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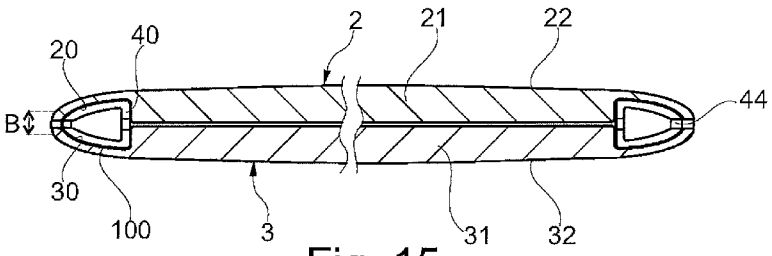


Fig. 15

(57) Abstract: A method of making a sound-absorbing screen (1), comprising: a)preparing two panels (2, 3) of felt material (21, 31), preferably comprising fibers including recycled textile fibers, bi-component fibers and polyester fibers; b)placing a first of the two panels (2, 3) in a press; c)placinga framework (4) onto said first panel (2, 3), d) placing the other one of the panels (2, 3), onto the other panel (2, 3), to sandwich said framework (4) and/or inserts between the panels (2, 3); and e)compressing the formed sandwich to the panels (2, 3) to one another to form a unit (1) by means of a bonding film (100).

A SCREEN, A PARTITION SCREEN SYSTEM AND A METHOD OF MAKING THE SCREEN

TECHNICAL FIELD

The present invention relates to a method of making a sound-absorbing screen.

It also relates to a screen, preferably sound-absorbing, including a framework, preferably also including panels carried by the framework.

Additionally, it relates to a partition screen system comprising at least two movable partition screens, each screen including a framework and preferably also panels carried by the framework.

In the present context, the term "screen" is intended to include not only screens standing on a floor or on a desk or table but also sound-absorbing screens to be attached to walls or ceilings and even be suspended in ropes or wires from the ceiling.

BACKGROUND ART

A portable wall partition is a room divider/screen that has two full panel end members, which provide support, rigidity, privacy and noise reduction. Portable partitions are used to divide space quickly where non-mobile permanent room dividers may be unavailable or impracticable. They may also be used as a convenient sight divider to conceal door openings to rest rooms, commercial kitchens and other backroom areas.

Room dividers that have two full panel end members, which provide support, rigidity, privacy and noise reduction are previously known, see for example US 3,592,288, US 4,535,577, US 6,134,852, US 6,341,457 B1, and US 6,951,085 B2. However, all of them have the drawbacks of having an exteriorly facing support frame, they are thick and heavy, and they are expensive to manufacture.

Less heavy designs of room dividers/screens are known, wherein lighter materials are used, e.g. paper board to provide sufficient rigidity. DE U 202006016905 discloses one such example. However, as well known, paper board is damp sensitive and therefore not a sufficiently reliable material in many applications. Furthermore, DE U 202006016905 presents a design wherein a plurality of room dividers are hingedly attached to one another, which does not provide a desired flexibility in many situations.

SUMMARY OF THE INVENTION

The main object of the present invention is to provide a method that permits comparatively thin and light screens, preferably sound-absorbing, to be made at a low cost.

This object is achieved in that the method in accordance with the present invention comprises the steps of:

a) preparing two panels of felt material, preferably comprising fibers including recycled textile fibers, bi-component fibers and polyester fibers;
b) placing a first of the two panels in a press;
d) placing the other one of the panels, onto the other panel, to sandwich the panels; and
e) compressing the formed sandwich to the panels to one another to form a unit by means of a bonding film.

A screen made by this method will be thinner, lighter and less expensive than those referred to above. Moreover, it provides a rigid and durable design thanks to the bonding film forming a reinforcing element of the unit. Moreover, it provides a construction that may withstand tough environments, e.g. damp, and that will facilitate a more esthetical impression than known designs, since rounded edges may be formed and possible inserts and frame work may be embedded within the screen. Further the panels may be formed to varying shapes to produce screens of varying shapes, e.g. plane screens, curved screens, curved and plane screens, etc.

Where it is desirable to protect an exposed felt material surface in the screen, it is recommendable, prior to step a), to apply a glue film and a cover fabric onto a felt material surface that is intended to form an outward facing panel surface in a finished partition screen and laminating the cover fabric to the felt material.

Prior to step c), it is suitable to form the framework by providing two substantially vertical framework members, preferably metal tubes, that are to extend inside of and adjacent side edges of the partition screen, and interconnecting the two tubes or other vertical framework members by a plurality of substantially horizontal laths. Such a framework is light but yet sufficiently stable, and it is inexpensive.

Preferably, at least one lath is made of a material offering a hold for a wood screw, preferably medium density fiberboard (MDF). This will contribute to the low weight and the low cost of the screen.

If it is desired to make a curved sound-absorbing screen, the screen preferably has relatively small horizontal extension to facilitate sufficient rigidity without use of any laths, or alternatively the laths are curved elements, e.g. curved tubes.

For screens intended to stand on the floor, the laths preferably are mounted at such levels that one of them is located at a level suitable for attaching a table top thereto.

Further, it is also preferred that one of the laths is located at a level suitable for attaching a shelf and/or a coat peg thereto.

Preferably, slots are made in the two tubes or other vertical framework members to receive ends of the laths. By fitting the lath ends into the two tubes or other vertical framework members, the rigidity of the framework will be improved and further the framework may be prefixed into a desired positioning/geometry by fixation of the laths to the tubes/frame members, in a fixture, that easily provides exact positioning and subsequently attaching/fixing them, e.g. by clamping.

If one partition screen is to be connected to an adjacent partition screen, it is suitable to make slots in the two tubes or other vertical framework members to receive ends of connector fittings for interconnecting the screens. According to a preferred design the screens may be dis/interconnected without use of tools, i.e. easily and quickly removable.

Then, after step b) but prior to step d), it is suitable to place temporary spacers outside the intended location of the connector fittings to prevent the two panels from binding to each other there during the pressing step, and thus to keep an entrance to connector fitting open. According to a preferred embodiment the spaces are releasably inserted into the framework.

During the pressing step e) it is preferred to compress the material in the panels at least 10% and more preferred substantially more (e.g. between 30-90%) adjacent the edge portions to achieve neatly shaped edge portions. To obtain straight and esthetic edges it is suitable to allow some of the material to expand outside of the intended shape and to

cut off surplus material whereby the edges are formed. In an embodiment with a framework the cutting will be performed outside the frame member, e.g. outside the tubes or other vertical framework members of a screen. Then, after the cutting, the felt material preferably projects limited distance (e.g. 5-30 mm) from the side of the steel tube or other vertical framework member.

When the screen is to stand on feet, the feet are suitably mounted to the framework after step e). Preferably, the feet are mounted at least indirectly to the two tubes or other vertical framework members at intended lower ends thereof.

To make a rectangular sound-absorbing movable partition screen for positioning on a top of a desk or table, the method of the present invention further may comprise: prior to step c), forming the framework by providing an elongate plane base (e.g. of steel) and attaching thereto a support member shaped to be located inside and extend along three sides of the partition screen. The plane base will make the screen stand safely on the top of the table but will still permit the screen to be moved easily. To avoid an accidental turning over of the screen, the base may be wider at its middle than at its ends.

The support member is suitably made from steel wire, to be sufficiently stable while simultaneously keeping costs down.

In accordance with the present invention, the object of the invention is achieved also in a sound-absorbing screen of the kind referred to in the second paragraph above, in that that the two panels comprise a sound absorbing felt material made from fibers from recycled textile and polyester material, and that the framework is sandwiched between the two panels to form a laminated screen.

Such a screen will be thinner, lighter and less expensive than those referred to above.

Preferably, the framework comprises two substantially vertical framework members, preferably steel tubes, which extend along adjacent side edges of the partition screen, and a plurality of substantially horizontal laths interconnecting said two framework members. Such a framework is light but yet sufficiently stable, and it is inexpensive.

At least one lath is suitably made of a material offering a hold for a wood screw, preferably medium density fiberboard. This will contribute to the low weight and the

low cost of the screen. If the screen isn't plane but a curved one, the laths suitably are curved elements, such as curved steel tubes.

For screens intended to stand on the floor, the laths preferably are mounted at such levels that one of them is located at a level suitable for attaching a table top thereto. Then, it is recommendable that one of the laths is located at a level suitable for attaching a shelf and/or a coat peg thereto.

Preferably, slots are provided in the two tubes or other vertical framework members to receive ends of the laths. By fixing the lath ends in the two tubes or other vertical framework members, the rigidity of the framework will be improved.

To permit easy connection of one screen to an adjacent one, a side edge of the screen suitably has at least one opening extending between the two panels up to the framework to permit access and attachment of a connector fitting to the tube or other vertical framework member so as to permit coupling the partition screen to an adjacent partition screen. Preferably, the connector fitting has two opposite ends provided with at least one flexible hook member at each end, and the framework of the screen has a slot for lockably receiving one end of the connector fitting, e.g. providing easy snap-in interconnection.

