen (64), um die Mineralfasern jedes der zueinander parallelen Mineralfaserstreifen (64) aus der im allgemeinen in der zweiten Querrichtung verlaufenden Anordnung in die auf die erste Längsrichtung und die zweite Querrichtung im allgemeinen senkrecht verlaufende Anordnung zu drehen,

e) fünfte Mittel (80) zum Anfügen der geschwenkten Mineralfaserstreifen (64) in einer angrenzenden Beziehung, um eine zweite Vliesstoff-Mineralfaserbahn (50'''') herzustellen, welche eine zweite Mineralfaserbahnhöhe definiert, die mit der Breite jedes der zueinander parallelen Mineralfaserstreifen (64) identisch ist, wobei die hergestellt werdende zweite Mineralfaserbahn (50'''') Mineralfasern enthält, welche im allgemeinen senkrecht auf die erste Längsrichtung und die zweite Querrichtung verlaufen,

f) sechste Mittel (70) zum Bewegen der zweiten Mineralfaserbahn (50'''') in die erste Längsrichtung,

g) siebente Mittel (72, 76', 76'', 76''', 78', 78'', 78''') zum Herstellen einer dritten Vliesstoff-Mineralfaserbahn (24), welche eine dritte Richtung definiert, die parallel zu der dritten Mineralfaserbahn (24) ist, wobei die hergestellt werdende dritte Mineralfaserbahn (24) Mineralfasern enthält, welche im allgemeinen in der dritten Richtung angeordnet sind, und ein zweites wärmehärtbares Bindemittel umfaßt, wobei die dritte Mineralfaserbahn (24) eine verglichen mit der zweiten Mineralfaserbahn (50'''') größere Kompaktheit aufweist,

h) achte Mittel (77') zum Anfügen der dritten Mineralfaserbahn (24) an die zweite Mineralfaserbahn (50'''') in Flächenkontakt damit zum Herstellen einer vierten Verbund-Mineralfaserbahn (90), und

i) neunte Mittel (92, 94) zum Härten des ersten und des zweiten härtbaren Bindemittels, um zu bewirken, daß sich die Mineralfasern der vierten Verbund-Mineralfaserbahn (90) aneinanderbinden und dadurch die Mineralfaserisolierbahn bilden.

13. Anlage nach Anspruch 12, wobei die siebenten Mittel (72, 76', 76'', 76''', 78', 78'', 78''') ausgebildet sind, um die dritte Vliesstoff-Mineralfaserbahn (24) durch Trennen einer Oberflächensegmentschicht (24) der ersten Mineralfaserbahn (50''') davon und durch Kompaktieren der Oberflächensegmentschicht (24) zum Herstellen der dritten Mineralfaserbahn (24) herzustellen.

14. Anlage nach einem beliebigen der Ansprüche 12 oder 13, des weiteren umfassend den siebenten Mitteln (72, 76', 76'', 76''', 78', 78'', 78''') ähnelnde zehnte Mittel zum Herstellen einer fünften Vliesstoff-Mineralfaserbahn, die der dritten Mineralfaserbahn (24) ähnlich ist, und elfte Mittel zum Anfügen der fünften Mineralfaserbahn an die zweite Mineralfaserbahn (50'''') in Flächenkontakt damit und um in der vierten Mineralfaserbahn (90) die zweite Mineralfaserbahn (50'''') zwischen die dritte (24) und die fünfte Mineralfaserbahn einzulagern.

15. Anlage nach einem beliebigen der Ansprüche 12 - 14, wobei die ersten Mittel (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') ausgebildet sind, um die erste Mineralfaserbahn (50''') aus einer Ausgangs-Vliesstoff-Mineralfaserbahn (40) durch Anordnen der Ausgangsmineralfaserbahn (40) in einander überlappenden Schichten herzustellen.

16. Anlage nach Anspruch 15, wobei die ersten Mittel (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') ausgebildet sind, um die Ausgangs-Vliesstoff-Mineralfaserbahn (40) im allgemeinen in der zweiten Querrichtung in einer sich überlappenden Beziehung anzuordnen.

17. Anlage nach einem beliebigen der Ansprüche 12 - 16, des weiteren umfassend zwölfte Mittel (52', 52'', 52''', 54', 54'', 54''') zum Höhenkomprimieren der ersten Vliesstoff-Mineralfaserbahn (50'''), welche durch die ersten Mittel (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') hergestellt wird.

18. Anlage nach einem beliebigen der Ansprüche 12 - 17, des weiteren umfassend dreizehnte Mittel (56', 56'', 56''', 58', 58'', 58''') zum Längskomprimieren der ersten Vliesstoff-Mineralfaserbahn (50'''), welche durch die ersten Mittel (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') hergestellt wird, und zusätzlich oder alternativ dazu vierzehnte Mittel (60'''') zum Längskomprimieren der zweiten Vliesstoff-Mineralfaserbahn (50''''), welche durch die fünften Mittel (80) hergestellt wird.

19. Anlage nach einem beliebigen der Ansprüche 12 - 18, des weiteren umfassend fünfzehnte Mittel (60"", 80) zum Querkomprimieren der zweiten Vliesstoff-Mineralfaserbahn, welche durch die fünften Mittel hergestellt wird.

20. Anlage nach einem beliebigen der Ansprüche 12 - 19, umfassend sechzehnte Mittel (60"", 80) zum Komprimieren der vierten Verbund-Mineralfaserbahn vor dem Härten der vierten Verbund-Mineralfaserbahn (90) mittels der neunten Mittel (92, 94).

21. Anlage nach einem beliebigen der Ansprüche 12 - 20, des weiteren umfassend siebzehnte Mittel (168, 97) zum Aufbringen einer Folie (67) auf einer Seitenoberfläche oder beiden Seitenoberflächen der ersten Vliesstoff-Mineralfaserbahn (50''') und/oder des Aufbringens einer Folie (99) auf einer Seitenoberfläche oder beiden Seitenoberflächen der zweiten Vliesstoff-Mineralfaserbahn (50"").

22. Anlage nach einem beliebigen der Ansprüche 12 - 21, des weiteren umfassend achtzehnte Mittel (96) zum Schneiden der gehärteten vierten Verbund-Mineralfaserbahn (90) in Plattensegmente (10').

