

SLAT ASSEMBLY FOR ROLLER SHUTTER, ROLLER SHUTTER, AND METHODS OF MANUFACTURE THEREOF

Technical Field

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[0001] Embodiments generally relate to a slat assembly for a roller shutter, a roller shutter, a method of manufacturing a slat assembly, and a method of manufacturing a roller shutter.

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Background

[0002] Roller shutter has been commonly installed at the entrance of various types of premises such as retail shops, warehouses, buildings, hangars, garages, etc. for controlling physical access into the enclosed space of the respective premises. When the shutter curtain of the roller shutter is down, it provides protection against environmental factors such as wind and/or rain. It also provides security protection against intrusion or breaking in. In certain applications, it is also required to act as a fire barrier to impede the spread of fire. Further, according to the fire codes of some countries, these fire shutters in compartment walls are also required to be insulated according to stringent standards. Since most of these shutters are made of metal such as steel which are good conductor of heat, in the event of a fire, while the shutter curtain of the roller shutter may physically prevent the flames from passing through for a period of time, the shutter curtain may not prevent the conduction of the heat which may also quickly lead to the spread of the fire to the other side of the shutter curtain.

[0003] In general, a common method of insulating a roller shutter is to place an insulation layer such as an insulation blanket or insulation mat or insulation sheet behind the shutter curtain of the roller shutter. For example, the insulation layer may be customized to the size of the shutter curtain of the roller shutter and be configured to be rolled together with the shutter curtain. To maintain the thermal insulation integrity of the insulation layer, the insulation layer may merely be placed flat against the shutter curtain. However, in such a configuration, the insulation layer may misalign or bulge or tear or over-stretch during rolling and unrolling with the shutter curtain. Accordingly, more recently, it has been proposed to secure the insulation

layer to the shutter curtain via rivets or screws puncturing through the insulation layer and to provide additional insulating components to minimize the conduct of heat through the insulation layer via the rivets or screws. However, such configuration is usually complex, is not economical and may require high maintenance to ensure that the insulating components are effective in minimizing the conduct of heat through the insulation layer via the rivets or screws.

Summary

10 **[0004]** According to various embodiments, there is provided a slat assembly for a roller shutter. The slat assembly may include a slat having a first receiving portion and a second receiving portion. The slat assembly may further include an insulation layer lined on the slat. The slat assembly may further include a retaining mechanism disposed on the insulation layer to urge a first portion of the insulation layer against the first receiving portion of the slat and to urge a second portion of the insulation layer against the second receiving portion of the slat such that the retaining mechanism may cooperate with the first and second receiving portions of the slat to hold the insulation layer between the retaining mechanism and the slat.

15 **[0005]** According to various embodiments, there is provided a roller shutter. The roller shutter may include a plurality of slats pivotally interlocked one after another to form a shutter curtain. The roller shutter may further include an insulation layer lined across at least two adjacent pivotally interlocked slats of the plurality of slats. The roller shutter may further include at least one retaining mechanism disposed on the insulation layer to urge a portion of the insulation layer against a first receiving portion of one of the at least two adjacent pivotally interlocked slats and to urge a further portion of the insulation layer against a second receiving portion of the one of the at least two adjacent pivotally interlocked slats such that the at least one retaining mechanism may cooperate with the first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats to hold the insulation layer between the at least one retaining mechanism and the at least two adjacent pivotally interlocked slats.

20 **[0006]** According to various embodiments, there is provided a method of manufacturing a slat assembly. The method may include providing a slat having a first receiving portion and a second receiving portion. The method may further

include lining an insulation layer on the slat. The method may further include disposing a retaining mechanism on the insulation layer to urge a first portion of the insulation layer against the first receiving portion of the slat and to urge a second portion of the insulation layer against the second receiving portion of the slat such that the retaining mechanism may cooperate with the first and second receiving portions of the slat to hold the insulation layer between the retaining mechanism and the slat.

[0007] According to various embodiments, there is provided a method of manufacturing a roller shutter. The method may include providing a plurality of slats pivotally interlocked one after another to form a shutter curtain. The method may further include lining an insulation layer across at least two adjacent pivotally interlocked slats of the plurality of slats. The method may further include disposing at least one retaining mechanism on the insulation layer to urge a portion of the insulation layer against a first receiving portion of one of the at least two adjacent pivotally interlocked slats and to urge a further portion of the insulation layer against a second receiving portion of the one of the at least two adjacent pivotally interlocked slats such that the at least one retaining mechanism may cooperate with the first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats to hold the insulation layer between the at least one retaining mechanism and the at least two adjacent pivotally interlocked slats.

Brief description of the drawings

[0008] For a more complete understanding of the description provided herein and the advantages thereof, reference is now made to the brief descriptions below, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts. In the drawings, figures are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. In the following description, various embodiments are described with reference to the following drawings.

FIG. 1A shows an exploded view of a slat assembly for a roller shutter according to various embodiments;

FIG. 1B shows an assembled view of the slat assembly of FIG. 1A according to various embodiments;

FIG. 1C shows a perspective view of a portion of the slat of the slat assembly of FIG. 1A according to various embodiments;

FIG. 1D shows a side view of the slat of FIG. 1C according to various embodiments;

5 FIG. 2A shows an exploded view of a slat assembly for a roller shutter according to various embodiments;

FIG. 2B shows an assembled view of the slat assembly of FIG. 2A according to various embodiments;

10 FIG. 3A shows a perspective view of a shutter curtain assembly according to various embodiments;

FIG. 3B shows a side view of the shutter curtain assembly of FIG. 3A according to various embodiments;

FIG. 3C shows an enlarged side view of a section of the shutter curtain assembly of FIG. 3A according to various embodiments;

15 FIG. 4 shows a perspective view of a shutter curtain assembly according to various embodiments;

FIG. 5A shows a side cross-sectional view of an upper portion of a vertical roller shutter according to various embodiments;

20 FIG. 5B shows a side cross-sectional view of a lower portion of the vertical roller shutter, when in a lowered state, according to various embodiments;

FIG. 6 shows a side cross-sectional view of an upper portion of a vertical roller shutter according to various embodiments;

FIG. 7 shows a top cross-sectional view of a lateral roller shutter according to various embodiments; and

25 FIG. 8 shows a top cross-sectional view of a lateral roller shutter according to various embodiments.

Detailed description

30 [0009] Embodiments described below in context of the apparatus are analogously valid for the respective methods, and vice versa. Furthermore, it will be understood that the embodiments described below may be combined, for example, a part of one embodiment may be combined with a part of another embodiment.

[00010] It should be understood that the terms “on”, “over”, “top”, “bottom”, “down”, “side”, “back”, “left”, “right”, “front”, “lateral”, “side”, “up”, “down” etc., when used in the following description are used for convenience and to aid understanding of relative positions or directions, and not intended to limit the orientation of any device, or structure or any part of any device or structure. In addition, the singular terms “a”, “an”, and “the” include plural references unless context clearly indicates otherwise. Similarly, the word “or” is intended to include “and” unless the context clearly indicates otherwise.