When the screen is intended to be freestanding on a floor, feet for supporting the screen are suitably mounted at intended lower ends of the two tubes or other vertical framework members.

Then, if desired, at least one of the feet may be a supporting foot that is to be mounted also to a lower end of a tube or other vertical framework member of at least one adjacent partition screen, thereby connecting the screens to one another. Hence, one foot may be provided with a plurality of vertical stub ends, each one fitting into a lower tube end of an adjacent screen.

To make the side edges of the screen more durable, the screen has side edges, where the felt material preferably projects a limited distance from the side of the steel tube or other vertical framework member.

If the screen is intended to be placed on top of a desk or table, the framework preferably comprises an elongate plane base (e.g. of steel), and a support member attached thereto

and shaped to be located inside and extend along three sides of the partition screen. Then, the support member may preferably be made from steel wire. The plane base will make the screen stand safely on the top of the table but will still permit the screen to be moved easily. To avoid an accidental turning over of the screen, the steel base may be wider at its middle than at its ends.

Where it is desirable to protect an exposed felt material surface in the screen, it is recommendable that at least one of the two panels has an exterior side including a cover fabric laminated to the felt material.

In accordance with the present invention, the object of the invention is achieved also in a partition screen system of the kind referred to in the third paragraph above, in that the two panels comprise a sound absorbing felt material, preferably including fibers from recycled textile and polyester material, and that the framework is sandwiched between the two panels to form a laminated screen, and the framework of each of said at least two screens being coupled to that of an adjacent screen by at least one connector fitting.

Preferably, the connector fitting has two opposite ends provided with at least one flexible hook member at each end, and the framework of each screen has a slot for lockably receiving one end of the connector fitting, to preferably achieve an easy snap-in connection.

It is suitable that the connector fitting at its middle has a transverse slot extending halfway over a width of the connector fitting. Then, two connector fittings may be combined in a transverse slot to transverse slot relationship to form a cross-shaped connector fitting for connecting four screens at right angles to one another.

Alternatively, the connector fitting is bent an angle, preferably of 60° or 90°, to permit connection of two screens at an enclosed angle of 120° or 90°, respectively, to each other.

Preferably, feet are provided for supporting the screens, and at least one single foot supports a corner of a screen and an adjacent corner of a connected adjacent screen.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be described in more detail with reference to preferred embodiments and the appended drawings.

Fig. 1 is a schematic perspective view of a sound-absorbing movable plane partition screen in accordance with a basic preferred embodiment of the present invention.

Fig. 2 is a perspective view of a framework, which in the screen of Fig. 1 may be sandwiched between two panels.

Fig.2B shows a front view of a screen and framework according to a preferred embodiment of the invention.

Fig. 3 is a perspective view of a sound-absorbing movable curved partition screen in accordance with a further embodiment of the present invention.

Fig. 4 is a perspective view of the bottom portions of two screens that are to be connected to each other by means of a common foot and a connector fitting.

Fig. 4A shows a perspective view of a preferred embodiment of an insert, coupling and frame member according to the invention.

Fig. 4B shows a cross-sectional view from above of a tube and a plastic insert for coupling according to a preferred embodiment of the invention.

Fig. 4C shows a perspective view of a plastic insert of Fig. 4.

Fig. 5 is a view similar to Fig. 4 but with a foot for connecting more than two screens to one another.

Fig. 6 is a perspective view of four screens connected to one another.

Fig. 7 is a perspective view of a flat foot.

Fig. 8 is a perspective view of a screen corner with a flat foot.

Fig. 9 is a perspective view of a two person working space formed with four screens, two table tops and two shelves.

Fig. 10 is a perspective view of a portion of the working space of Fig. 9 showing a shelf and two coat pegs.

Fig. 11 is a plan view of various possibilities of connecting the screens to form working spaces.

Fig. 12 is a perspective view of a screen to be placed on the top of a desk or table.

Fig. 13 is a perspective view of the screen of Fig. 12 with one panel removed to show the sandwiched framework.

Fig. 14 is a perspective view of two screens of the kind shown in Fig. 12 placed side by side on a table.

Fig. 15 is a cross-sectional view of one embodiment taken along line A–A in Fig. 1, showing a preferred framework arrangement.

Fig. 16 is a cross-sectional view taken along line B–B in Fig. 1.

Fig. 17 is a cross-sectional view of a gradually tapering side edge of a screen of the present invention

Fig. 18 is a perspective view of a preferred embodiment of a connector fitting for connecting two screens to each other.

DETAILED DESCRIPTION

Fig. 1 shows a sound-absorbing movable partition screen 1. The screen includes a framework 4 (two different embodiments are schematically shown in Fig. 2) and two panels 2, 3 carried by the framework 4, and feet 8 to support the screen 1.

In accordance with the present invention, the two panels 2, 3 comprise a sound absorbing felt material, preferably made from fibers including the groups of bi-component fibers, recycled textile fibers and polyester material fibers, wherein (optionally) a framework 4 is sandwiched between the two panels 2, 3 to form a laminated screen 1, wherein no part, or at least no substantial part, of the frame work 4 is shown. Indeed, according to one modification of the invention no actual framework at all will be needed, but sufficient rigidity and strength may be obtained merely by pressing and thereby sufficiently compressing (at least 10%, preferably at least 20%) and simultaneously bonding the two panels 2, 3 to each other.

One example of suitable felt material is available from Isovlas Oisterwijk BV in Oisterwijk, the Netherlands, for example, and comprises natural fibers (e.g. from flax), polyester fibers (e.g. from recycled polyethylene terephthalate bottles), bicomponent fibers and at least one flame retardant (e.g. ammonium phosphate). A screen according to the invention may be thinner, lighter and less expensive than prior art screens. A thickness of around 20 -35 mm, preferably 25-30 mm, is preferred.

In Fig. 2 there is schematically presented two different embodiments of a basic part of the frameworks 4 in connection with the invention. In a first embodiment the basic part of the framework 4 (which may be used for different embodiments) comprises four framework members 40 put in a rectangle, anchored to one another at the corners and extending horizontally and vertically, respectively, along the sides of the screen 1 to form a strong rectangle. The framework members 40 are preferably made of metal, e.g. extruded aluminum or steel, possibly reinforced with steel tubes as shown in Fig. 2. When tubes are used, they can be of any arbitrary cross section, round, square, triangular, etc. In Fig. 15 and 16, which are a cross-sectional views taken along lines A–A and B-B in Fig. 1, it is shown that the framework members 40 preferably have a

triangular cross-sections wherein the bases 40B face inwardly such that the top 40A of the triangle is positioned closest to the edges 1A of the screen 1. Thanks to this design neatly formed edges 1A may be formed, i.e. having a width B that is substantially smaller than the main thickness, e.g. B = 3-10 mm. It is evident that combinations of different kind of framework members 40 may be used, e.g. using tubes or flat bars for the framework members 40, for example. The four framework members 40 can be anchored to one another by welding, for example, or can be fixed to one another by means of rivets/screws (not shown).

According to a preferred embodiment the basic part of the framework 4 merely comprises two tubes 41 (e.g. metal) extending in the vertical direction, as shown in more detail in Fig. 2B.

Further, the framework 4 comprises a plurality of transverse laths 45 extending between and interconnecting the two vertical framework members 40. Each one of the two vertical framework members has a series of slots 43 provided on its side facing the other vertical framework member 40, one for each lath 45. Each of the laths 45 has its ends inserted in a respective slot 43. In a floor screen, preferably at least one of the laths 45 is made of a material offering a hold for a wood screw (not shown), preferably medium density fiberboard (MDF). Such a framework is light but yet sufficiently stable, and it is inexpensive. The width W of the laths 45 is preferably in the range of 20-200 mm, more preferred 40- 120 mm.

If the sound-absorbing movable partition screen 1 is curved as shown in Fig. 3, no laths are used or the laths 45 (not shown) have to be curved elements and suitable are pre-formed.

In a floor screen, the laths 45 are preferably mounted at such levels that one of them is located at a level suitable for attaching a table top 90 thereto as shown in Fig. 9. Also, it is recommendable that one of the laths 45 is located at a level suitable for attaching a shelf 91 and/or a hanger/coat peg 92 thereto as shown in Fig. 10, or for attaching a table top 90 intended for a person standing up.

As indicated in Fig. 4, to permit easy connection of one screen 1 to an adjacent one, a vertical side edge of the screen 1 suitably has at least one opening 44 extending between the two panels 2, 3 and preferably through the framework 4 to permit access and

attachment of a connector fitting 5 so as to permit coupling the partition screen 1 to an adjacent partition screen.