Revendications

1. Procédé de production d'une bande d'isolation en fibres minérales comprenant les étapes suivantes:

a) réalisation d'une première bande en fibres minérales non tissées (50''') définissant une première direction longitudinale parallèle à ladite première bande en fibres minérales (50''') et une deuxième direction transversale parallèle à ladite première bande en fibres minérales (50'''), ladite première bande en fibres minérales (50''') contenant des fibres minérales agencées sensiblement suivant ladite deuxième direction transversale et contenant un premier agent de liaison thermodurcissable, ladite première bande en fibres minérales non tissées (50''') définissant une hauteur de première bande en fibres minérales (50'''),
b) déplacement de ladite première bande en fibres minérales (50''') dans ladite première direction longitudinale de ladite première bande en fibres minérales (50'''),
c) découpe de ladite première bande en fibres minérales (50''') parallèlement à ladite première direction longitudinale et perpendiculairement à ladite deuxième direction transversale, de manière à réaliser une pluralité de bandelettes en fibres minérales mutuellement parallèles (64) s'étendant dans ladite première direction longitudinale, lesdites bandelettes en fibres minérales mutuellement parallèles (64) étant d'une largeur identique,
d) basculement de chacune desdites bandelettes en fibres minérales mutuellement parallèles (64) de manière à faire tourner lesdites fibres minérales de chacune desdites bandelettes en fibres minérales mutuellement parallèles (64) d'un agencement sensiblement suivant ladite deuxième direction transversale à un agencement sensiblement perpendiculaire à ladite première direction longitudinale et à ladite deuxième direction transversale,
e) juxtaposition desdites bandes en fibres minérales basculées (64) en relation de butée de manière à réaliser une deuxième bande en fibres minérales non tissées (50"") définissant une seconde hauteur de bande en fibres minérales identique à ladite largeur de chacune de ladite pluralité de bandelettes en fibres minérales mutuellement parallèles (64), ladite deuxième bande en fibres minérales (50"") contenant des fibres minérales agencées sensiblement perpendiculairement à ladite première direction longitudinale et à ladite deuxième direction transversale,
f) déplacement de ladite deuxième bande en fibres minérales (50"") suivant ladite première direction longitudinale,
g) réalisation d'une troisième bande en fibres minérales non tissées (24) définissant une troisième direction parallèle à ladite troisième bande en fibres minérales (24), ladite troisième bande en fibres minérales (24) contenant des fibres minérales agencées sensiblement suivant ladite troisième direction et contenant un second agent de liaison thermodurcissable, ladite troisième bande en fibres minérales (24) étant une bande en fibres minérales d'une compacité supérieure comparée à celle de ladite deuxième bande en fibres minérales (50""),
h) juxtaposition de ladite troisième bande en fibres minérales (24) à ladite deuxième bande en fibres minérales (50"") en contact facial avec celle-ci afin de réaliser une quatrième bande en fibres minérales composite (90), et
i) durcissement desdits premier et second agents durcissables de manière à relier lesdites fibres minérales de ladite quatrième bande en fibres minérales composite (90) les unes aux autres, formant ainsi ladite bande d'isolation en fibres minérales.

2. Procédé selon la revendication 1, ladite troisième bande en fibres minérales non tissées (24) étant réalisée en séparant une couche d'une zone superficielle de ladite première bande en fibres minérales (50''') de cette dernière et en compactant ladite couche superficielle afin de produire ladite troisième bande en fibres minérales (24).

3. Procédé selon l'une quelconque des revendications 1 ou 2, comprenant l'étape supplémentaire, similaire à l'étape g), de réalisation d'une cinquième bande en fibres minérales non tissées similaire à ladite troisième bande en fibres minérales (24), et l'étape de juxtaposition à l'étape h) de ladite cinquième bande en fibres minérales à ladite deuxième bande en fibres minérales (50'''') en contact facial avec celle-ci et de manière à intercaler ladite deuxième bande en fibres minérales (50'''') entre lesdites troisième (24) et cinquième bandes en fibres minérales dans ladite quatrième bande en fibres minérales (90).

4. Procédé selon l'une quelconque des revendications 1 à 3, comprenant l'étape préliminaire de réalisation de ladite première bande en fibres minérales (50''') à partir d'une bande en fibres minérales non tissées de base (40) en agençant ladite bande en fibres minérales non tissées de base (40) en couches se recouvrant.

5. Procédé selon la revendication 4, ladite bande en fibres minérales non tissées de base (40) étant agencée en relation de recouvrement sensiblement suivant ladite deuxième direction transversale.

6. Procédé selon l'une quelconque des revendications 1 à 5, comprenant, en outre, l'étape supplémentaire de compression de hauteur de ladite première bande en fibres minérales non tissées (50''') réalisée à l'étape a).

7. Procédé selon l'une quelconque des revendications 1 à 6, comprenant, en outre, l'étape supplémentaire de compression longitudinale de ladite première bande en fibres minérales non tissées (50''') réalisée à l'étape a) et, en plus, ou en variante, l'étape supplémentaire de compression longitudinale de ladite deuxième bande en fibres minérales non tissées (50'''') réalisée à l'étape e).

8. Procédé selon l'une quelconque des revendications 1 à 7, comprenant, en outre, l'étape supplémentaire de compression transversale de ladite deuxième bande en fibres minérales non tissées (50'''') réalisée à l'étape e).

9. Procédé selon l'une quelconque des revendications 1 à 8, comprenant l'étape supplémentaire de compression de ladite quatrième bande en fibres minérales composite (90) avant introduction à l'étape il de ladite quatrième bande en fibres minérales composite dans un four de durcissement (92, 94).

10. Procédé selon l'une quelconque des revendications 1 à 9, comprenant, en outre, l'étape d'application d'une feuille (67) sur une face ou sur les deux faces de ladite première bande en fibres minérales non tissées (50''') et/ou d'application d'une feuille (99) sur une face ou les deux faces de ladite deuxième bande en fibres minérales non tissées (50'''').

11. Procédé selon l'une quelconque des revendications 1 à 10, comprenant, en outre, l'étape de découpage de ladite quatrième bande en fibres minérales composite (90) durcie en segments plats (10').

12. Installation destinée à réalisér une bande d'isolation en fibres minérales comprenant:

a) des premiers moyens (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') destinés à réaliser une première bande en fibres minérales non tissées (50''') définissant une première direction longitudinale parallèle à ladite première bande en fibres minérales (50''') et une deuxième direction transversale parallèle à ladite première bande en fibres minérales (50'''), ladite première bande en fibres minérales (50''') étant réaliser de manière à contenir des fibres minérales agencées sensiblement suivant ladite deuxième direction transversale et contenant un premier agent de liaison thermodurcissable, ladite première bande en fibres minérales non tissées (50''') étant réaliser de manière à définir une hauteur de première bande en fibres minérales,
b) des deuxièmes moyens (70) destinés à déplacer ladite première bande en fibres minérales (50''') dans ladite première direction longitudinale de ladite première bande en fibres minérales (50'''),
c) des troisièmes moyens (60) destinés à découper ladite première bande en fibres minérales (50''') parallèlement à ladite première direction longitudinale et perpendiculairement à ladite deuxième direction transversale de manière à réaliser une pluralité de bandelettes en fibres minérales mutuellement parallèles (64) s'étendant dans ladite première direction longitudinale, lesdites bandelettes en fibres minérales mutuellement parallèles (64) étant d'une largeur identique,
d) des quatrièmes moyens (62) destinés à basculer chacune desdites bandelettes en fibres minérales mutuel-

