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SHUTTER CURTAIN FOR FITTING TO A BUILDING

5 The present invention relates to a shutter curtain for fitting to a building such as a house or an office building.

10 A shutter curtain for a building is usually wound on, for example, a take-up drum and it is opened/shut while being guided by guide rails formed on the two end portions of an opening in the building. The shutter curtain must be constituted in such a manner that it can be curved so as to be wound onto the take-up drum from an attitude of a straight line aligned along the guide rails. Accordingly, a conventional
15 shutter curtain is constituted by interlocked slats each of which is formed by bending an elongated plate, so that it can be curved. However, a problem arises in the conventional shutter curtain in that noise is generated when the shutter curtain is opened or closed
20 or when wind blows against the curtain when it is shut because there are gaps between the interlocked portions which makes the structure of the curtain loose and causes rattling.

Although an attempt has been made to eliminate the gaps in the interlocked portions, in so doing, another problem arises in that the structure of the interlocked portions then becomes too complicated to
5 be used practically.

To this end, an object of the present invention is to provide a shutter curtain for a building capable of alleviating the above-described problems.

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According to one aspect of the present invention, there is provided a shutter curtain for a shutter for a building comprising:

15 a plurality of main slats made of a rigid material; and a plurality of sub-slats made of a relatively elastic material, said main slats and sub-slats each having a slat surface to constitute the shutter curtain;

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wherein the end portions of each main slat and each sub-slat are bent or folded to facilitate integral connection with each other to form said shutter curtain.

An advantage of the present invention is that the noise generated by, e.g. rattling of the interlocked portions of the structure, is substantially eliminated.

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A shutter curtain according to the present invention substantially eliminates gaps in the junctions between the slats compared with conventional structures in which rigid slats are connected by interlocking, in
10 such a manner that the slats can be folded. Therefore, noise generated due to the collision of the slats when the shutter curtain is being opened or closed or when it receives a gust of wind can be eliminated. As a result, a substantially silent (i.e. a low-noise type)
15 shutter for a building may be realized. Furthermore, since there are no gaps in the junctions between the slats, good effects in terms of preventing fire, stopping smoke and sound insulation can be obtained. In addition, when the shutter curtain according to the
20 present invention is wound onto a take-up drum, the sub-slats which possess elasticity and flexibility are curved rather than the main slats. Thus the curtain can be smoothly wound onto the winding drum to form a

coil-like shape as is achieved by the conventional interlock type shutter curtain.

5 Other and further objects, features and advantages of the invention will appear more fully from the following description, by way of example only, of embodiments of the invention described with reference to the accompanying drawings in which:-

10 Figure 1 is a schematic front elevational view which illustrates a shutter for a building;

Figure 2 is a perspective view which illustrates a portion of a shutter curtain;

15 Figure 3 illustrates the operation of the shutter curtain;

20 Figures 4C to 4M, 4O, 4Q and 4S are pattern drawings which illustrate a variety of embodiments of the shutter curtain;

Figures 5A to 5G, 5I and 5J are pattern drawings which illustrate other embodiments of the shutter curtain;

5 Figures 6A to 6D are pattern drawings which illustrate other embodiments of the shutter curtain;

10 Figures 7A and 7B are respectively a front elevational view and a side cross-sectional view which illustrate a main slat;

Figures 7C and 7D respectively are a front elevational view and a side cross-sectional view which illustrate a sub-slat;

15 Figure 7E is a side cross-sectional view which illustrates a state where the slats are connected;

20 Figures 8A to 8C are side cross-sectional views which illustrate a variety of states in each of which slats are connected;

Figures 9A and 9B respectively are a side cross-sectional view and a top elevational view which

illustrate the main slat in the form of a U-like-shape;

5 Figures 9C and 9D respectively are a side cross-sectional view and a top elevational view which illustrate the sub-slat in the form of the above-described shape;

10 Figure 9E is a side elevational view which illustrates a state where the slats in the form of the above-described shape are connected;

15 Figure 9F is an enlarged cross-sectional view which illustrates a junction;

20 Figures 10A to 10E are perspective views which illustrate fastening members formed in the sub-slats;

20 Figure 11A is a side cross-sectional view which illustrates a modified main slat;

Figure 11B is an enlarged cross-sectional view which illustrates a junction for connecting the modified main slats;

5 Figures 11C and 11D are enlarged cross-sectional views which illustrate a variety of examples of a junction;

Figures 12A and 12B are pattern drawings which
10 illustrate examples in which the shutter curtain is accommodated when opened;

Figure 13A is a schematic side elevational view which illustrates a state where the shutter curtain is being
15 wound in a forward manner with fronts of the slats facing out from a coil;

Figure 13B is a partially enlarged view which illustrates this state;

20 Figure 14A is a schematic side elevational view which illustrates a state where the shutter curtain is wound reversely with backs of the slats facing out from a coil;

Figure 14B is a partially enlarged view which illustrates the above-described state;

5 Figure 15 is a side elevational cross-sectional view which illustrates another embodiment of the shutter curtain;

10 Figure 16 is an operational view which illustrates a state where the shutter curtain is wound to form a coil-like shape having a small diameter;

Figures 17A to 17D are enlarged cross-sectional views which illustrate a variety of junctions; and

15 Figures 18A and 18B are side elevational cross-sectional views which illustrate modified sub-slats.

20 Referring to the drawings, reference numeral 1 represents a shutter curtain for a shutter for a building, the shutter curtain 1 being wound on a take-up drum 2 suitably mounted above an opening of the building. The shutter curtain 1 is arranged in such a manner that it is guided by guide rails 3 disposed on

the two sides of the opening so that it can be moved vertically in order to open or close the shutter.