In Fig. 2B there is shown a preferred embodiment of a framework 4 according to the invention, having parallel vertical tubes 41 interconnected by means of horizontal laths 45. The tubes 41 are positioned inside of the vertical edge 1A of the screen, preferably fully enclosed, such that preferably no parts of the tubes 41 are visible (without looking into a slot/opening). During the final pressing of the two parts 2, 3 inserts (not shown) are used to form recesses 20, 30 to create adapted voids for the framework 41, 45. Further also insert are used to create openings 44, 41A for insertion of couplings and feet respectively, from the sides and from below respectively. As will be presented more in detail below different feet may be used in connection with the screens, having a mating interface to obtain reliable and strong upright positioning of the screens. In the preferred embodiment this is achieved by using the lower ends of the tubes to receive a mating stub end 80 of a foot portion, i.e. a stub end having a slightly smaller diameter than in the inner diameter of the tube 41. Further, it is indicated that the tubes 41 at the position of the openings 44 (for the couplings 5) are arranged with plastic inserts 57 in order to improve the ability to easily insert and take out a coupling 5.

In Fig. 4A it is shown an upper part of a tube 41 according to a preferred embodiment of a coupling 5 to be used in connection with the invention. It is shown that the tube is arranged with through holes 43 having rectangular shape adapted to the cross-sectioned shape of a lath 45. According to a preferred embodiment the through hole 43 goes all the way through the tube 41 enabling each lath to protrude all the way through the tubes, there by achieving improved stability (to the skilled person it is, evident that in many applications it may be sufficient to merely have one opening 43 and allow the lath 45 support in that single opening). As is evident the design preferably is such that the front part of the coupling 5 substantially protrudes past the inner tube opening 44A in the tube a distance into the space between the two interconnected parts 2 and 3 of the screen 1. Thanks to this design an easy connectible coupling 5 is achieved having a front part that is easily steered into and through the openings 44, followed by a flexible snap in mechanism that assist to obtain an easy, correct positioning of the coupling 5 within in the tubes 41. (A preferred coupling 5 is described more in detail in connection with Fig. 18.) According to further embodiment plastic inserts 57 are positioned within the openings 44A within the tubes 41, e.g. to enable extra reliability for the assembly and disassembly of couplings 5. In the preferred embodiment the inserts 57 are securely retained in the openings 44A by means of a snap-in mechanism that fixates the inserts

57 in the intended position within the openings 44. According to a preferred embodiment this is a achieved by arranging the outwardly facing portions of the openings 44A with a tapering α (e.g. $70^{o} < \alpha < 100^{o}$) and producing the plastic inserts 57 with side portions adapted to this tapering and further arranging front portions 570 of the insert 57 to be elastic. The rear portion 571 of the insert 57 maybe more or less rigid and preferably also interconnected by transverse horizontal bottom and top portions 573. Centrally in the plastic insert 57 there is a arrange a through hole 572 adapted to snuggly inter-fit with the coupling 5.

Various embodiments of the connector fitting 5 can be conceived, but a preferred embodiment is shown in Fig.18. Preferably, the connector fitting 5 has two opposite ends provided with at least one flexible hook member 52 at each end, and the vertical tube of the screen has a slot 40A for lockably receiving one end of the connector fitting 5. The connector fitting 5 has two symmetrical, opposite ends provided with protruding members 51, 52 at each end and a wider intermediate body 50, wherein said intermediate body 50 is arranged with stop edges 54 arranged to allow each protruding member 51, 52 to be locked within and protrude through a slot 44 in the tubes 41. In that position the outer surface of the vertical tube 41 (or plastic insert 57) will be in contact with the stop 54 and the inner surface of the tube 41 (or plastic insert 57) will be in contact with tapered portions of flexible hook members 52, thereby creating a retaining force. The slot 40A goes all the way through the vertical 41 allowing the protruding members 51, 52 to protrude into the screen 1 between the two members 2, 3. Basically, the connector fitting 5 is a piece of strip-shaped metal or plastic dimensioned so as to achieve the desired flexibility of the at least one hook member 52. Of course, if desired the connector fitting 5 may be of another design than the one shown in Fig. 18, which only shows a preferred embodiment. The connector fitting 5 enables connecting two screens 1 to each other.

The sound-absorbing screen 1 may be attached to walls or ceilings and even be suspended in ropes or wires from the ceiling. However, as shown in Figs. 4–8, when the screen 1 is intended to be freestanding on a floor, feet 8 for supporting the screen or screens 1 are suitably mounted at intended lower ends of tubes 41 or other vertical members.

As shown in Figs. 4, 5, and 6, the feet 8 may have various designs, e.g. be designed to connect bottom corners of two or more screens 1. In the embodiment shown in Fig. 4, the foot 8 has a lower foot portion carrying a two-armed straight cross member, and

each arm end of the cross member has an upward directed peg/stub end 80 that is to be received in a complementary opening in the framework 4 of one of the screens 1. Such an embodiment is suitable when the two screens are to form a straight partition wall. However, when two screens are to form an angle with each other, suitably an enclosed angle of 120° or 90°, the two-armed cross member suitably is bent to enclose the same angle. Similarly, if three or four screens are to share a foot 8 and are arranged an enclosed angle of 120° or 90°, the cross member has to be three-armed or four-armed. The four-armed version has four enclosed angles of 90°, while there are two three-armed versions, one having three enclosed angles of 120° and another having two enclosed angles of 90°. Workplaces using screens connected at an angle to one another are shown in plan view in Figs. 9, 10 and 11. With a single screen 1 or a straight wall section of connected screens, the lower foot portion of the foot 8 preferably is flat as shown at 7 in Fig. 7 to improve the stability of the screen or screen wall. When the screens 1 are connected at an angle to each other, the lower foot portion can be narrow as shown at 8 in Fig. 8.

If the screen is intended to be placed on top of a desk or table, as shown in Fig. 12 and 13, the framework 4 preferably comprises a flat shaped support member 48 and an elongate plane base 11 attached thereto. The support member 48 is shaped to be located inside and extend along three sides of the partition screen 1'. In this embodiment the support member 48 may suitably be made from metal/steel wire. The plane base 11, e.g. made of steel, will make the screen 1' stand safely on the top of the table but will still permit the screen 1' to be moved easily. To avoid an accidental turning over of the screen 1', the steel base11 may be wider at its middle than at its ends. While the floor screen 1 has a preferred thickness of around 27 mm, the table screen 1' at the middle of its base has a preferred thickness of around 70 mm.

As shown in Fig. 17 a screen 1' according to the invention (also applies to floor screens 1) has edges, where the felt material 21, 31 preferably projects further than the framework 4 and encloses it. The very edge 1A can be formed by a gradually tapering (symmetrically as in Fig. 15, or asymmetrically as in Fig. 17) to have a pleasant appearance. The felt material 21, 31 at the edges of a screen 1 may project some millimeters (if the frame work is tapering) or some centimeters (if the frame work 48 has wide outer edges). Fig. 17 also shows that a table top screen 1' instead of having a non fixed base 11 may be arranged with a holder device 110 that can be attached to a table 6 in any appropriate manner, e.g. by means of a clamping mechanism (not shown) attached to the table 6.

A partition screen system comprises at least two sound-absorbing movable partition screens 1, and preferably each screen 1 includes a framework 4 and two panels 2, 3 carried by the framework 4. In accordance with the present invention, the two panels 2, 3 comprise a sound absorbing felt material 21, 31 made from fibers, e.g. from recycled textile and polyester material, and the framework 4 is sandwiched between the two panels 2, 3 to form a laminated screen 1, and the framework 4 of each of said at least two screens 1 is coupled to that of an adjacent screen by at least one connector fitting 5.

As described above and shown in Fig. 18, the connector fitting 5 preferably has two opposite ends provided with at least one flexible hook member 52 at each end, and the framework 4 of each screen 1 has a slot 44 for lockably receiving one end of the connector fitting 5. Basically, the connector fitting 5 is a piece of strip-shaped metal or plastic dimensioned so as to achieve the desired flexibility of the at least one hook member 52. Of course, if desired the connector fitting 5 may be of another design than the one shown in Fig. 18, which only shows a preferred embodiment.

The provision of the flexible hook members 52 may facilitate easy locking of the connector fitting 5 in the slots 44 of the vertical 41 and thereby connects two screens 1 to each other. The four corners 55 of the strip may be rounded to facilitate the entry of the connector fitting 5 in the associated slot 44. Adjacent each corner 55, a slot 53 is made that extends at first in the cross direction of the strip and then along the strip to form a narrow tongue 52, defined on one side by the slot 53 and on the other side by the long side of the strip. Between the two narrow tongues 52, at each side, a central broad tongue 51 is formed. Behind a point where the inner edge of the rounded corner 55 faces the tongue 52, the tongue 52 is provided with a V-shaped engagement portion 52A, obtained by material cut away from an inner portion 52B of the tongue 52, i.e. to form it into the shape of a hook member 52 that preferably has an inner half 52B with a side extending in parallel with the longitudinal extension of the connector fitting 5 and an outer half 52A, extending from a midsection 56, that diverges to form an angle α (e.g. about 20-30 °) in relation to the longitudinal extension of the connector fitting 5. By means of the cut away a shoulder 54 is formed at the root of the flexible hook member 52. The shoulder 54 abuts the vertical framework member 40, 41 when the connector fitting 5 is fully inserted in its associated slot 44 in the framework member 40, 41. Preferably the framework member 41 is provided with a through-passing slot 40A, implying two slots if the frame member 40, 41 is a tube, i.e. a diametrically

opposed second slot may be provided to permit the outmost end of the connector fitting 5 to pass through the tube and emerge on the other side.