lement parallèles (64) de manière à faire tourner lesdites fibres minérales de chacune desdites bandelettes en fibres minérales mutuellement parallèles (64) à partir de l'agencement globalement suivant ladite seconde deuxième direction transversale vers l'agencement globalement perpendiculaire à ladite première direction longitudinale et à ladite deuxième direction transversale,

e) des cinquièmes moyens (80) destinés à juxtaposer lesdites bandes en fibres minérales basculées (64) en relation de butée de manière à réaliser une deuxième bande en fibres minérales non tissées (50'''') définissant une deuxième hauteur de bande en fibres minérales identique à ladite largeur de chacune de ladite pluralité de bandelettes en fibres minérales mutuellement parallèles (64), ladite deuxième bande en fibres minérales (50'''') étant réaliser de manière à contenir des fibres minérales agencées sensiblement perpendiculairement à ladite première direction longitudinale et à ladite deuxième direction transversale,

f) des sixièmes moyens (70) destinés à déplacer ladite deuxième bande en fibres minérales (50'''') suivant ladite première direction longitudinale,

g) des septièmes moyens (72, 76', 76'', 76''', 78', 78'', 78''') destinés à réaliser une troisième bande en fibres minérales non tissées (24) définissant une troisième direction parallèle à ladite troisième bande en fibres minérales (24), ladite troisième bande en fibres minérales (24) étant réalisée de manière à contenir des fibres minérales agencées sensiblement suivant ladite troisième direction et contenant un second agent de liaison thermodurcissable, ladite troisième bande en fibres minérales (24) étant une bande en fibres minérales d'une compacité supérieure comparée à celle de ladite deuxième bande en fibres minérales (50''''),

h) des huitièmes moyens (77') destinés à juxtaposer ladite troisième bande en fibres minérales (24) sur ladite deuxième bande en fibres minérales (50'''') en contact facial avec celle-ci afin de réaliser une quatrième bande en fibres minérales composite (90), et

i) des neuvièmes moyens (92, 94) destinés à durcir lesdits premier et second agents durcissables de manière à relier lesdites fibres minérales de ladite quatrième bande en fibres minérales composite (90) les unes aux autres, formant ainsi ladite bande d'isolation en fibres minérales.

13. Installation selon la revendication 12, lesdits septièmes moyens (72, 76', 76'', 76''', 78', 78'', 78''') étant adaptés afin de réaliser ladite troisième bande en fibres minérales non tissées (24) en séparant une couche de segment de surface (24) de ladite première bande en fibres minérales (50''') de cette dernière et en compactant ladite couche de segment de surface (24) afin de réaliser ladite troisième bande en fibres minérales (24).

14. Installation selon l'une quelconque des revendications 12 ou 13, comprenant, en outre, des dixièmes moyens similaires auxdits septièmes moyens (72, 76', 76'', 76''', 78', 78'', 78''') destinés à réaliser une cinquième bande en fibres minérales non tissées similaire à ladite troisième bande en fibres minérales (24), et des onzièmes moyens destinés à juxtaposer ladite cinquième bande en fibres minérales sur ladite deuxième bande en fibres minérales (50'''') en contact facial avec celle-ci et de manière à intercaler ladite deuxième bande en fibres minérales (50'''') entre lesdites troisième (24) et cinquième bandes en fibres minérales dans ladite quatrième bande en fibres minérales (90).

15. Installation selon l'une quelconque des revendications 12 à 14, lesdits premiers moyens (52', 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') étant adaptés afin de réaliser ladite première bande en fibres minérales (50''') à partir d'une bande en fibres minérales non tissées de base (40) en agençant ladite bande en fibres minérales non tissées de base (40) en couches se recouvrant.

16. Installation selon la revendication 15, lesdits premiers moyens (52', 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') étant adaptés de manière à agencer ladite bande en fibres minérales non tissées de base (40) en relation de recouvrement sensiblement suivant ladite deuxième direction transversale.

17. Installation selon l'une quelconque des revendications 12 à 16, comprenant, en outre, des douzièmes moyens (52', 52'', 52''', 54', 54'', 54''') destinés à compresser en hauteur ladite première bande en fibres minérales non tissées (50''') réalisée par lesdits premiers moyens (52, 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''').

18. Installation selon l'une quelconque des revendications 12 à 17, comprenant, en outre, des treizièmes moyens (56', 56'', 56''', 58', 58'', 58''') destinés à compresser longitudinalement ladite première bande en fibres minérales non tissées (50''') réalisée par lesdits premiers moyens (52', 52'', 52''', 54', 54'', 54''', 56', 56'', 56''', 58', 58'', 58''') et, en plus, ou en variante, des quatorzièmes moyens (60'''') destinés à compresser longitudinalement ladite deuxième bande en fibres minérales non tissées (50'''') réalisée par lesdits cinquièmes moyens (80).

19. Installation selon l'une quelconque des revendications 12 à 18, comprenant, en outre, des quinzièmes moyens

(60"", 80) destinés à compresser transversalement ladite deuxième bande en fibres minérales non tissées réalisée par lesdits cinquièmes moyens.

20. Installation selon l'une quelconque des revendications 12 à 19, comprenant, en outre, des seizièmes moyens (60"", 80) destinés à compresser ladite quatrième bande en fibres minérales composite avant le durcissement de ladite quatrième bande en fibres minérales composite (90) au moyen desdits neuvièmes moyens (92, 94).

21. Installation selon l'une quelconque des revendications 12 à 20, comprenant, en outre, des dix-septièmes moyens (168, 97) destinés à appliquer une feuille (67) sur une face ou sur les deux faces de ladite première bande en fibres minérales non tissées (50"') et/ou à appliquer une feuille (99) sur une face ou les deux faces de ladite deuxième bande en fibres minérales non tissées (50"").

22. Installation selon l'une quelconque des revendications 12 à 21, comprenant, en outre, des dix-huitièmes moyens (96) destinés à découper ladite quatrième bande en fibres minérales composite (90) durcie en segments plats (10').