[00011] Various embodiments of a slat assembly for a roller shutter, a roller shutter, a method of manufacturing a slat assembly for a roller shutter and a method of manufacturing a roller shutter have been provided to address at least some of the issues identified earlier.

[00012] According to various embodiments, an insulation layer in the form of an insulation blanket or an insulation mat or an insulation sheet may be secured or attached or fastened to a slat of a shutter curtain of a roller shutter without puncturing or penetrating the insulation layer with fasteners. Accordingly, the insulation layer may be secured or attached or fastened to the shutter curtain of the roller shutter such that the slats of the shutter curtain may be free of any fasteners that may form a “thermal bridge” through the insulation layer. Hence, the insulation layer may be intact and the thermal insulation integrity of the insulation layer may be fully preserved such that the insulation layer may be effective in providing insulation to the shutter curtain. At the same time, the insulation layer may be properly secured, attached or fastened to the shutter curtain such that the insulation layer may be rolled or unrolled together with the shutter curtain in a manner which minimizes or eliminates misalignment or bulging or tearing or over-stretching of the insulation layer.

[00013] FIG. 1A shows an exploded view of a slat assembly 100 for a roller shutter according to various embodiments. FIG. 1B shows an assembled view of the slat assembly 100 of FIG. 1A according to various embodiments. According to various embodiments, the slat assembly 100 may include a slat 110 having a first receiving portion 130 and a second receiving portion 140.

[00014] According to various embodiments, the slat 110 may be a narrow flat strip of material, for example metal such as steel or aluminum. According to various embodiments, the first receiving portion 130 and the second receiving portion 140 of

the slat 110 may include, for example, recess portions, indentations, slots, grooves, depressions, folded portions, bent portions, channels, cuts, furrows, trench, gutter or any suitable feature which provides a cavity, gap, hollow, void, or empty space configured for receiving, containing, accommodating, holding, or retaining an external insulation element or part or component, such as an insulation layer.

[00015] FIG. 1C shows a perspective view of a portion of the slat 110 according to various embodiments. FIG. 1D shows a side view of the slat 110 according to various embodiments. The slat 110 may include a main portion 112 between a first longitudinal edge portion 114 and a second longitudinal edge portion 116. The main portion 112 of the slat 110 may be the main body of the slat 110 for lining abreast or placing side by side with the main portion of adjacent slat so as to form a shutter curtain.

[00016] As shown, the first receiving portion 130 of the slat 110 may be an inward bend 132 (or inward fold) at the first longitudinal edge portion 114 of the slat 110.

According to various embodiments, the slat 110 may be formed or shaped or profiled or made or molded or pressed from an elongated sheet of material, such as an elongated sheet of metal. Accordingly, the inward bend 132 at the first longitudinal edge portion 114 may be formed from bending or folding a first longitudinal edge 113 of the sheet of material lengthwise inwardly towards a longitudinal axis 111 of the slat 110. Hence, the inward bend 132 may be immediately adjacent to the main portion 112 of the slat 110. As shown, the second receiving portion 140 of the slat 110 may be an inward bend 142 (or inward fold) at a second longitudinal edge portion 116 of the slat 110. According to various embodiments, the inward bend 142 at the second longitudinal edge portion 116 may be formed from bending or folding a second longitudinal edge 115 of the sheet of material lengthwise inwardly towards the longitudinal axis 111 of the slat 110. Accordingly, the inward bend 142 may be immediately adjacent to the main portion 112 of the slat 110. As shown, the pair of inward bends 132, 142 at the respective first longitudinal edge portion 114 and the second longitudinal edge portion 116 may extend through the entire length of the slat 110 and may be at least substantially parallel to each other. According to various other embodiments, the inward bend at the first longitudinal edge portion and the inward bend at the second longitudinal edge portion may extend along only a portion of the length of the slat. According to various other embodiments, the pair of inward bends may also be non-parallel to each other.

[00017] According to various embodiments, the inward bend 132 at the first longitudinal edge portion 114 and the inward bend 142 at the second longitudinal edge portion 116 may form a pair of grooves 134, 144, which may be opposing each other. Accordingly, the pair of grooves 134, 144 may be a pair of inwardly bent portions (or folded portions) of the slat 110.

[00018] As shown in FIG. 1C and FIG. 1D, the inward bend 132 at the first longitudinal edge portion 114 may be followed by an outward bend 118 (or outward fold) formed from subsequent bending or folding of the first longitudinal edge 113 of the elongated sheet of material lengthwise away from the longitudinal axis 111 of the slat 110. Further, the outward bend 118 of the first longitudinal edge portion 114 may be followed by an inward curl 120 formed from subsequent curling of the first longitudinal edge 113 of the elongated sheet of material lengthwise inwardly towards the longitudinal axis 111 of the slat 110. Hence, the inward curl 120 may form a first curled edge portion of the slat 110. The first curled edge portion of the slat 110 may be a first interlocking element of the slat 110. Accordingly, the first curled edge portion of the slat 110 may be configured for engaging, interlocking, or interacting with a corresponding interlocking element of another slat to pivotably join the two slats together. According to various embodiments, the first longitudinal edge portion 114 of the slat 110 may include the inward bend 132, the outward bend 118 and the inward curl 120.

[00019] Further, as also shown, the inward bend 142 at the second longitudinal edge portion 116 may be followed by an outward curl 122 formed from subsequent curling of the second longitudinal edge 115 of the elongated sheet of material lengthwise outwardly away from the longitudinal axis 111 of the slat 110. Hence, the outward curl 122 may form a second curled edge portion of the slat 110. The second curled edge portion of the slat 110 may be a second interlocking element of the slat 110. Similar to the first curled edge portion, the second curled edge portion of the slat 110 may be configured for engaging, interlocking, or interacting with a corresponding interlocking element of another slat to pivotably join the two slats together. According to various embodiments, the second longitudinal edge portion 116 of the slat 110 may include the inward bend 142 and the outward curl 122.

[00020] According to various embodiments, a curl radius of the inward curl 120 at the first longitudinal edge portion 114 may be smaller than a curl radius of the outward curl 122 at the second longitudinal edge portion 116. Accordingly, two

adjacent slats may be joined together by, for example, overlapping, fitting, interlocking, engaging, interacting or joining of an inward curl at a first longitudinal edge portion of a first slat to an outward curl at a second longitudinal edge portion of a second slat such that the first slat may be pivotably joined to the second slat.

5 According to various embodiments, the slat 110 may be configured to overlap or fit or interlock or joined with a further slat 110, one after another in a series, so as to form a shutter curtain.