It is suitable that the connector fitting 5 at its middle has a transverse slot 58 extending halfway over a width of the connector fitting 5. Then, two connector fittings 5 may be combined in a transverse slot 58 to transverse slot 58 relationship to form a cross-shaped connector fitting for connecting four screens 1 at right angles to one another as shown in Fig. 6. In an alternative embodiment, the connector fitting 5 may also be bent an angle, preferably of 60° or 90°, to permit connection of two screens at an enclosed angle of 120° or 90°, respectively, to each other. Such bent connector fittings 5 are used to mount the workplaces illustrated in Figs. 9, 10 and 11.

Preferably, feet 8 are provided for supporting the screens 1 included in the screen system. Preferably the screen system includes at least one single foot that supports both a corner of a screen and an adjacent corner of a connected adjacent screen. As shown in Figs. 4, 5, and 6, the feet can be designed to connect bottom corners of two or more screens 1. In the embodiment shown in Fig. 4, the foot 8 has a lower foot portion carrying a two-armed straight cross member, and each arm end of the cross member has an upward directed peg 80 that is to be received in a complementary opening in the framework 4 of one of the screens 1. Such an embodiment is suitable when the two screens are to form a straight partition wall. However, when two screens are to form an angle with each other, suitably an enclosed angle of 120° or 90°, the two-armed cross member suitably is bent to enclose the same angle. Similarly, if three or four screens are to share a foot and are arranged an enclosed angle of 120° or 90°, the cross member has to be three-armed or four-armed. The four-armed version has four enclosed angles of 90°, while there are two three-armed versions, one having three enclosed angles of 120° and another having two enclosed angles of 90°. Workplaces using screens connected at an angle to one another are shown in plan view in Figs. 9, 10 and 11. With a single screen 1 or a straight wall section of connected screens, the lower foot portion of the foot 8 preferably is flat as shown at in Fig. 7 to improve the stability of the screen or screen wall. When the screens 1 are connected at an angle to each other, the lower foot portion can be narrow as shown in Fig. 8.

To produce a comparatively thin and light sound-absorbing screen 1 at a low cost, the following steps may be taken:

a) heating two panels 2, 3 of sound absorbing felt material 21, 31 made from fibers, preferably including recycled textile fibers , bi-component fibers and polyester fibers;
b) placing one of the two panels 2, 3 in a press;
c) optionally placing a framework 4 for the movable partition screen 1 on the panel 2 or 3 in the press;
d) placing the other one of the panels 2, 3 on the framework 4 to sandwich the framework between the panels 2, 3; and
e) pressing the formed sandwich to be compressed and to bind its components to one another, by means of an interconnecting adhesive layer 100.

A screen made by this method will be thinner, lighter and less expensive than those referred to above. In accordance with the present invention, the two panels 2, 3 comprise a sound absorbing felt material made from fibers, e.g. from recycled textile and polyester material, and the framework 4 is sandwiched between the two panels 2, 3 to form a laminated screen 1. Such felt material is e.g. available from Isovlas Oisterwijk BV in Oisterwijk, the Netherlands, for example, and comprises natural fibers (e.g. from flax), polyester fibers (e.g. from recycled polyethylene terephthalate bottles), bicomponent fibers and at least one flame retardant (e.g. ammonium phosphate). Such a screen will be thinner, lighter and less expensive than prior art screens. A standard thickness of the produced screen 1 is around 27 mm.

Where it is desirable to protect an exposed felt material surface 21, 31 in the screen 1, it is recommendable, prior to step a), to apply a glue film 101 and a cover fabric 22, 32 onto a felt material surface 21, 31 that is intended to form an outward facing panel 2, 3 surface in a finished partition screen 1 and laminating the cover fabric 22, 32 to the felt material 21, 31.

During step e), there will be formed recesses 20, 30 fitting the framework 4 between the panels 2, 3, and also recesses if further inserts are also used. Thereby, the components of the sandwich formed by the two panels 2, 3 and the intermediary framework 4 will be located in their intended locations relative one another.

To make the panels 2, 3 ready for lamination in a press, it is suitable to preheat them to a temperature well above the melting temperature of the material forming the bonding layer 100, before placing them in said press, and then press them at sufficient heat and pressure to achieve a bonding layer 100 that joins the two panels 2, 3.

According to another embodiment of the invention the two panels are preformed with recesses for the framework 4 prior to bonding them together, whereby the bonding alternatively may be achieved by means of an added adhesive 100 whereby also the framework will be securely fixed in a sandwiched state between the panels 2, 3.

Prior to step c), it is suitable to form the framework 4 by interconnecting framework members 41 and a plurality of substantially horizontal laths 45. Such a framework 41 is light but yet sufficiently stable, and it is inexpensive. When tubes are used as the vertical framework members 41, they can be of any arbitrary cross section, round, square, triangular, etc. In Fig. 15, which is a cross-sectional view taken along line A–A in Fig. 1, the two vertical framework members 40 are tubes having a triangular cross-section. The other two framework members 40 are substantially horizontal and can be tubes or flat bars, for example. If steel tubes are used for all of the four framework members 40, they can be anchored to one another by welding, for example, while in case the horizontal framework members 40 are made of flat aluminum bars, for example, the framework members can be fixed to one another by means of screws (not shown). Preferably, at least one of the laths 45 is made of a material offering a hold for a wood screw (not shown), preferably medium density fiberboard (MDF). This will contribute to the low weight and the low cost of the screen.

According to the invention a preferred felt material may be used that contains about 30 to 50% of textile fibers, preferably recycled textile fibers, 30-50% of by bi-components fibers (that is partly meltable) and 10-30% of non meltable polymer fibers. The bi-components fiber has a non melt able core and an outer layer that is meltable, by means of which the felt composition will interconnect to obtain a stable form comprising a network structure of interconnected fibers. This is achieved by heating the felt material above the melting temperature of the meltable outer layer. The melting temperature will normally be around 120° C for a preferred kind of bi-component fiber. In the most preferred embodiment the felt material shall contain at least 1/3 of a bi-component fiber.

When producing a partition screen in accordance with an embodiment of the invention (using a preferred kind of material as mentioned above) the production is initiated by cutting out pieces of felt material having desired measures adapted to fit into a mould/press, used in a later stage of the process. Thereafter a cloth 32, 22 may be applied to the outward facing side of each panel 2, 3, by means of applying a layer of adhesive 101 and thereafter applying the cloth thereon. In a next step the two panels 2, 3

of a unit 1 are preheated (preferably in an oven) to a temperature well above a melting temperature, e.g. 120 °C, preferably in the range of 160-200 °C. At this temperature the meltable layer of the bicomponent fibers will be in a melted state. In the next stage a first panel 2 is placed into a press/mould (not shown). In most applications a framework 4 will thereafter be positioned on to the first panel 2 (onto that side of the first panel 2 that will be positioned in the center of the unit 1). Directly thereafter the second panel 3 is positioned on top of the first panel 2 (and the framework 4, if used). Now the upper mould half is moved against the other mould half to compress the two panels 2, 3 against each other. The compression of the two panels 2, 3 may be within a range of 10 – 90%, i.e. normally at least 10%. During this compression melted parts of bicomponent fibers will get into contact with each other also in the center plane between the two panels 2, 3 thereby forming a binding intermediate layer 100. And now the compressed panels 2, 3 (possibly having a framework 4 in between) are cooled for a while within the press/mould, preferable between 2 - 10 minutes to allow the compressed unit 1 to cool sufficiently to obtain a stable form, e.g. implying a temperature of 70° or lower. The cooling is achieved by means of the mould, which is made in a material having good heat conductive properties, e.g. metal such as aluminum. The cooling capacity maybe increased by having cooling channels to force the cooling of the mould. The time needed for achieving sufficient cooling of the unit 1 depends on the size of the unit and of course also the cooling capacity of the mould. In many applications it is sufficient to use a metal mould having room temperature at the start of the production and to allow the mould to absorb and transfer the heat from the unit 1 without any cooling channels, since the heat capacity of a mould may be relatively large, i.e. the temperature increase is relatively small for the mould upon cooling one unit and therefore a series of at least 10 units may be produced subsequently without need of any forced/further cooling. According to a preferred embodiment the cycle time, from placing the first panel 2 into the mould until taking out the cooled/stabilized unit 1 normally is between 3 to 6 minutes.