5 The shutter curtain 1 comprises main slats 4, each of which is made of a rigid material such as metal exemplified by steel, aluminium and the like or a synthetic resin each of which is employed in a conventional shutter curtain, and sub-slats 5 which are made of a material having a relatively weak
10 rigidity and relatively high elasticity such as spring steel, a synthetic resin and the like and which are connected between each main slat 4.

15 That is, each of the main slats 4 and the sub-slats 5 is, according to this embodiment, arranged to be in the form of a flat plate. Their two confronting end portions are fastened to each other in a flat-lock seam state so that the main slats 4 and the sub-slats 5 are integrally connected to one another. The
20 shutter curtain 1 thus formed in series can be wound to the take-up drum 2 in such a manner that the sub-slats 5 having relatively weak rigidity are elastically deformed and curved.

According to this embodiment of the present invention constituted as described above, the opening is opened or closed by moving the shutter curtain 1 upwards or downwards, this movement being guided by the guide rails 3. According to the shutter curtain 1 thus-
5 formed, the presence of undesirable gaps in the junction portions between connected slats can be eliminated, the gaps being involved in the conventional structure in which the rigid slats are
10 connected by utilising interlocking in such a manner that the rigid slats can be folded. As a result, the generation of noise due to collision between adjacent slats can be avoided: the noise is generated when the shutter is being opened or closed or when it is
15 exposed to the wind. Therefore, a silent shutter exhibiting low noise for a building can be constituted. Furthermore, since the gaps can be eliminated from the junctions between the slats, the shutter curtain according to this embodiment possesses
20 advantages in terms of preventing fire, stopping smoke and sound insulation.

In addition, the shutter curtain according to this embodiment is wound onto the take-up drum 2 in such a manner that the sub-slats 5 having elasticity and flexibility are bent in place of the main slats 4.

5 Therefore, it can be smoothly wound to form a coil-like shape similar to the conventional structure having interlocking connections.

10 Furthermore, since the shutter curtain according to this embodiment can be bent to be adapted for both forward winding with fronts of the slats facing away from the take-up drum and reverse winding with fronts of the slats facing the take-up drum, it can be used in a manner similar to that of a conventional
15 interlocked type shutter curtain. Therefore, no problem will arise with the shutter curtain according to this embodiment.

20 The present invention is not limited to the above-described embodiment if the structure is arranged in such a manner that the slats possessing relatively strong rigidity, that is the main slats and slats possessing relatively weak rigidity but possessing elasticity, that is, the sub-slats are

used in series to form the shutter curtain. Therefore, other structures shown below may be employed.

Thus the shutter curtain may be structured according to embodiments the pattern of each of which is shown in Fig.4 to 6. Referring to each of these pattern drawings, continuous lines show the rigid main slats and the dashed lines show the relatively elastic sub-slats. Referring to Fig.4, embodiments are respectively arranged in such a manner that both the main slats 4 and the sub-slats 5 are in the form of flat plates (see Figs.4C and 4D). Another structure is shown in which the main slats and/or the sub-slats are generally z-like in cross-section (see Fig.4E). Another structure is shown which is arranged in such a manner that the main slats and/or the sub-slats are generally U-shaped in cross-section (Figs.4F to 4H). Other structures as modifications to the U-shape facing side are shown which are arranged in such a manner that the main slats and/or the sub-slats are respectively generally Σ shaped in cross section, semicircular in cross section, generally shaped like a sine wave in cross section, zigzag shaped in cross section and castellated in cross section (see Figs.4I

to 4M). Furthermore, another structure is arranged in which a plurality of the main slats 4 or the sub-slats 5 are connected in series (see Figs. 40 and 4Q). In addition, a structure is shown in which the sub-slats 5 are longer than the main slats 4 (Fig. 4S).

Furthermore, a structure in which the main slats 4 are hollow (see Figs. 5A to G, I and J), may be employed.