Fig. 1

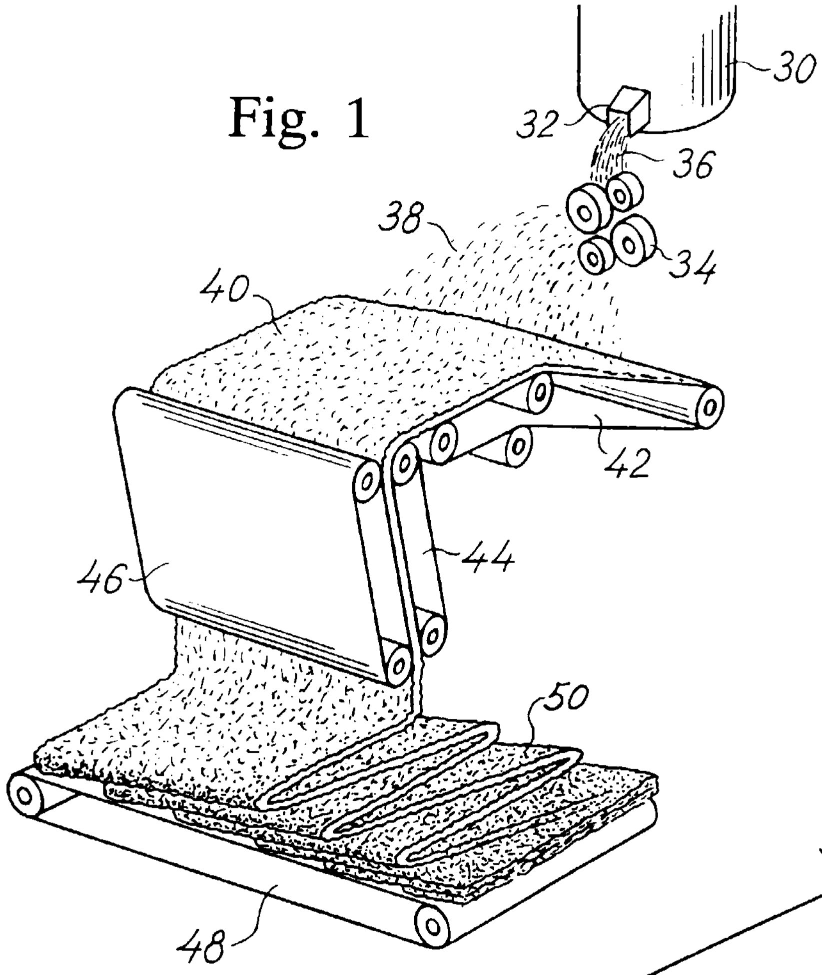
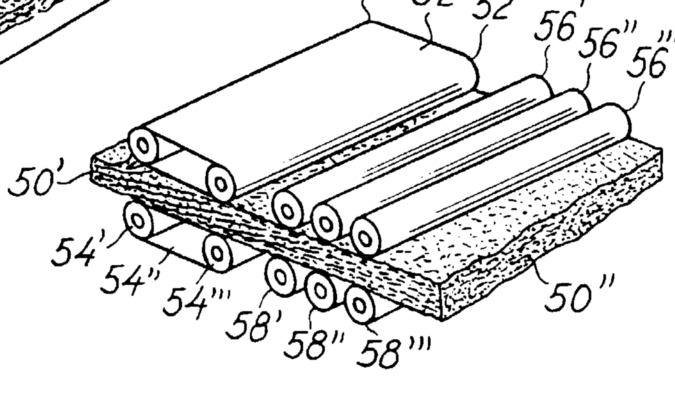


Fig. 2



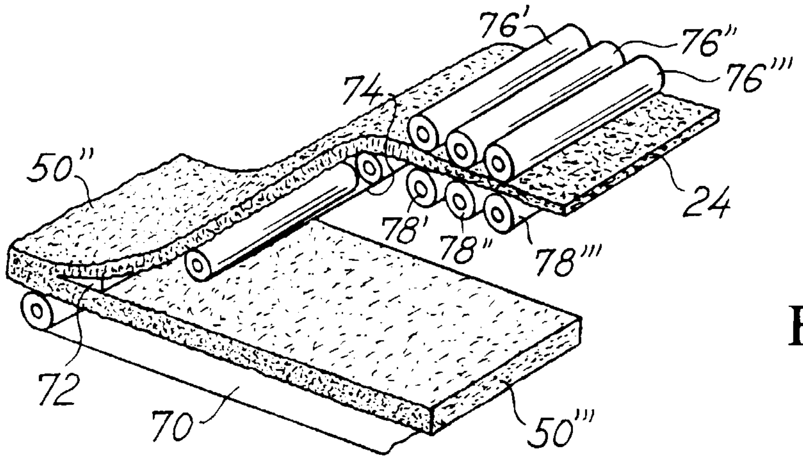


Fig. 3

Fig 4a

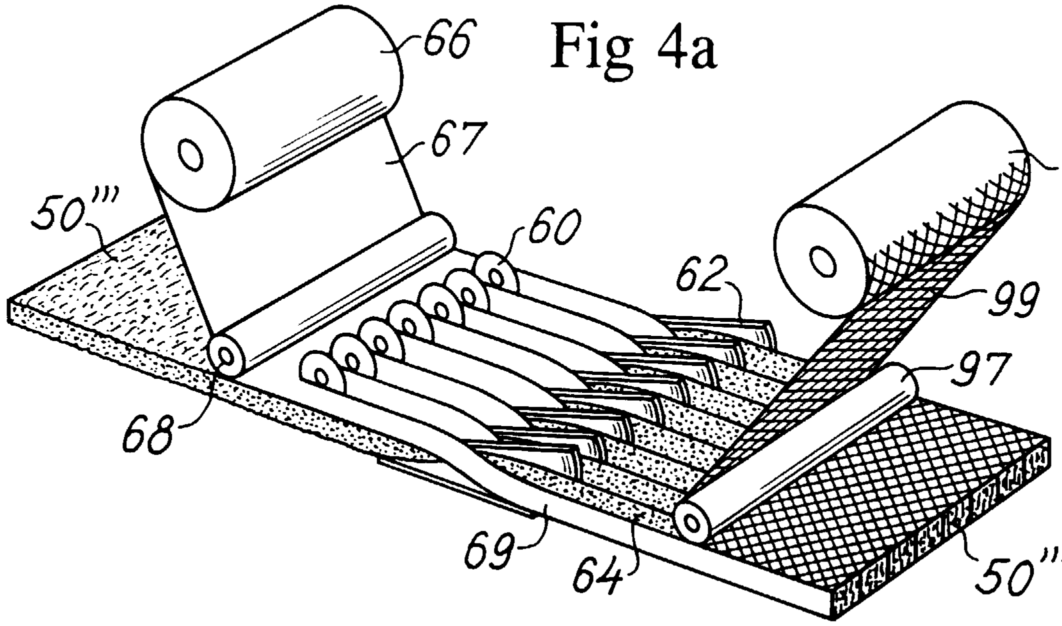

66
67
98
50'''
60
62
99
97
68
69
64
50''''