In many applications a framework 4 will be used to achieve improved stability/rigidity and also to arrange for support members 45 within the unit 1 that may be used to attach an external device, e.g. (a desk top 90) to the screen 1. As mentioned, in relation to Fig. 2B above, a preferred framework 4 comprises two vertical members 41, preferably hollow metal members, arranged with through holes 43, fitting onto ends of the horizontal laths 45. Further the vertical members 41 have other through holes 44A arranged to enable passage of coupling members 5. In order to achieve desired and reliable positioning of the framework 4, it preferably is prefixed in a step prior to

placing it in the press, i.e. placing it on top of the first panel 2 in de mould. This is preferably arranged for in a fixture that safeguards exactly desired positioning of the vertical members 41 and the laths 45 and their interconnection. Once the desired positioning is achieved, the ends of the laths 45 are fixed within the through holes 43 of the vertical members. This may for instance be achieved by applying pressure onto the hollow members 41 to attain a clamping force on to the lath ends, which may be easily achieved by means of using plastically deformable metallic vertical members 41. Also other fixations methods, e.g. using adhesive, may be a used. Preferably the laths are allowed to protrude at least 5mm outside of the vertical members 41, more preferred in the range of 5-15 mm, thereby further assisting in achieving a stable unit 1. Moreover inserts 57, e.g. made of plastic or metal may be positioned within a through hole 44A, 572, intended for the couplings, and also at the lower ends of the vertical members 41, to achieved desire opening 44, 41A in the final unity 1 for introduction of a coupling 5 and also interconnecting parts 80 of feet 8.

As also mentioned in accordance with Fig. 2B inserts 57 may preferably be used to achieve easy coupling and decoupling of coupling members 5. If plastic material is used in this insert 57 it shall preferably have a melting temperature that is high enough not to be negatively influenced during the compression/bonding stage, implying a melting temperature of above 170° Celsius, preferably above 200° Celsius.

Inserts (not shown, e.g. in the form a connector fitting 5) are preferably introduced into the connector holes 44 of the framework 4 prior to putting the framework 4 into the mould, to form space for the connector fittings 5. Once the unit has been formed and taken out of the mould the removable inserts in the holes 44 for the connectors 5 may be removed, for use in a next coming framework 4.

For screens 1 intended to stand on the floor, the laths 45 preferably are mounted at such levels that one of them is located at a level suitable for attaching a table top 90 thereto as shown in Fig. 9. Then, it is also preferred that one of the laths 45 is located at a level suitable for attaching e.g. a shelf 91 and/or a coat peg 92 thereto.

Preferably, slots 43 are made in the two tubes or other vertical framework members 40 to receive ends of the laths 45. By fitting the lath ends into the two tubes or other vertical framework members 40, the rigidity of the framework 4 will be improved.

If one partition screen 1 is to be connected to an adjacent partition screen, it is suitable to make slots 44 in the two tubes or other vertical framework members 44 to receive ends of connector fittings 5 for interconnecting the screens 1. Then, after to step b) but prior to step d), it is suitable to place temporary spacers outside the intended location of the connector fittings 5 to prevent the two panels 2, 3 from binding to each other there during the pressing step, and thus to keep an entrance to the slot 44 receiving the connector fitting 5 open.

During the pressing step e) it is preferred to compress the material in the panels at least 10% and more preferred substantially more (e.g. between 30-90%) adjacent the edge portions to achieve neatly shaped edge portions. To obtain straight and esthetic edges it is suitable to allow some of the material to expand outside of the intended shape during pressing and to cut off surplus material to obtain nicely looking edges 1A. Then, after the cutting 5, the felt material 21, 31 preferably projects a limited distance from the side of the steel tube or other vertical framework member.

The sound-absorbing screen 1 may be attached to walls or ceilings and even be suspended in ropes or wires from the ceiling. However, as shown in Figs. 4–8, when the screen 1 is intended to be freestanding on a floor, the feet 8 are suitably mounted to the framework 4 after step e). Preferably, the feet 8 are mounted at least indirectly to the two tubes or other vertical framework members 40 at intended lower ends thereof. Figs. 1–3 illustrate an embodiment where vertical frame members 41, suitably steel tubes, are mounted in/on the two vertical tubes or other vertical framework members 40 and have an upper end bearing against a stop, not shown, provided in/on the two vertical tubes or other vertical framework members 40 to prevent the frame members 41 from being completely pushed into the framework 4. The framework members 41 can contribute to the rigidity of the two vertical tubes or other vertical framework members 40. When the framework members 41 are used, the feet 8 may be mounted to them.

To make a rectangular sound-absorbing movable partition screen 1' for positioning on a top of a desk or table 6 as shown in Figs. 13 and 14, the method of the present invention further comprises prior to step c), forming the framework 10 by providing an elongate plane base 11 of steel and attaching thereto a support member 12 shaped to be located inside and extend along three sides of the partition screen 1'. The plane base 11 of steel will make the screen 1' stand safely on the top of the table but will still permit the screen 1' to be moved easily. To avoid an accidental turning over of the screen 1', the steel base 11 may be wider at its middle than at its ends. A maximum width of around 70 mm is

preferred. The support member 12 is suitably made from steel wire to be sufficiently stable while simultaneously keeping costs down.

INDUSTRIAL APPLICABILITY

The method of the present invention permits comparatively thin and light sound-absorbing screens to be made at a low cost. The manufactured screens are useful not only as sound-absorbing screens to be attached to walls or ceilings or even be suspended in ropes or wires from the ceiling, but also as portable wall partitions, "floor screens", that also are connectable to form a screen system to get privacy and noise reduction by dividing space quickly where non-mobile permanent room dividers may be unavailable or impracticable. They may also be used as a convenient sight divider to conceal door openings to rest rooms, commercial kitchens and other backroom areas, and in addition as "table screens" to be placed on the top of a shared desk or table.

It is evident for the skilled person that the embodiments described above does not limit the scope of the invention as defined by the enclosed claims, but that various modifications may be made without departing from the scope of the claims, e.g. when using the basic concept of the invention to produce a partition table screen 1, it is foreseen that instead of using an integrated plane base 11, various designs of releasable attachment members may be used to arrange for adjustable fixation of a table screen to a table, either to have it fixed or movable.

CLAIMS

1. A method of making a sound-absorbing screen (1), comprising:
   a) preparing two panels (2, 3) of felt material (21, 31) including bi-component fibers, said fibers preferably also comprising fibers including recycled textile fibers and polyester fibers;
   b) preheating the two panels (2, 3) to a temperature well above a melting temperature,
   c) placing a first of the two panels (2, 3) in a mould;
   d) placing the other one of the panels (2, 3), onto the other panel (2, 3), to sandwich the panels (2, 3) in the mould; and
   e) compressing the formed sandwich of the panels (2, 3) to one another to form a unit (1) by means of a bonding film (100) produced by said felt material (21, 31).

2. A method as claimed in claim 1, further comprising:
prior to step a), applying a glue film (101) and a cover fabric (22, 32) onto a surface of said felt material (21, 31) that is intended to form an outward facing part of said panel (2, 3) in a finished partition screen (1) and laminating the cover fabric (22, 32) to the felt material (21, 31).

3. A method as claimed in claim 1 or 2, further comprising:
also placing inserts and/or a framework (4) onto said first panel (2, 3) before step d), and forming recesses (20, 30, 44, 41A) fitting said framework (4) between the panels (2, 3) in step (e).

4. A method as claimed in any one of claims 1–3, further comprising:
prior to step c), forming said framework (4) by providing two substantially vertical, framework members (40, 41), preferably metal beams or tubes, that are to extend at least partly adjacent, preferably totally inside of, side edges (1A) of the partition screen (1), such that recesses (20, 30) preferably enclose said framework (4) at least along the vertical sides of said framework (4).

5. A method as claimed in claim 4, further comprising;
interconnecting said vertical framework members (40, 41) by a plurality of substantially horizontal laths (45), wherein preferably said framework (4) is fixed in a desired geometry prior to placing it into said press..

6. A method as claimed in claim 5, wherein at least one lath (45) has a width (W) in the range of 20-200 mm and is made of a material offering a hold for a screw, preferably a wood screw, wherein said material preferably is medium density fiberboard.

7. A method as claimed in claim 6, for making a curved sound-absorbing movable partition screen, wherein said curvature is created by said press.

8. A method as claimed in any one of claims 5–7, further comprising mounting the laths (45) at such levels that one of them is located at a level suitable for attaching a table top (90) thereto.

9. A method as claimed in any of claims 5-8, wherein one of the laths (45) is located at a level suitable for attaching a shelf (91) and/or a hanger (92) and/or a highly mounted table top (90) thereto.

10. A method as claimed in any one of claims 5–9, further comprising making slots (43) in the vertical framework members (40, 41) to receive ends of the laths (45), wherein preferably said slots (43) transversally pass all the way through said vertical framework member (40, 41).

11. A method as claimed in any one of claims 5–10, further comprising making slots (44A) in the vertical framework members (40, 41) to directly or indirectly receive ends of connector fittings (5) for connection of the partition screen (1) to an adjacent partition screen.