[00021] Referring back to FIG. 1A and FIG. 1B, the slat assembly 100 may further include an insulation layer 150 lined on the slat 110. According to various
10 embodiments, the insulation layer 150 may be in the form of an insulation blanket, an insulation mat, or an insulation sheet. According to various embodiments, the insulation layer 150 may be configured to provide thermal insulation. According to various embodiments, the insulation layer 150 may include a layer of insulation wool sandwiched between two layers of insulation cloths. According to various
15 embodiments, the insulation wool may include ceramic fiber wool or rock wool etc. According to various embodiments, the insulation cloth may include silica fabric or fibre-glass fabric etc.

[00022] According to various embodiments, the insulation layer 150 may cover or lay or spread or stretch across a side of the slat 110 whereby the first receiving portion
20 130 and the second receiving portion 140 may be accessible. Accordingly, the side of the slat 110 on which the insulation layer 150 is lined may be opposite to the exterior side or surface of the slat 110 exposed to the exterior of the premises which the shutter may be installed.

[00023] As shown in FIG. 1A and FIG. 1B, the slat assembly 100 may further
25 include a retaining mechanism 160 (or at least one retaining mechanism) disposed on the insulation layer 150 to urge or press or push a first portion of the insulation layer 150 against the first receiving portion 130 of the slat 110 and to urge or press or push a second portion of the insulation layer 150 against the second receiving portion 140 of the slat 110 such that the retaining mechanism 160 may cooperate with the first
30 receiving portion 130 and the second receiving portion 140 of the slat 110 to hold or clamp or grip or clench the insulation layer 150 between the retaining mechanism 160 and the slat 110. Accordingly, the insulation layer 150 may be sandwiched between the retaining mechanism 160 and the slat 110. According to various embodiments, a first surface of the insulation layer 150 may be in contact with the slat while the

retaining mechanism 160 may be placed or received or disposed on a second surface of the insulation layer 150. The first surface and the second surface of the insulation layer 150 may be opposite surfaces.

[00024] While FIG. 1A and FIG. 1B show that one retaining mechanism 160 may be disposed to simultaneously urge the first portion of the insulation layer 150 against the first receiving portion 130 of the slat 110 and the second portion of the insulation layer 150 against the second receiving portion 140 of the slat 110, it should be understood by those skilled in the art that various changes, modification, variation may be made.

[00025] According to various embodiments, the slat assembly 100 may include one or two or more or a plurality of retaining mechanisms 160. Referring back to FIG. 1A and FIG. 1B, according to various embodiments, the retaining mechanism 160 may include a first end 164 and a second end 166. According to various embodiments, the first end 164 and the second end 166 may be opposite ends of the retaining mechanism 160. The first end 164 may be configured for urging or pressing or pushing the first portion of the insulation layer 150 against the first receiving portion 130 of the slat 110. Accordingly, the first portion of the insulation layer 150 may be sandwiched between the first end 164 of the retaining mechanism 160 and the first receiving portion 130 of the slat 110. Further, the second end 166 may be configured for urging or pressing or pushing the second portion of the insulation layer 150 against the second receiving portion 140 of the slat 110. Accordingly, the second portion of the insulation layer 150 may be sandwiched between the second end 166 of the retaining mechanism 160 and the second receiving portion 140 of the slat 110. According to various embodiments, the first receiving portion 130 of the slat 110 and the second receiving portion 140 of the slat 110 may be at opposing longitudinal edge portions 114, 116 of the slat 110.

[00026] According to various embodiments, the retaining mechanism 160 may be pre-loaded so as to supply an expansion force for urging, pressing, or pushing the first portion and the second portion of the insulation layer 150 against the respective first receiving portion 130 and the second receiving portion 140 of the slat 110. Accordingly, the retaining mechanism 160 may be pre-compressed prior to being disposed on the insulation layer 150, such that when the retaining mechanism 160 is disposed on the insulation layer 150, the retaining mechanism 160 may apply a spreading force or expansion force on the insulation layer 150 such that the retaining

mechanism 160 may urge or press or push respective portions of the insulation layer 150 against the respective first receiving portion 130 and the second receiving portion 140 of the slat 110, which may be opposing facing relative to each other. Hence, the retaining mechanism 160 may be pre-loaded such that the first end 164 and the second end 166 of the retaining mechanism 160 may be biased away from each other so as to engage or contact or interact with the respective portions of the insulation layer 150 for urging or pressing or pushing the respective portions of the insulation layer 150 against the respective first receiving portion 130 and second receiving portion 140 of the slat 110.

10 [00027] According to various embodiments, the retaining mechanism 160 may be configured to press the first portion of the insulation layer 150 into the first receiving portion 130 of the slat 110 and to press the second portion of the insulation layer 150 into the second receiving portion 140 of the slat 110. Accordingly, the force exerted by the first end 164 of the retaining mechanism 160 may cause the first portion of the insulation layer 150 to be received, contained, accommodated, held, or retained in the first receiving portion 130 of the slat 110. Similarly, the force exerted by the second end 166 of the retaining mechanism 150 may cause the second portion of the insulation layer 150 to be received, contained, accommodated, held, or retained in the second receiving portion 140 of the slat 110. Hence, the first end 164 and the second end 166 of the retaining mechanism 160 may cooperate with the first receiving portion 130 and the second receiving portion 140 of the slat 110 to hold or clamp or grip or clench the insulation layer 150 therebetween.

25 [00028] Referring back to FIG. 1A and FIG. 1B, the retaining mechanism 160 may include an insert 162 in the form of a strip of resilient material. The resilient material may include high tensile steel or any other suitable materials. According to various embodiments, the insert 162 in the form of the strip of resilient material may have a length longer than a distance, such as a transverse distance or a perpendicular distance, between the first receiving portion 130 and the second receiving portion 140 of the slat 110. Accordingly, the insert 162 may have to be bent elastically prior to disposing the insert 162 on the insulation layer 150 until a direct distance between the two ends 164, 166 of the insert 162 is smaller than the distance between the first receiving portion 130 and the second receiving portion 140 of the slat 110. Subsequently, when the insert 162 is disposed on insulation layer 150, the force applied to bend the insert 162 may be removed such that the insert 162 may reverse

the bending and try to return to the unbended state. Accordingly, the tendency of the insert 162 to unbend may cause the respective ends 164, 166 of the insert 162 to urge or press or push the corresponding portions of the insulation layer 150 into the respective first receiving portion 130 and the second receiving portion 140 of the slat 110.