Fig. 4b

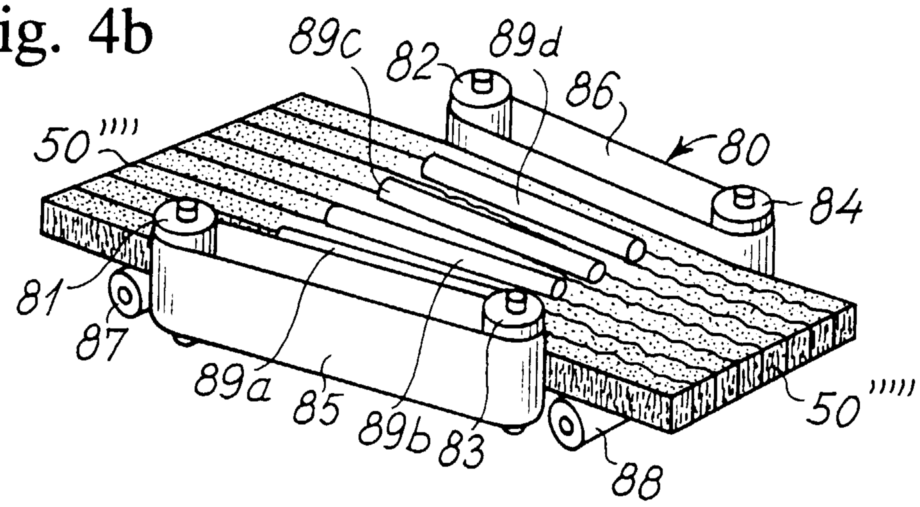
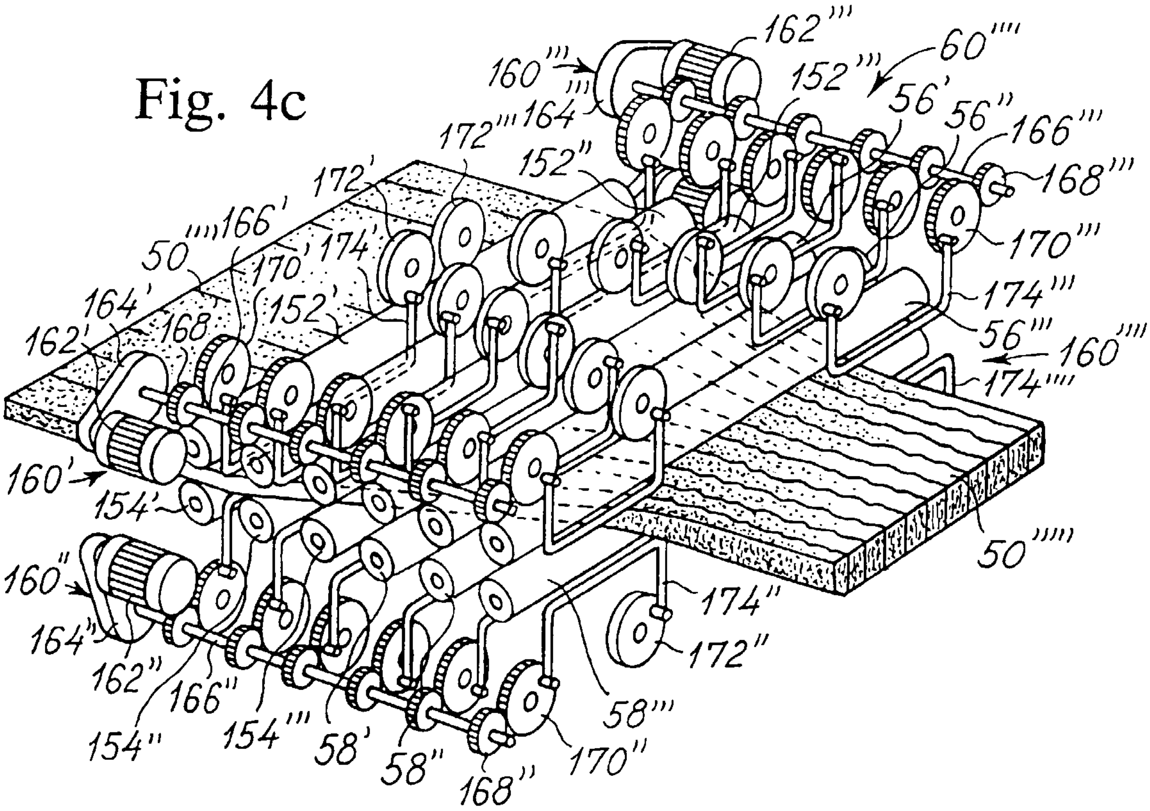

89c
82
89d
86
80
50''''
84
81
87
89a
85
89b
83
50'''''
88

Fig. 4c


162'''
60''''
160'''
152'''
164
56'
56''
166'''
172'''
168'''
152''
172'
170'''
50'''''
166'
174'
170'
174'''
152'
56'''
164'
168
160''''
162'
174''''
160'
154'
50'''''
160''
174''
164''
172''
162''
166''
154''
154'''
58'
58'''
58''
170''
168''