12. A method as claimed in claim 11, wherein inserts (57), preferably plastic, are fixed in said slots (44A), arranged with a through hole (572) adapted to mate with said connector fittings (5).

13. A method as claimed in any one of claims 1–12, further comprising forming converging edge portions having peripheral edges (1A) of a width (B) within the range of 1-20 mm, preferably 10 mm or less, and wherein preferably said peripheral edges (1A) are formed by cutting off protruding surplus material.

14. A method as claimed in any one of claims 1–13 for making a rectangular sound-absorbing movable partition screen (1) for positioning on a floor, further comprising

after step e) mounting feet (8), at least indirectly, to the framework member (40, 41) at intended lower end thereof and/or to said vertical framework member (40, 41).

15. A method as claimed in any one of claims 2–14 for making a rectangular sound-absorbing movable partition screen (1') for positioning on a top of a desk or table, further comprising:
prior to step c), forming the framework (4) by providing a flat shaped support member (48) and an elongate plane base (11) attached thereto to function as a stand, wherein preferably said support member (12) is made from metal wire.

16. A screen, preferably sound-absorbing, including two panels (2, 3), wherein the two panels (2, 3) comprise a felt material (21, 31) made from fibers, preferably comprising recycled textile and polyester material, the two panels (2, 3) are joined by a bonding film (100) to form a laminated screen unit (1, 1'), characterized in that said panels (2,3) include bi-component fibers and that said bonding film (100) is formed by melted and compressed material included in said felt material.

17. A sound-absorbing screen as claimed in claim 16, wherein said screen (1) is supported by a framework (4) including at least one vertical framework members (40, 48) substantially enclosed by the panels (2, 3) at least along the vertical edges of the screen unit (1, 1') and that that at least one of said panels (2, 3) includes at least on recess (20, 30) housing the framework (4) between the panels (2, 3).

18. A sound-absorbing screen as claimed in claim 17, wherein said frame work (4) includes at least one substantially horizontal lath (45) interconnecting two vertical framework members (40).

19. A screen as claimed in claim 18, wherein at least said one lath (45) is made of a material offering a hold for a screw, preferably a wood screw and wherein preferably said material is medium density fiberboard, and preferably mounted at a level suitable for attaching a table top (90) thereto.

20. A partition screen as claimed in any one of claims 16-19, wherein a further lath (45) is located at a level suitable for attaching a shelf (91) and/or a hanger (92) thereto.

21. A partition screen as claimed in any one of claims 18-20, wherein slots (43) are provided in the two tubes or other vertical framework members (40, 41) to receive ends of the laths (45).

22. A partition screen as claimed in any one of claims 16-21, wherein a vertical side edge of the screen has at least one recess (44) extending between the two panels (2, 3) to permit access and attachment of a connector fitting (5) to the vertical framework member (40, 41) so as to permit coupling the partition screen (1) to an adjacent partition screen.

23. A partition screen as claimed in claim 22, wherein the connector fitting (5) has two symmetrical, opposite ends provided with protruding members (51, 52) at each end and a wider intermediate body (50), wherein said intermediate body (50) is arranged with stop edges (54) arranged to allow each protruding member (51, 52) to lockable interconnect with a slot (44) in vertical framework member (40, 41) of the screen (1).

24. A partition screen as claimed in any one of claims 16-23, wherein said screen (1, 1') is arranged with peripheral edges (1A) of a width (B) within the range of 1-20 mm, preferably 10 mm or less, at least along its vertical sides.

25. A partition screen as claimed in any one of claims 16-24, comprising mounting feet (8), at least indirectly connected, to the framework member (40, 41) at an intended lower end thereof and/or to said vertical framework member (40, 41).

26. A sound-absorbing screen as claimed in claim 16 for use as a partition table screen (1'), wherein the framework (4) comprises a flat shaped support member (48).

27. A sound-absorbing screen as claimed in claim 26 for use as a movable partition table screen (1'), wherein the framework (4) is connected to an integrated plane base (11) or to attachment members.

28. A partition screen as claimed in any of claim 26-27, wherein the support member (48) is made metal steel wire.

29. A partition screen as claimed in any one of claims 16-28, wherein at least one of the two panels (2, 3) has an exterior side including a cover fabric (22, 32) laminated to the felt material (21, 31).

30. A partition screen system comprising at least two movable partition screens (1), each screen (1) including a framework (4) and two panels (2, 3) carried by the framework, said two panels (2, 3) comprising a felt material (21, 31) made from fibers, preferably comprising recycled textile and polyester material, said the framework (4) being sandwiched between the two panels (2, 3) to form a laminated screen (1), and the framework (4) of each of said at least two screens (1) being coupled to that of an adjacent screen by at least one connector fitting (5).

31. A partition screen system as claimed in claim 30, wherein the connector fitting (5) has two opposite ends provided with at least one flexible hook member (52) at each end, and the framework (4) of each screen (1) has a slot (44) for lockably receiving one end of the connector fitting (5).

32. A partition screen system as claimed in claim 30 or 31, wherein the connector fitting (5) at its middle has a transverse slot (58) extending halfway over a width of the connector fitting (5).

33. A partition screen system as claimed in claim 32, wherein two connector fittings (5) are combined in a transverse slot (58) to form a cross-shaped connector fitting for connecting four screens (1) perpendicularly to one another.

34. A partition screen system as claimed in any one of claims 30-33, wherein feet (8) are provided for supporting the screens (1), and at least one single foot (8) supports a corner of a screen (1) and an adjacent corner of a connected adjacent screen (1).