5 [00029] As shown in FIG. 1A and FIG. 1B, the slat assembly 100 may further include a first pusher member 170. The first pusher member 170 may be disposed between the first portion of the insulation layer 150 and the retaining mechanism 160 (for example the first end 164 of the insert 162). The first pusher member 170 may be aligned with the first receiving portion 130 (for example a first groove 134 of the pair of grooves 134, 144 as shown). Accordingly, the retaining mechanism 160 may urge or push or press the first pusher member 170 at a portion of the first pusher member 170 which may then be translated into the first pusher member 170 urging or pushing or pressing the first portion of the insulation layer 150 evenly against or into the entire length of the first receiving portion 130 of the slat 110. According to various embodiments, the first pusher member 170 may include a bar with a V-shaped cross-section or a U-shaped cross-section or a horse-shoe shaped cross-section or any suitable cross-section that may be accommodated in the first receiving portion 130 of the slat 110.

20 [00030] As shown in FIG. 1A and FIG. 1B, the slat assembly 100 may further include a second pusher member 172. Similarly, the second pusher member 172 may be disposed between the second portion of the insulation layer 150 and the retaining mechanism 160 (for example the second end 166 of the insert 162). The second pusher member 172 may be aligned with the second receiving portion 140 (for example a second groove 144 of the pair of grooves 134, 144 as shown). Accordingly, the retaining mechanism 160 may urge or push or press the second pusher member 172 at a portion of the second pusher member 172 which may then be translated into the second pusher member 172 urging or pushing or pressing the second portion of the insulation layer 150 evenly against or into the entire length of the second receiving portion 140 of the slat 110. According to various embodiments, the second pusher member 172 may include a bar with a V-shaped cross-section or a U-shaped cross-section or a horse-shoe shaped cross-section or any suitable cross-section that may be accommodated in the second receiving portion 140 of the slat 110.

[00031] FIG. 2A shows an exploded view of a slat assembly 200 for a roller shutter according to various embodiments. FIG. 2B shows an assembled view of the slat assembly 200 of FIG. 2A according to various embodiments. The slat assembly 200 of FIG. 2A and FIG. 2B differs from the slat assembly 100 of FIG. 1A and FIG. 1B in that the slat assembly 200 include two side covers 280, 282 (or end-clips) attached to respective ends 124, 126 of the slat 110. Accordingly, one side cover may be attached to one end of the slat 110. The side covers 280, 282 may be configured to cover or contain or enclose or conceal or wrap around respective edge portion of the insulation layer 150 along the respective ends 124, 126 of the slat 110. Accordingly, the side covers 280, 282 may prevent the insulation layer 150 from sliding out of the slat 110 via either ends 124, 126 of the slat 110. Further, the side cover 280, 282 may be a three-sided rigid pressed-steel component (with substantially U-shaped cross section) enclosing or concealing or covering the edge portions of the insulation layer 150 to protect the respective edge portions of the insulation layer 150 from scuffing or scraping against the guide rails or shutter guide channels while rolling and unrolling of the shutter curtain during shutter operation. Such scuffing or scraping of the insulation layer 150 may cause the respective edge portions of the fabric forming the insulation layer 150 to fray, which may in turn lead to unraveling of the fabric resulting in loose fibre threads etc. These loose fibre threads may be caught or entangled in the roller shutter assembly (for example, protrusions or projections or features that are jutting out) to cause further tearing of the insulation layer 150. Thus, the side covers 280, 282 may minimize or prevent damage and fraying of the insulation layer 150 due to wear and tear by enclosing the respective edge portions of the insulation layer 150 and prevent the respective edge portions of the insulation blanket from coming into contact with the guide rails or shutter guide channels. According to various embodiments, the side-cover 280, 282 in the form of the three-sided rigid pressed-steel component may include a flat rectangular base portion 283 and a pair of wall portions 285, 287 extending perpendicularly from two longitudinal edges of the flat rectangular base portion 283. Accordingly, the respective edge portions of the insulation layer 150 may be slotted or fitted in or inserted between the pair of wall portions 285, 287 and aligned to the base portion 283.

[00032] FIG. 3A shows a perspective view of a shutter curtain assembly 300 according to various embodiments. FIG. 3B shows a side view of the shutter curtain assembly 300 of FIG. 3A according to various embodiments. FIG. 3C shows an

enlarged side view of a section of the shutter curtain assembly 300 of FIG. 3A according to various embodiments. According to various embodiments, shutter curtain assembly 300 may be a component of a roller shutter. As shown, the shutter curtain assembly 300 may include a plurality of slats 310 pivotally interlocked one after another in a series to form a shutter curtain. According to various embodiments, one slat may be joined to another slat along its length. Accordingly, multiple slats may be joined in sequence, one after another in a series, to form the shutter curtain.

[00033] As shown, the shutter curtain assembly 300 may further include an insulation layer 350 lined across at least two adjacent pivotally interlocked slats of the plurality of slats 310. According to various embodiments, the insulation layer 350 may be sized to line across a desired number of slats 310. According to various embodiments, the insulation layer 350 may also be sized to line across the entire shutter curtain made up of the plurality of slats 310. According to various embodiments, the insulation layer 350 may be formed by stitching or joining multiple pieces. According to various embodiments the insulation layer 350 may be weaved as a single piece.

[00034] According to various embodiments, the shutter curtain assembly 300 may further include at least one retaining mechanism 360 disposed on the insulation layer 350 to urge or press or push a portion of the insulation layer 350 against a first receiving portion 330 of one of the at least two adjacent pivotally interlocked slats 310 and to urge or press or push a further portion of the insulation layer 350 against a second receiving portion of the one of the at least two adjacent pivotally interlocked slats 310 such that the at least one retaining mechanism 360 may cooperate with the first receiving portion 330 and the second receiving portion 340 of the one of the at least two adjacent pivotally interlocked slats 310 to hold or clamp or grip or clench the insulation layer 350 between the retaining mechanism 360 and the at least two adjacent pivotally interlocked slats 310. The retaining mechanism 360 may, similar to the retaining mechanism 160 of FIG. 1A and FIG. 1B, include a first end configured for urging or pressing or pushing the first portion of the insulation layer 350 against the first receiving portion 330 of the slat 310. The retaining mechanism 360 may, similar to the retaining mechanism 160 of FIG. 1A and FIG. 1B, also include a second end configured for urging or pressing or pushing the second portion of the insulation layer 350 against the second receiving portion 340 of the slat 310.

[00035] As shown in FIG. 3A and FIG. 3B, the shutter curtain assembly 300 may include one or two or more or a plurality of retaining mechanism 360. Further, each slat 310 of the plurality of slats 310 may also include respective first receiving portion 330 and second receiving portion 340. Accordingly, the insulation layer 350 may be
5 lined across the plurality of slats 310 and corresponding portions of the insulation layer 350 may be hold or clamp or grip or clench between the respective retaining mechanism 360 and the respective slat 310.