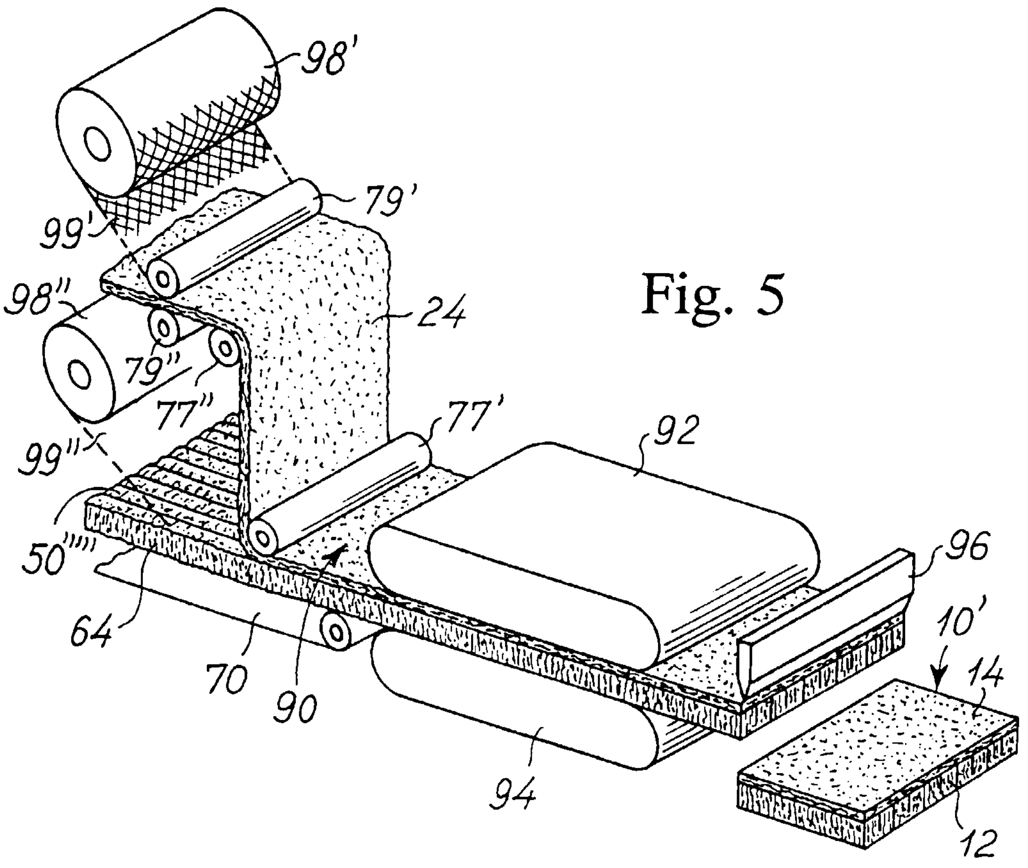

98'
79'
99'
98''
24
79''
77''
77'
92
99''
50'''''
96
10'
64
14
70
90
94
12

Fig. 5

Fig. 6a

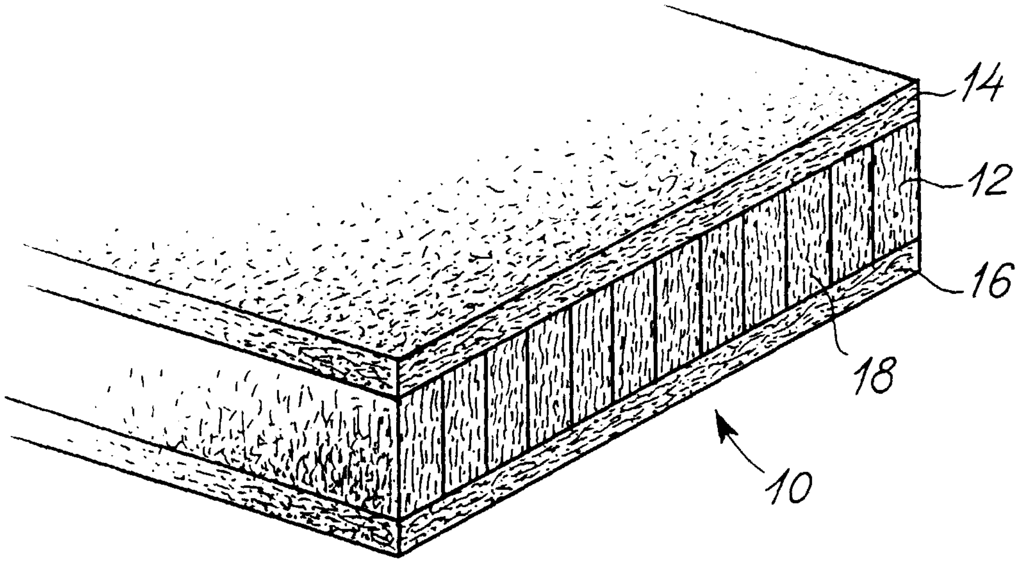


Fig. 6b

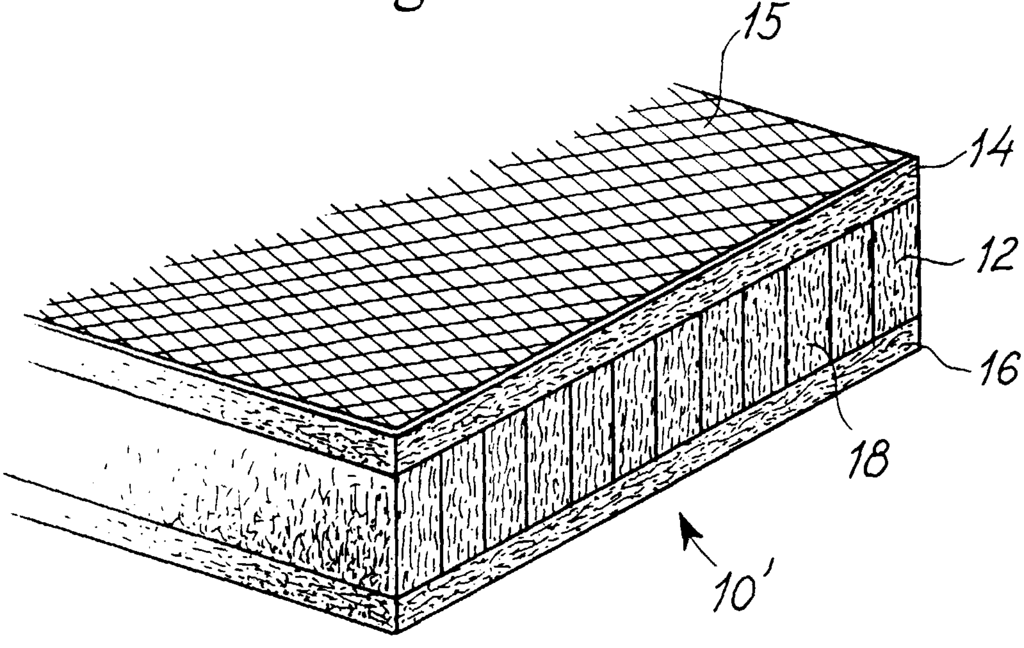
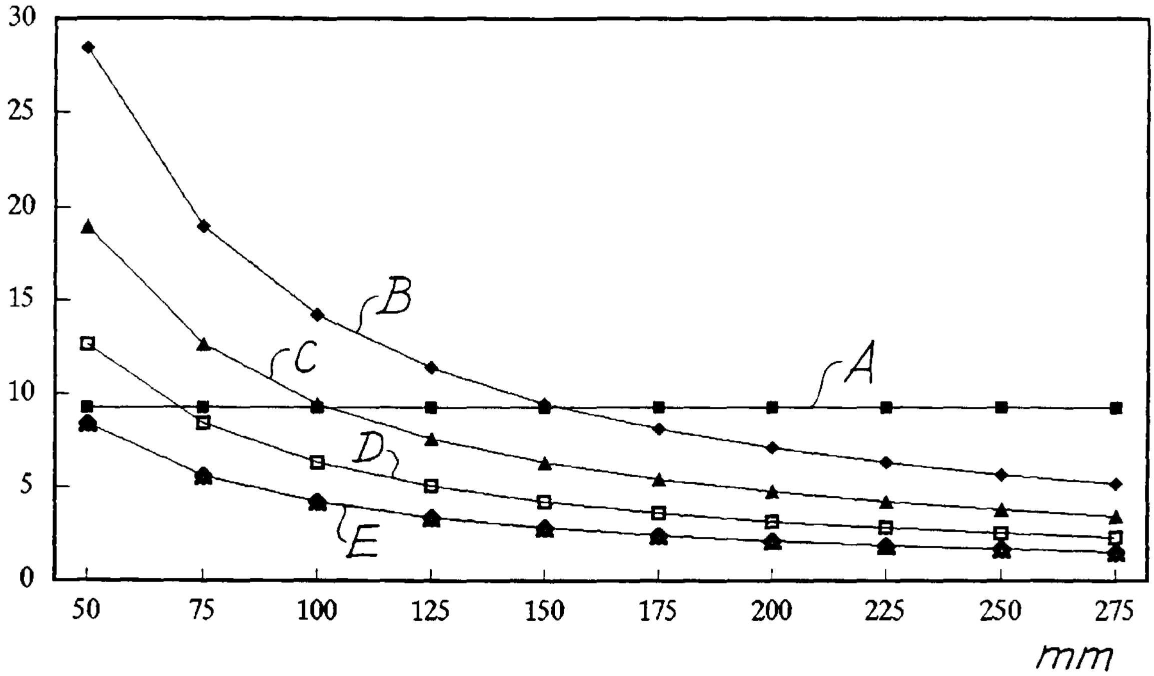