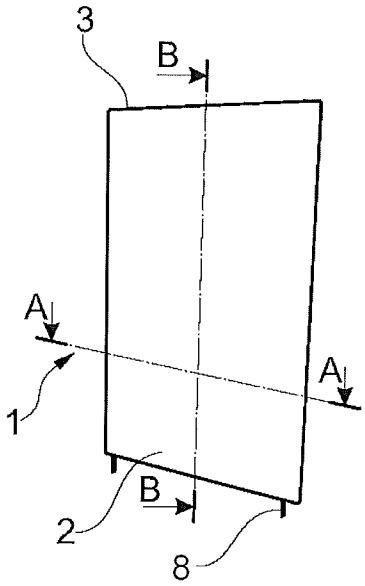


Fig. 1

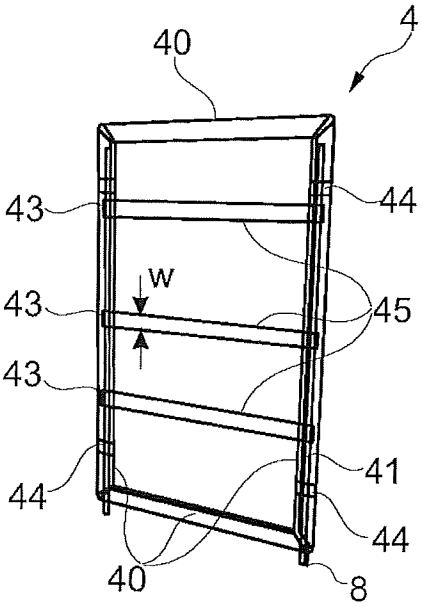


Fig. 2

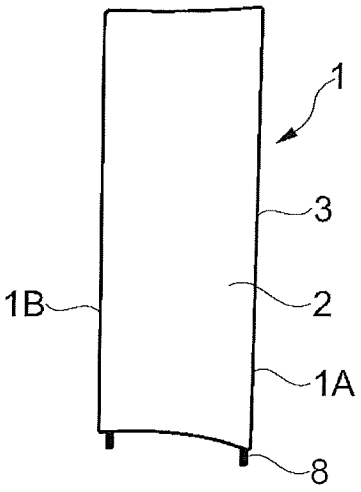


Fig. 3

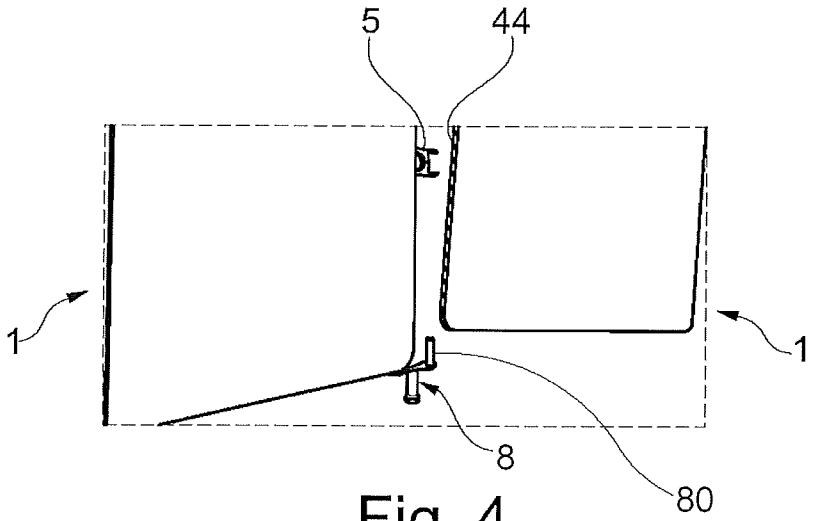


Fig. 4

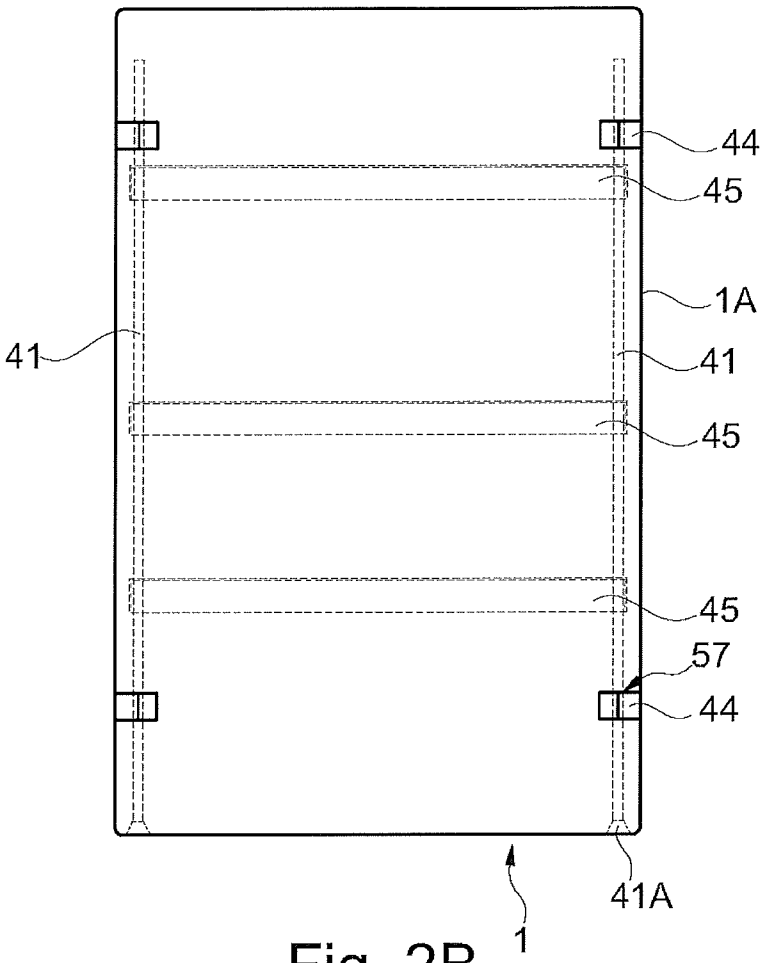


Fig. 2B

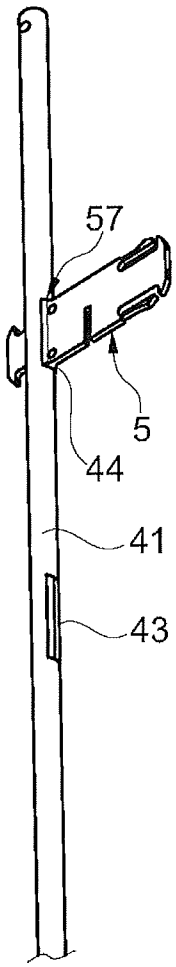


Fig. 4A

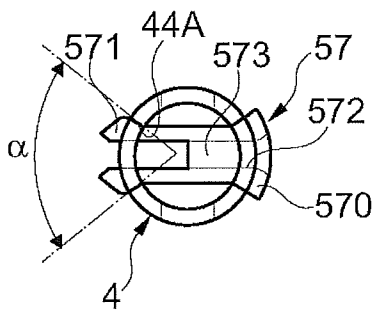


Fig. 4B

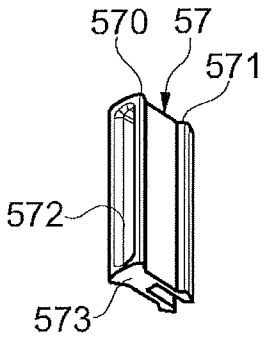


Fig. 4C

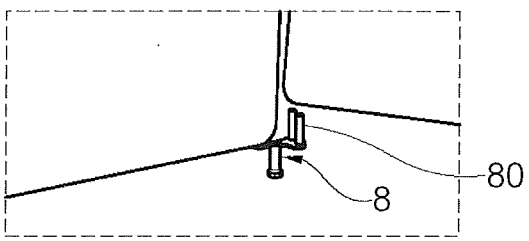


Fig. 5

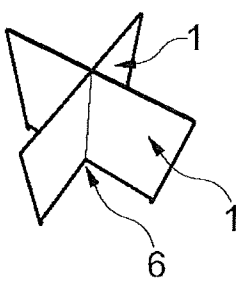


Fig. 6

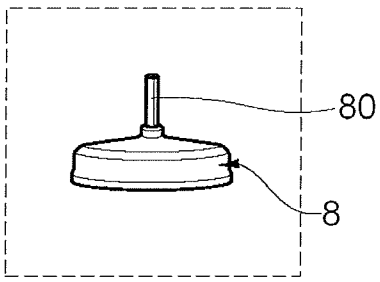


Fig. 7

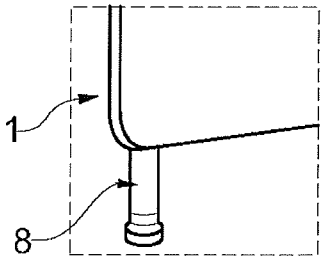


Fig. 8

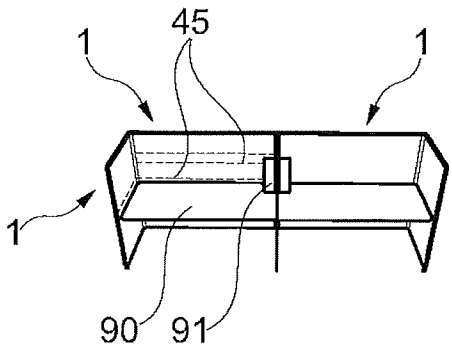


Fig. 9

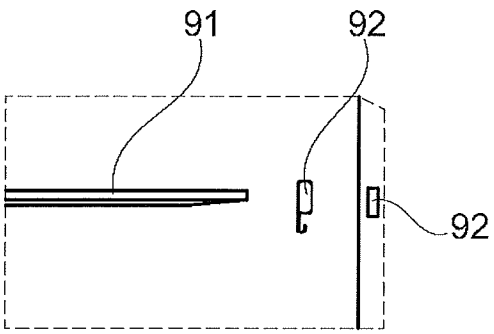


Fig. 10

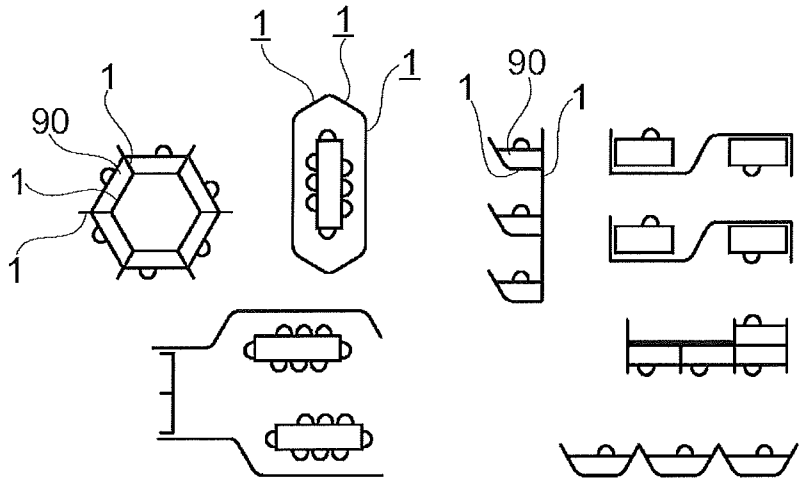


Fig. 11

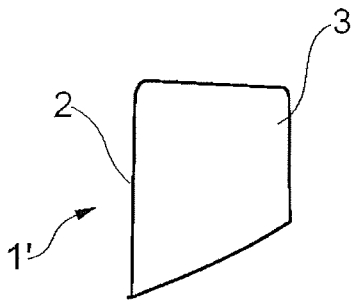


Fig. 12

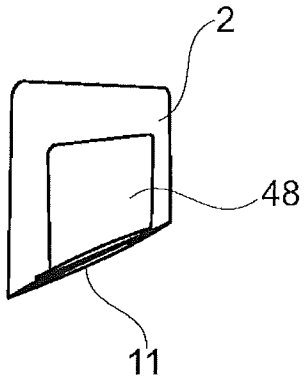


Fig. 13

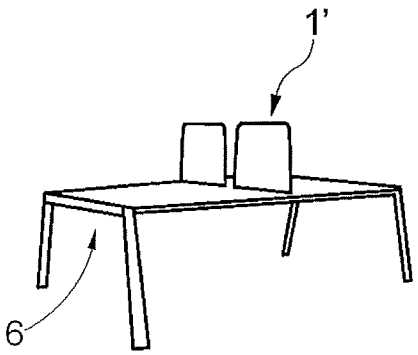


Fig. 14

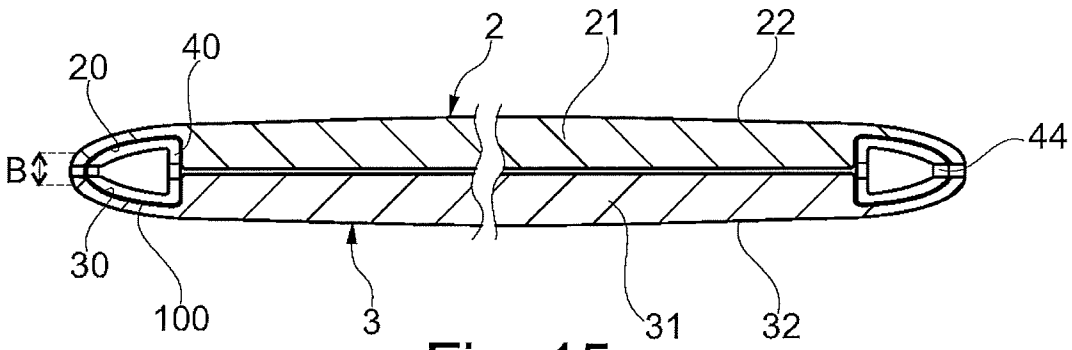


Fig. 15

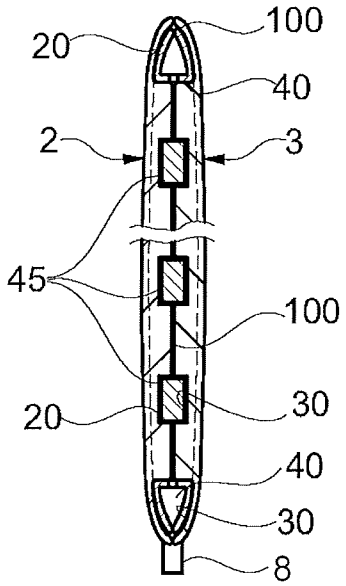
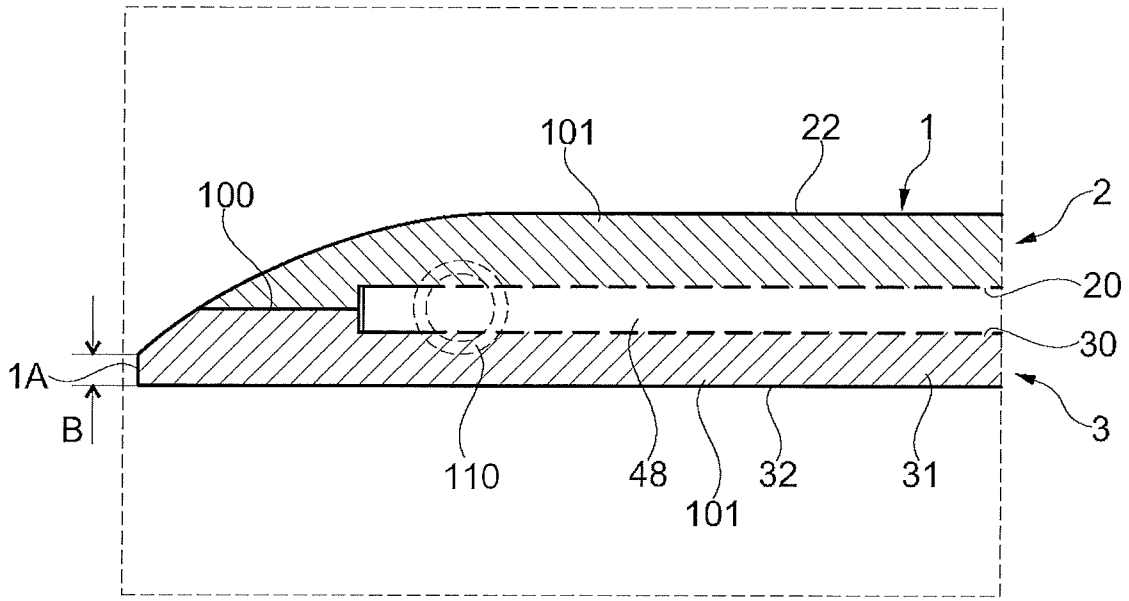


Fig. 16


101
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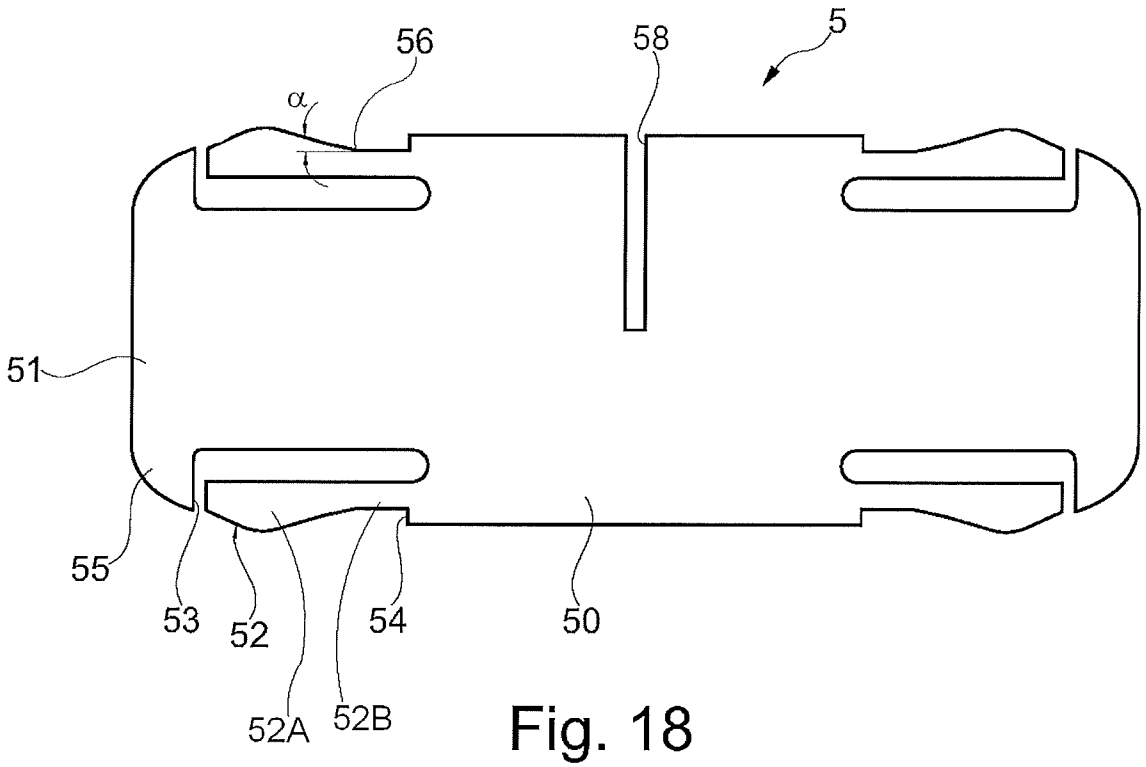
32
31
101

Fig. 17


56
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52B

Fig. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2015/050061

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: E04B