[00036] Similar to the slat assembly 100 of FIG. 1A and FIG. 1B, the first receiving portion 330 and the second receiving portion 340 of the slat 310 may be a pair of
10 parallel opposing grooves which may be a pair of bent portions of the slat 310. Further, the at least one retaining mechanism 360 may be pre-loaded to supply an expansion force for biasing the first end and the second end of the retaining mechanism 360 away from each other so as to urge or press or push the respective portions of the insulation layer against the respective first receiving portion 330 and
15 second receiving portion 340 of the respective slat 310. The at least one retaining mechanism 360 may also be configured to press respective portions of the insulation layer 350 into the respective first receiving portion 330 and second receiving portion 340 of the respective slat 310. Furthermore, the retaining mechanism 360 may be an insert 362 in the form of a strip of resilient material which has a length longer than a
20 distance between the respective first receiving portion 330 and second receiving portion 340 of the respective slat. In addition, the insulation layer 350 may include a layer of insulation wool sandwiched between two layers of insulation cloths. According to various embodiments, the insulation wool may include ceramic fiber wool or rock wool etc. According to various embodiments, the insulation cloth may
25 include silica fabric or fibre-glass fabric etc.

[00037] According to various embodiments, the shutter curtain assembly 300 may further include at least one pusher member 370. The at least one pusher member 370 may be disposed between the insulation layer 350 and the at least one retaining mechanism 360. The at least one pusher member 370 may be aligned with one of the
30 first receiving portion 330 or the second receiving portion 340 (for example a groove of the pair of parallel opposing grooves) of at least one slat 310. The at least one pusher member 370 may include a bar with a V-shaped cross-section or a U-shaped cross-section or horse-shoe shaped cross-section or any suitable cross-section for accommodating in the respective receiving portions 330, 340 of the slat 310.

[00038] As shown in FIG. 3A and FIG. 3B, the shutter curtain assembly 300 may include one or two or more or a plurality of pusher members 370. According to various embodiments, there may be two pusher members 370 aligned to the two receiving portions 330, 340 of each slat 310. Accordingly, respective retaining
5 mechanism 360 may urge or press or push the respective two pusher members 370 such that corresponding portions of the insulation layer 350 may be urged or pressed or pushed into the respective receiving portions 330, 340 of each slat 310 so as to be held or clamp or grip or clench between the respective pusher member 370 and the respective receiving portion 330, 340 of the slat 310.

10 [00039] FIG. 4 shows a perspective view of a shutter curtain assembly 400 according to various embodiments. The shutter curtain assembly 400 of FIG. 4 differs from the shutter curtain assembly 300 of FIG. 3A and FIG. 3B in that the shutter curtain assembly 400 may include at least two side covers 480 attached to respective ends of at least one slat 310. As shown in FIG. 4, the shutter curtain assembly 400
15 may include a plurality of side covers such that one side cover 480 is attached to one end of each slat 310.

[00040] FIG.5A shows a side cross-sectional view of an upper portion 502 of a vertical roller shutter 500 according to various embodiments. FIG. 5B shows a side cross-sectional view of a lower portion 504 of the vertical roller shutter 500, when in
20 a lowered state, according to various embodiments. As shown, the vertical roller shutter 500 may include a pair of shutter curtain assemblies 506, 508. The vertical roller shutter 500 may be configured such that the pair of shutter curtain assemblies 506, 508 may be raised up and lowered down vertically. Accordingly, when in the lowered state, the pair of shutter curtain assemblies 506, 508 may be spaced apart and
25 parallel to each other such that the pair of shutter curtain assemblies 506, 508 may be facing each other. According to various embodiments, each of the pair of shutter curtain assemblies 506, 508 may be the shutter curtain assembly 300 of FIG. 3A & FIG. 3B, and/or the shutter curtain assembly 400 of FIG. 4. According to various embodiments, the respective insulating layers of the respective shutter curtain
30 assemblies 506, 508 may be lined on respective surfaces of the respective shutter curtain assemblies 506, 508 that are facing each other. According to various embodiments, a first shutter curtain assembly 506 of the pair of shutter curtain assemblies may be coupled to a first drum 507 with the plurality of slats of the first shutter curtain assembly 506 arranged at least substantially parallel to a longitudinal

axis of the first drum 507 such that the first shutter curtain assembly 506 may be rolled on and off the first drum 507. Similarly, a second shutter curtain assembly 508 of the pair of shutter curtain assemblies may be coupled to a second drum 509 with the plurality of slats of the second shutter curtain assembly 508 arranged at least substantially parallel to a longitudinal axis of the second drum 509 such that the second shutter curtain assembly 508 may be rolled on and off the second drum 509.

[00041] The roller shutter 500 may further include a housing 503 configured to be mounted to a wall or a beam or an overhanging structure. The housing 503 may be configured to enclose the pair of drums 507, 509 and a motor assembly 505. The motor assembly 505 and the pair of drums 507, 509 may be arranged such that the motor assembly 505 may drive the rotation of the pair of drums 507, 509 synchronously. For example, as shown, the pair of drums 507, 509 and the motor assembly 505 may be arranged in a lateral arrangement (or horizontally) with their rotational axes lying on a horizontal plane. In this arrangement, a belt or a chain mechanism may couple the pair of drums 507, 509 to the motor assembly 505 such that the motor assembly 505 may simultaneously drive the rotation of both the drums 507, 509 in a coordinated manner to roll in or roll out both the shutter curtain assemblies 506, 508 at the same time in a synchronized manner.

[00042] Further, according to various embodiments, guide rails 599 (or shutter guide channels) may be provided along the sides of the wall, which the roller shutter 500 may be mounted to, such that the side edges of the pair of shutter curtain assemblies 506, 508 may be inserted or slotted or placed into the guide rails 599 (or shutter guide channels) so as to be raised up or lowered down in a guided manner.

[00043] In FIG. 5B, the lower portion 504 of the pair of shutter curtain assemblies 506, 508 is shown. The first shutter curtain assembly 506 may have a foot component 590 connected to the last slat of the first shutter curtain assembly 506. The second shutter curtain assembly 508 may also have a foot component 592 connected to the last slat of the second shutter curtain assembly 508. The respective foot components 590, 592 of the respective shutter curtain assemblies 506, 508 may have a substantively 'inverted-T' shape cross-section. Accordingly, each foot component 590, 592 may have a lateral base portion 591, 593 and a connecting portion 594, 595 extending perpendicularly from a middle or centerline or longitudinal axis of the respective lateral base portion 591, 593. As shown, a longitudinal edge portion of the respective connecting portions 594, 595 of the respective foot components 590, 592

may be curled inwardly towards the respective lateral base portion 591, 593 to form respective curled edge portions 594', 595' so as to engage with the outward curled edge portion of the last slat of the respective shutter curtain assemblies 506, 508.