Fig. 7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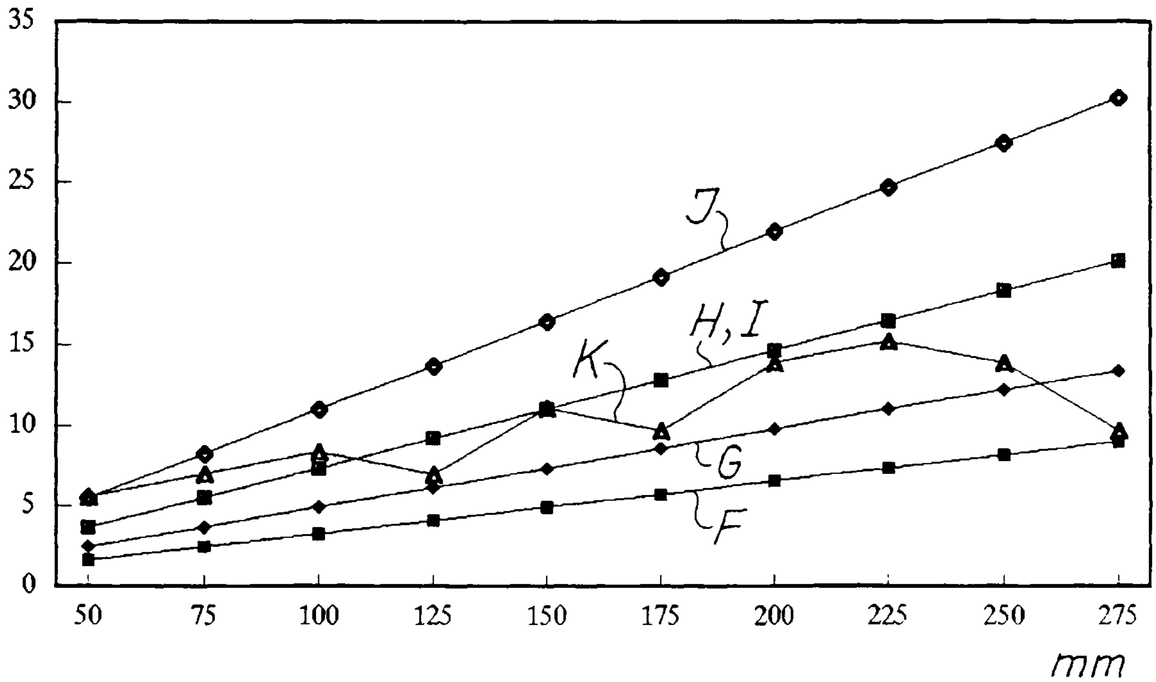
25
20
15
10
5
0
50
75
100
125
150
175
200
225
250
275
mm
A
B
C
D
E

Fig. 8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25
20
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5
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75
100
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mm
J
H, I
K
G
F

Fig. 9

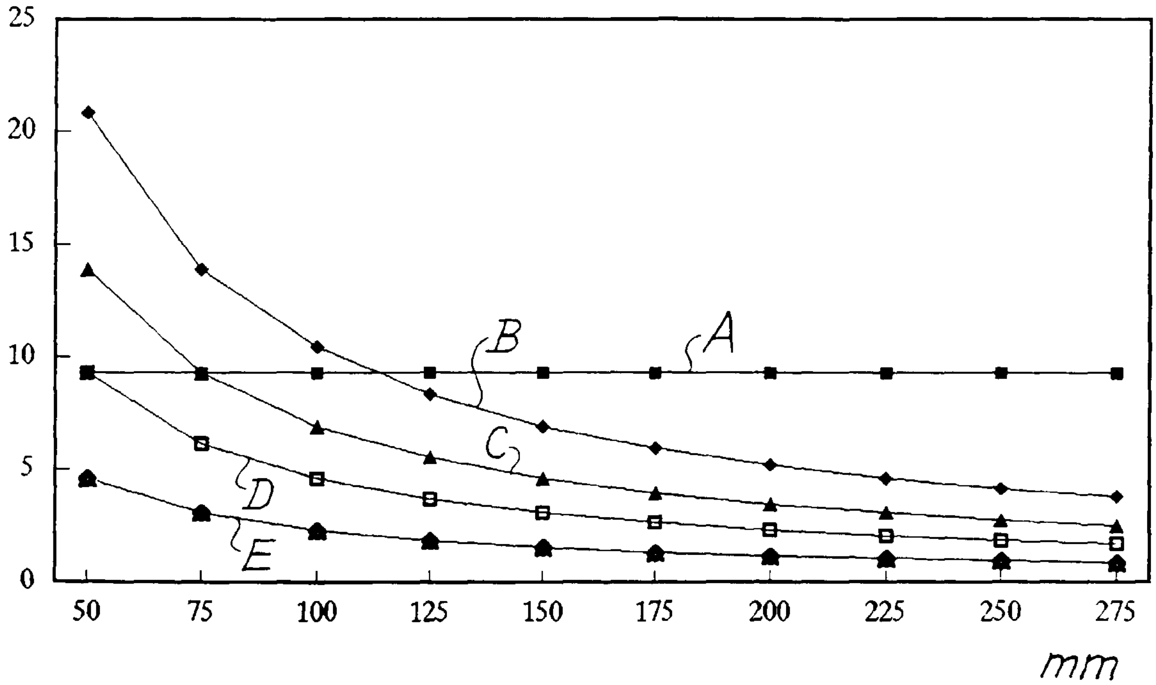
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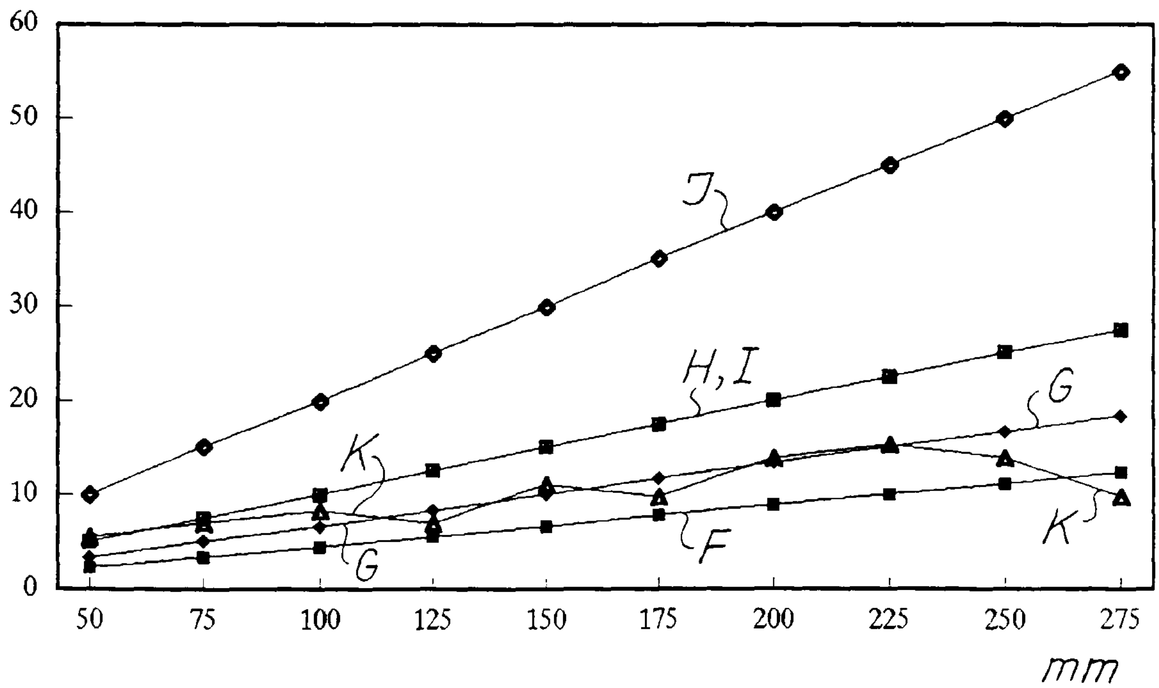
Fig. 10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mm
J
H, I
G
K
G
F
K