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 202006016905 U1 (ERIC THOMAS), 1 March 2007 (2007-03-01); abstract; paragraphs [0001]-[0002], [0005], [0037]-[0044]; figures 1-8	1-34
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Y	US 20080057283 A1 (BLINKHORN ARTHUR ET AL), 6 March 2008 (2008-03-06); abstract; paragraphs [0003], [0020], [0031], [0060], [0074]-[0075]; figures 1-3	1-34
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A	US 5111579 A1 (ANDERSEN CARL W), 12 May 1992 (1992-05-12); abstract; column 4, line 59 - column 5, line 26; column 8, line 36 - column 10, line 23; figures 1, 20,21,	1-34
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07-05-2015	07-05-2015

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2015/050061

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 20130260362 A1 (MELASHENKO CONNIE ET AL), 3 October 2013 (2013-10-03); abstract; figures 1-6 --	1-34
A	SE 1150973 A1 (PIKVAL OY), 26 April 2012 (2012-04-26); figures 1-2 --	1-34
A	FR 1385822 A (FIRMA VELOX-WERK HERBERT SCHNELLE), 15 January 1965 (1965-01-15); page 1, column 2, paragraph [0005] - page 2, column 1, paragraph [0002]; figures 1-2 --	1-34
A	US 4047337 A1 (BERGSTROM TORSTEN), 13 September 1977 (1977-09-13); abstract; figures 1-4 -- --------	1-34

International application No.
PCT/SE2015/050061

Continuation of: second sheet

International Patent Classification (IPC)

E04B 2/74 (2006.01)

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