[00044] As shown in FIG. 5B, according to an example implementation, the foot component 590, 592 may include two elongated L-shaped bars, wherein the vertical portions of the respective elongated L-shaped bars are arranged back-to-back. Further, the foot component 590, 592 may include a half-slat element with an inwardly curled portion along one of the longitudinal edge and a flat portion along the other longitudinal edge. Accordingly, the flat portion of the half-slat element may be sandwiched between the vertical portions of the respective elongated L-shaped bars and joined together to form the respective foot components 590, 592. The joining may be via bolt and nut or any other suitable fasteners.

[00045] According to various embodiments, the insulating layer of the respective shutter curtains 506, 508 may also extend over and cover the connecting portions 594, 595 of the respective foot components 590, 592. Accordingly, the respective connecting portions 594, 595 of the respective foot components 590, 592 may be lined with the respective insulating layers. According to various embodiments, the foot components 590, 592 of the pair of shutter curtain assemblies 506, 508 may include an insulating seal arrangement to seal a gap between the foot component 590 of the first shutter curtain assembly 506 and the foot component 592 of the second shutter curtain assembly 508.

[00046] For example, as shown in FIG. 5B, each of the foot components 590, 592 may further include an insulating block 596, 598 laid on the respective lateral base portions 591, 593. According to various embodiments, the insulating block 596, 598 may be laid on the part of the respective lateral base portions 591, 593 that is extending towards the other shutter curtain assemblies 506, 508. As shown, the insulating block 596 of the foot component 590 of the first shutter curtain assembly 506 may be laid on the part of the lateral base portion 591 extending towards the second shutter curtain assembly 508. Similarly, the insulating block 598 of the foot component 592 of the second shutter curtain assembly 508 may be laid on the part of the lateral base portion 593 extending towards the first shutter curtain assembly 506.

[00047] According to various embodiments, an overlapping insulating block 597 may be attached to either the insulating block 596 of the foot component 590 of the first shutter curtain assembly 506 or the insulating block 598 of the foot component

592 of the second shutter curtain assembly 508. In this configuration, the overlapping insulating block 597 may seal off a gap between the foot component 590 of the first shutter curtain assembly 506 and the foot component 592 of the second shutter curtain assembly 508. Accordingly, an enclosed void or space between the first shutter curtain assembly 506 and the second shutter curtain assembly 508 may be insulated to form an insulating air gap which may enhance the fire insulation of the roller shutter 500.

[00048] FIG. 6 shows a side cross-sectional view of an upper portion 602 of a vertical roller shutter 600 according to various embodiments. The vertical roller shutter 600 of FIG. 6 differs from the vertical roller shutter 500 of FIG. 5A in that the first drum 607 of the first shutter curtain assembly 606 of roller shutter 600 may be driven by a first motor 605 and the second drum 609 of the second shutter curtain assembly 608 may be driven by a second motor 605'. Accordingly, in this configuration, the first drum 607 and the second drum 609 may be arranged such that the first drum 607 may be above the second drum 609 within the housing 603. Hence, the space between the first shutter curtain assembly 606 and the second shutter curtain assembly 608, when in the lowered state, may be reduced as compared to the vertical roller shutter 500 of FIG. 5A.

[00049] FIG. 7 shows a top cross-sectional view of a lateral roller shutter 700 according to various embodiments. The lateral roller shutter 700 of FIG. 7 differs from the vertical roller shutters 500 of FIG. 5A and the roller shutter 600 of FIG. 6 in that the pair of shutter curtain assemblies 706, 708 of the lateral roller shutter 700 are arranged to be rolled in and out sideways instead of up and down. Accordingly, the respective drums 707, 709 and motors may be arranged with their respective rotational axis in a vertical orientation. Further, the lateral ends of the pair of shutter curtain assemblies 706, 708 may also differ from the foot components 590, 592 of the vertical roller shutter 500 of FIG. 5A in that the lateral ends of the pair of shutter curtain assemblies 706, 708 may be joined together by an insulating block 796. Furthermore, on the wall which the lateral roller shutter 700 closes, a striker 796' with recess to receive the insulating block may be provided.

[00050] FIG. 8 shows a top cross-sectional view of a lateral roller shutter 800 according to various embodiments. The lateral roller shutter 800 of FIG. 8 differs from the lateral roller shutter 700 of FIG. 7 in that two pairs of shutter curtain assemblies 806, 808, 806', 808' are provided. The first pair of shutter curtain

assemblies 806, 808 may be arranged to close sideways from left to right, and the second pair of shutter curtain assemblies 806', 808' may be arranged to close sideways from right to left. The first pair of shutter curtain assemblies 806, 808 may, similar to the pair of shutter curtain assemblies 706, 708 of FIG. 7, include an insulating block 896 joining the lateral ends of the pair of shutter curtain assemblies 806, 808. On the other hand, the second pair of shutter curtain assemblies 806', 808' may include a latch 896' configured to receive the joined lateral ends of the first pair of shutter curtain assemblies 806, 808. The latch 896' may include one or more insulating blocks 897, 898 between the jaws of the latch 896'.

10 **[00051]** According to various embodiments, there is provided a slat assembly for a roller shutter. The slat assembly may include an insulation layer. The slat assembly may further include a slat having a first receiving portion and a second receiving portion. The slat may be lined with the insulation layer. The slat assembly may further include a (or at least one) retaining mechanism disposed on the insulation layer to urge a first portion of the insulation layer against the first receiving portion of the slat and to urge a second portion of the insulation layer against the second receiving portion of the slat such that the retaining mechanism may cooperate with the first and second receiving portions of the slat to hold the insulation layer between the retaining mechanism and the slat.

20 **[00052]** According to various embodiments, the first and second receiving portions of the slat may extend longitudinally along the slat and may be parallel to each other.

[00053] According to various embodiments, the first and the second receiving portions of the slat may be a pair of grooves. According to various embodiments, the pair of grooves may be opposing each other. According to various embodiments, the pair of grooves is a pair of bent portions of the slat.

[00054] According to various embodiments, the slat assembly may further include a first pusher member. The first pusher member may be disposed between the first portion of the insulation layer and the retaining mechanism. The first pusher member may be aligned with a first groove of the pair of grooves. According to various embodiments, the first pusher member may include a bar with a V-shaped cross-section or a U-shaped cross-section or horse-shoe shaped cross-section.

[00055] According to various embodiments, the slat assembly may further include a second pusher member. The second pusher member may be disposed between the second portion of the insulation layer and the retaining mechanism. The second

pusher member may be aligned with a second groove of the pair of grooves. According to various embodiments, the second pusher member may include a bar with a V-shaped cross-section or a U-shaped cross-section or a horse-shoe shaped cross-section.

5 **[00056]** According to various embodiments, the retaining mechanism may be pre-loaded to supply an expansion force for urging the first and second portions of the insulation layer against the respective first and second receiving portions of the slat.

10 **[00057]** According to various embodiments, the retaining mechanism may be configured to press the first portion of the insulation layer into the first receiving portion of the slat and to press the second portion of the insulation layer into the second receiving portion of the slat.