Fig. 11

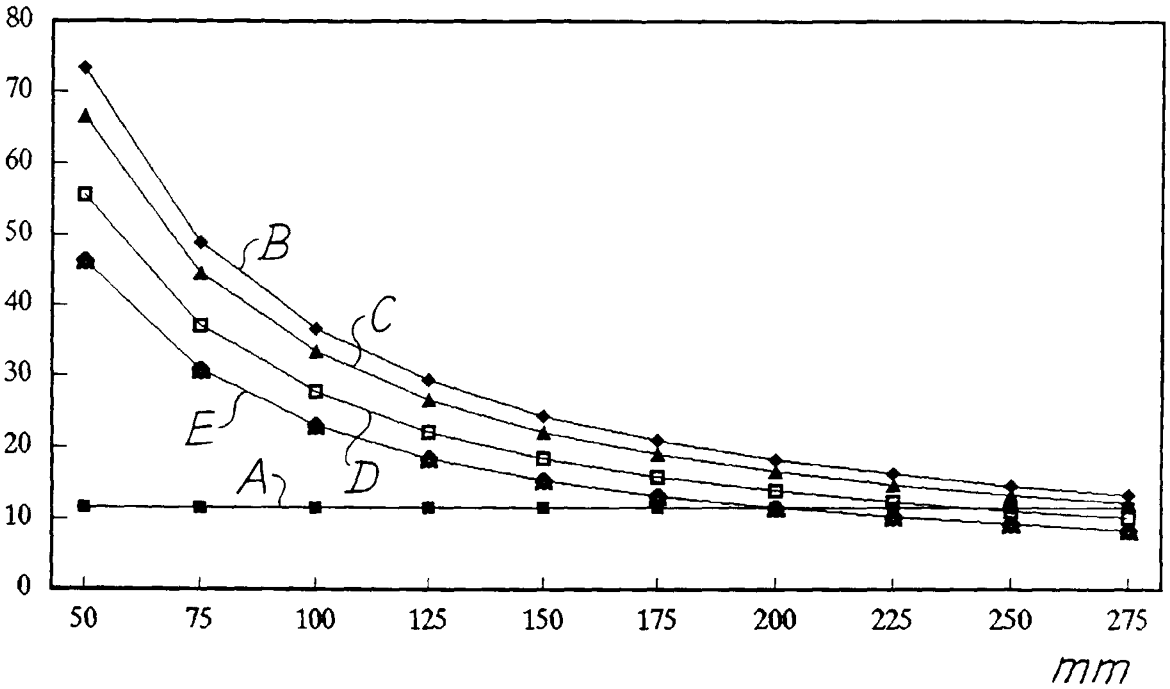
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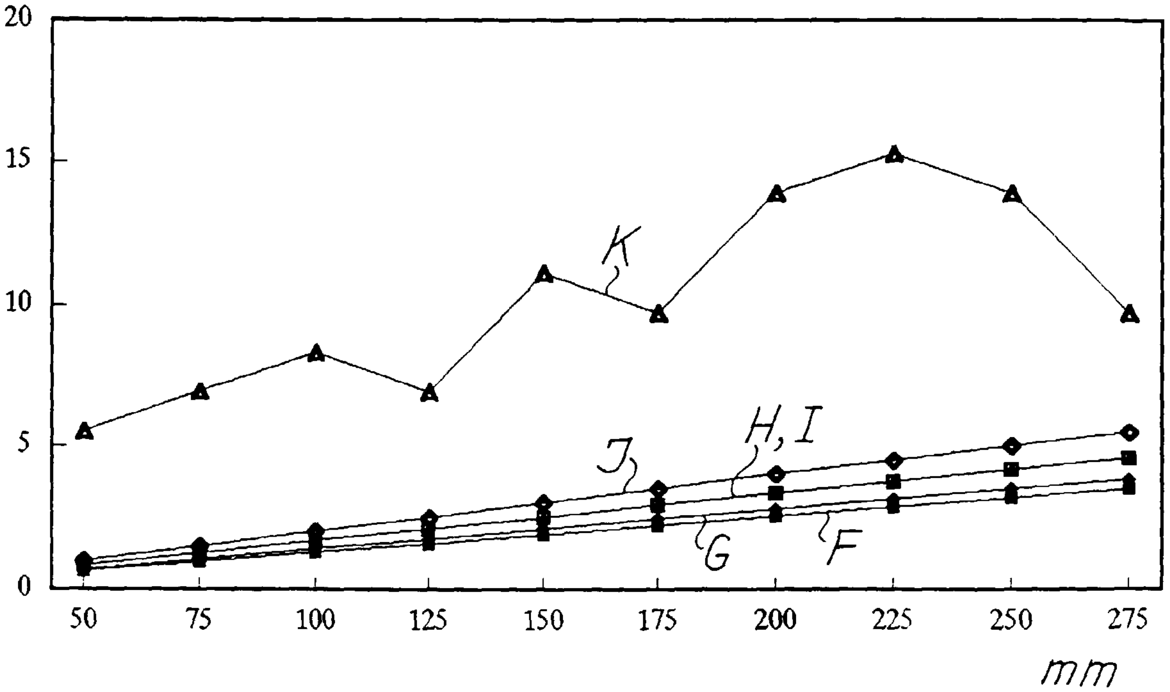
Fig. 12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