15 **[00058]** According to various embodiments, the retaining mechanism may include an insert in the form of a strip of resilient material which may have a length longer than a distance between the first and second receiving portions of the slat.

20 **[00059]** According to various embodiments, a first longitudinal edge portion of the slat may be curled inwardly towards a longitudinal axis of the slat to form a first curled edge portion and a second longitudinal edge of the slat may be curled outwardly away from the longitudinal axis of the slat to form a second curled edge portion. According to various embodiments, the first curled edge portion may have a smaller curl radius than the second curled edge portion.

25 **[00060]** According to various embodiments, the insulation layer may include a layer of insulation wool sandwiched between two layers of insulation cloths. The insulation wool may include ceramic fiber wool or rock wool etc. The insulation cloth may include silica fabric or fibre-glass fabric etc.

30 **[00061]** According to various embodiments, the slat assembly may further include two side covers. One side cover may be attached to one end of the slat. Each side cover may be configured to cover respective edge portion of the insulation layer along the respective end of the slat.

35 **[00062]** According to various embodiments, there is provided a roller shutter. The roller shutter may include a plurality of slats pivotally interlocked one after another to form a shutter curtain. The roller shutter may further include an insulation layer lined across at least two adjacent pivotally interlocked slats of the plurality of slats. The roller shutter may further include at least one retaining mechanism disposed on the insulation layer to urge a portion of the insulation layer against a first receiving

portion of one of the at least two adjacent pivotally interlocked slats and to urge a further portion of the insulation layer against a second receiving portion of the one of the at least two adjacent pivotally interlocked slats such that the at least one retaining mechanism may cooperate with the first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats to hold the insulation layer between the at least one retaining mechanism and the at least two adjacent pivotally interlocked slats.

[00063] According to various embodiments, the first and the second receiving portions of the one of the at least two adjacent pivotally interlocked slats may be a pair of parallel opposing grooves. According to various embodiments, the pair of parallel opposing grooves may be a pair of bent portions of the one of the at least two adjacent pivotally interlocked slats.

[00064] According to various embodiments, the roller shutter may further include at least one pusher member. The at least one pusher member may be disposed between the insulation layer and the at least one retaining mechanism. The at least one pusher member may be aligned with a groove of the pair of parallel opposing grooves of the one of the at least two adjacent pivotally interlocked slats. According to various embodiments, the at least one first pusher member may include a bar with a V-shaped cross-section or a U-shaped cross-section or horse-shoe shaped cross-section.

[00065] According to various embodiments, the at least one retaining mechanism may be pre-loaded to supply an expansion force for urging the respective portions of the insulation layer against the respective first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats.

[00066] According to various embodiments, the at least one retaining mechanism may be configured to press respective portions of the insulation layer into the respective first and second receiving portion of the one of the at least two adjacent pivotally interlocked slats.

[00067] According to various embodiments, the at least one retaining mechanism may include an insert in the form of a strip of resilient material which may have a length longer than a distance between the first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats.

[00068] According to various embodiments, the insulation layer may include a layer of insulation wool sandwiched between two layers of insulation cloths. The insulation

wool may include ceramic fiber wool or rock wool etc. The insulation cloth may include silica fabric or fibre-glass fabric etc.

5 **[00069]** According to various embodiments, the roller shutter may include two sets of the plurality of slats to form two shutter curtains. The two shutter curtains may be spaced apart and may be directly facing each other.

[00070] According to various embodiments, foot portions of the two shutter curtains may be configured to cooperate to insulate and seal a gap between the foot portions of the two shutter curtains. According to various embodiments, the foot portions of the two shutter curtains may include insulating blocks in an overlapping arrangement to
10 seal a gap between the foot portions of the two shutter curtains. Accordingly, one or more insulating blocks on the foot portion of a first shutter curtain may overlap one or more insulating blocks on the foot portion of a second shutter curtain.

[00071] According to various embodiments, there is provided a method of manufacturing a slat assembly. The method may include providing a slat having a
15 first receiving portion and a second receiving portion. The method may further include lining an insulation layer on the slat. The method may further include disposing a (or at least one) retaining mechanism on the insulation layer to urge a first portion of the insulation layer against the first receiving portion of the slat and to urge a second portion of the insulation layer against the second receiving portion of the slat
20 such that the retaining mechanism may cooperate with the first and second receiving portions of the slat to hold the insulation layer between the retaining mechanism and the slat.

[00072] According to various embodiments, the method may further include configuring the slat assembly according to the various embodiments as described
25 herein.

[00073] According to various embodiments, there is provided a method of a roller shutter. The method may include providing a plurality of slats pivotally interlocked one after another to form a shutter curtain. The method may further include lining an insulation layer across at least two adjacent pivotally interlocked slats of the plurality
30 of slats. The method may further include disposing at least one retaining mechanism on the insulation layer to urge a portion of the insulation layer against a first receiving portion of one of the at least two adjacent pivotally interlocked slats and to urge a further portion of the insulation layer against a second receiving portion of the one of the at least two adjacent pivotally interlocked slats such that the at least one retaining

mechanism may cooperate with the first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats to hold the insulation layer between the retaining mechanism and the at least two adjacent pivotally interlocked slats.

5 [00074] According to various embodiments, the method may further include configuring the roller shutter according to the various embodiments as described herein.

[00075] Various embodiments have provided a fire-insulated shutter curtain assembly or a fire-insulated roller shutter which include an insulation layer secured or
10 attached or fastened to a shutter curtain of a roller shutter without puncturing or penetrating the insulation layer with fasteners. Accordingly, the fire-insulated shutter curtain assembly or the fire-insulated roller shutter may be free of any fasteners that may form a “thermal bridge” through the insulation layer. Hence, the insulation layer may be intact and the thermal insulation integrity of the insulation layer may be fully
15 preserved such that the insulation layer may be effective in providing insulation to the shutter curtain or the roller shutter. At the same time, the insulation layer may be properly secured, attached or fastened to the shutter curtain such that the insulation layer may be rolled or unrolled together with the shutter curtain in a manner which minimizes or eliminates misalignment or bulging or tearing or over-stretching of the
20 insulation layer.

[00076] While the invention has been particularly shown and described with reference to specific embodiments, it should be understood by those skilled in the art that various changes, modification, variation in form and detail may be made therein without departing from the scope of the invention as defined by the appended claims.
25 The scope of the invention is thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.

Claims

1. A slat assembly for a roller shutter, the slat assembly comprising:
an insulation layer;
a slat having a first receiving portion and a second receiving portion, the slat being lined with the insulation layer;
and
a retaining mechanism disposed on the insulation layer to urge a first portion of the insulation layer against the first receiving portion of the slat and to urge a second portion of the insulation layer against the second receiving portion of the slat such that the retaining mechanism cooperates with the first and second receiving portions of the slat to hold the insulation layer between the retaining mechanism and the slat.
2. The assembly as claimed in claim 1, wherein the first and second receiving portions of the slat extend longitudinally along the slat and are parallel to each other.
3. The assembly as claimed in claim 1 or 2, wherein the first and the second receiving portions of the slat are a pair of grooves.
4. The assembly as claimed in claim 3, wherein the pair of grooves is opposing each other.
5. The assembly as claimed in claim 3 or 4, wherein the pair of grooves is a pair of bent portions of the slat.
6. The slat assembly as claimed in any one of claims 3-5, further comprising a first pusher member, wherein the first pusher member is disposed between the first portion of the insulation layer and the retaining mechanism, and wherein the first pusher member is aligned with a first groove of the pair of grooves.
7. The slat assembly as claimed in claim 6, wherein the first pusher member comprises a bar with a V-shaped cross-section or a U-shaped cross-section or horse-shoe shaped cross-section.

8. The slat assembly as claimed in claim 6 or 7, further comprising a second pusher member, wherein the second pusher member is disposed between the second portion of the insulation layer and the retaining mechanism, and wherein the second pusher member is aligned with a second groove of the pair of grooves.
9. The slat assembly as claimed in claim 8, wherein the second pusher member comprises a bar with a V-shaped cross-section or a U-shaped cross-section or a horse-shoe shaped cross-section.
10. The slat assembly as claimed in any one of claims 1 to 9, wherein the retaining mechanism is pre-loaded to supply an expansion force for urging the first and second portions of the insulation layer against the respective first and second receiving portions of the slat.
11. The slat assembly as claimed in any one of claims 1 to 10, wherein the retaining mechanism is configured to press the first portion of the insulation layer into the first receiving portion of the slat and to press the second portion of the insulation layer into the second receiving portion of the slat.
12. The slat assembly as claimed in any one of claims 1 to 11, wherein the retaining mechanism comprises an insert in the form of a strip of resilient material which has a length longer than a distance between the first and second receiving portions of the slat.
13. The slat assembly as claimed in any one of claims 1 to 12, wherein a first longitudinal edge portion of the slat is curled inwardly towards a longitudinal axis of the slat to form a first curled edge portion and a second longitudinal edge of the slat is curled outwardly away from the longitudinal axis of the slat to form a second curled edge portion.
14. The slat assembly as claimed in claim 13, wherein the first curled edge portion has a smaller curl radius than the second curled edge portion.

15. The slat assembly as claimed in any one of claims 1 to 14, wherein the insulation layer comprises a layer of insulation wool sandwiched between two layers of insulation cloths.

16. The slat assembly as claimed in any one of claims 1 to 15, further comprising two side covers, wherein one side cover is attached to one end of the slat and wherein each side cover is configured to cover respective edge portion of the insulation layer along the respective end of the slat.

17. A roller shutter comprising:

a plurality of slats pivotally interlocked one after another to form a shutter curtain;

an insulation layer lined across at least two adjacent pivotally interlocked slats of the plurality of slats;

at least one retaining mechanism disposed on the insulation layer to urge a portion of the insulation layer against a first receiving portion of one of the at least two adjacent pivotally interlocked slats and to urge a further portion of the insulation layer against a second receiving portion of the one of the at least two adjacent pivotally interlocked slats such that the at least one retaining mechanism cooperates with the first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats to hold the insulation layer between the at least one retaining mechanisms and the at least two adjacent pivotally interlocked slats.

18. The roller shutter as claimed in claim 17, wherein the first and the second receiving portions of the one of the at least two adjacent pivotally interlocked slats are a pair of parallel opposing grooves.

19. The roller shutter as claimed in claim 18, wherein the pair of parallel opposing grooves is a pair of bent portions of the one of the at least two adjacent pivotally interlocked slats.

20. The roller shutter as claimed in claim 18 or 19, further comprising at least one pusher member, wherein the at least one pusher member is disposed between the

insulation layer and the at least one retaining mechanism, and wherein the at least one pusher member is aligned with a groove of the pair of parallel opposing grooves of the one of the at least two adjacent pivotally interlocked slats.

21. The roller shutter as claimed in claim 20, wherein the at least one first pusher member comprises a bar with a V-shaped cross-section or a U-shaped cross-section or horse-shoe shaped cross-section.

22. The roller shutter as claimed in any one of claims 17 to 21, wherein the at least one retaining mechanism is pre-loaded to supply an expansion force for urging the respective portions of the insulation layer against the respective first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats.

23. The roller shutter as claimed in any one of claims 17 to 22, wherein the at least one retaining mechanism is configured to press respective portions of the insulation layer into the respective first and second receiving portion of the one of the at least two adjacent pivotally interlocked slats.

24. The roller shutter as claimed in any one of claims 17 to 23, wherein the at least one retaining mechanism comprises an insert in the form of a strip of resilient material which has a length longer than a distance between the first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats.

25. The roller shutter as claimed in any one of claims 17 to 24, wherein the insulation layer comprises a layer of insulation wool sandwiched between two layers of insulation cloths.

26. The roller shutter as claimed in any one of claims 17 to 24, wherein the roller shutter comprises two sets of the plurality of slats to form two shutter curtains, wherein the two shutter curtains are spaced apart and facing each other.

27. The roller shutter as claimed in claim 26, wherein foot portions of the two shutter curtains comprise insulating blocks in an overlapping arrangement to seal a gap between the foot portions of the two shutter curtains.

28. A method of manufacturing a slat assembly, the method comprising:
providing a slat having a first receiving portion and a second receiving portion;
lining an insulation layer on the slat; and
disposing a retaining mechanism on the insulation layer to urge a first portion of the insulation layer against the first receiving portion of the slat and to urge a second portion of the insulation layer against the second receiving portion of the slat such that the retaining mechanism cooperates with the first and second receiving portions of the slat to hold the insulation layer between the retaining mechanism and the slat.
29. The method as claimed in claim 28 further comprises configuring the slat assembly according to any one of claims 1 to 16.
30. A method of manufacturing a roller shutter, the method comprising:
providing a plurality of slats pivotally interlocked one after another to form a shutter curtain;
lining an insulation layer across at least two adjacent pivotally interlocked slats of the plurality of slats;
disposing at least one retaining mechanism on the insulation layer to urge a portion of the insulation layer against a first receiving portion of one of the at least two adjacent pivotally interlocked slats and to urge a further portion of the insulation layer against a second receiving portion of the one of the at least two adjacent pivotally interlocked slats such that the at least one retaining mechanism cooperates with the first and second receiving portions of the one of the at least two adjacent pivotally interlocked slats to hold the insulation layer between the at least one retaining mechanism and the at least two adjacent pivotally interlocked slats.
31. The method as claimed in claim 30 further comprises configuring the roller shutter according to any one of claims 17 to 27.