Fig.6 shows a shutter curtain having slats which are U-shaped in cross section defining recesses or hollow portions which may be filled with heat insulating materials 6. In this case, any structure may be selected from a group consisting of a structure in which the recessed portions of the main slats 4 are filled with the heat insulating materials 6 (see Fig.6A), a structure in which the recessed portions of the sub-slats 5 are filled with the heat insulating materials (Fig.6B) and a structure in which the recessed portions of the main slats 4 and the sub-slats 5 are filled with the heat insulating materials 6 (see Fig.6C). In a case where the sub-slats are filled with the heat insulating materials, it is preferable that the heat insulating

material is an elastic material so that the sub-slats may be bent as shown in Fig.6D. The heat insulating material may be selected from foam or non-foamed synthetic resin materials exemplified by a
5 polyurethane resin material (which may be a hard material, a semi-hard material or a soft material), a denaturated polyisocyanurate resin material which exhibits excellent heat insulating characteristics, a polyethylene resin material, a polystyrene resin
10 material, a urea resin material, a phenol resin material or a polyvinyl chloride resin material. Furthermore, the following heat insulating materials may be employed solely or in a properly combined manner: various rubber materials possessing elasticity
15 such as natural rubber and synthetic rubber; various inorganic heat insulating materials such as glass wool, rock wool, calcium silicate, perlite and vacuum-lite; natural heat insulating materials such as cork; and brick materials such as heat insulating
20 brick. The heat insulating material may be fastened to the slats by utilising the adhesive strength of the material in the case of, for example, the polyurethane resin material which is exhibited during the chemical reaction to form the resin. In addition, one or a

plurality of known methods shown below can be selected to fasten the selected heat insulating material onto the slats: adhesion, pasting, welding, fastening and securing by using fixing members such as bolts, pins, screws, rivets or the like.

As a means for connecting adjacent slats together, a variety of known connecting methods exemplified below may be employed: rivets 7 may be used (see Figs. 4D to 4F, 4I to 4M, 4O, 4Q and 4S, Fig. 5F); alternatively they may be connected by a flat-lock-seam method. The structures in which the slats are in the form of the flat shape and a structure in which the same are in the form of the z-shape may be arranged in such a manner that the slats are connected in a louver manner (see Figs. 4C, 4D and 4E); this results in excellent weathering characteristics. The structures, in which the rivets are employed to fix the slats, may, as shown in Figs. 4I, 4J and 4K, be arranged in such a manner that the two confronting sides of the slats for connection are folded over to double their thickness to improve the strength of the connection.

In a case where the main and sub-slats are in the form of flat plates, means for connecting the slats together to form a structure as shown in Fig.7 may be employed. That is, end portions of the main slats 4
5 are folded twice to form grooved receiving portions 4a and 4b. Each grooved receiving portions 4a and 4b respectively defines a recess which faces or opens onto the adjacent sub-slats 5. Then, the end portions of the sub-slats 5 are inserted into the recesses and
10 fastened in to the grooved receiving portions 4a and 4b, so that the thus-formed shutter curtain 1, in which the slats 4 and 5 are connected in series, can be assembled. In this structure, a mechanism for keeping the sub-slats 5 in place in the structure is
15 as follows: A series of fastening holes 4c are formed in the grooved receiving portions 4a and 4b, separated by a distance A from each other, and facing the inside of the building, each of the fastening holes 4c having a width B measured in the direction in which
20 the separation of the fastening holes 4c is measured. Sub-slat 5 has a series of fastening members 5a formed by embossing (pressing and cutting) in the two end portions thereof, the fastening members 5a are spaced

apart at half the width of the fastening holes 4c (i.e. $B/2$ apart).

As shown in Fig.7E, the lower end portion of the sub-slat 5 is push fitted into an upper grooved receiving portion 4a and the upper end portion of the sub-slat 5 is similarly inserted into a lower grooved receiving portion 4b in such a manner that the fastening members 5a are fastened in the corresponding fastening holes 4c. As a result, the main slats 4 and the sub-slats 5 can be connected in series and prevented from being separated. In the structure thus constituted, loads acting on the sub-slats 5, when the shutter curtain 1 has been closed, can be made to act in the plane of the face plate. Also, the main slats 4 and the sub-slats 5 are easy to connect together. The application of excessive load to the bent portions, which happens when the structure is arranged so that junctions between the main slats 4 and the sub-slats 5 are bent toward the inside of the building, can be prevented, resulting in a strong structure. Furthermore, since the junctions between the slats 4 and 5 are not exposed to the outside of the building, the shutter looks good. The same feature assists crime

prevention and corrosion prevention. Furthermore, since the fastening members 5C are inserted and fastened into the fastening holes 4, undesirable lateral displacement can be prevented. Therefore, a need for providing metal end stoppers as are necessary in the conventional structures, in which the interlocking connection method is employed for the purpose of preventing the lateral deviation of the slats, can be eliminated.

The structures shown in Figs.8A, 8B and 8C respectively may also be used for connecting the flat slats together. Fig.8A shows an embodiment in which receiving grooves 4d and 5d opening downwards are formed in the lower end portions of both the main slats 4 and the sub-slats 5. The upper end portions of the adjacent slats 4 and 5 are inserted into the receiving grooves 4d and 5d thus-formed. In the above-described case, it is convenient to utilise fastening claw mechanisms in order to prevent the separation of the slats 4 and 5.

Figs.8B and 8C show embodiments in which curved portions 4z extend towards the inside of the building from the grooves 4a and 4b so as to increase the apparent thickness of the slats 4 and 5. As a result contact between the overlapped slats, which takes place when the shutter curtain is wound onto the take-up drum 2, may be prevented. Fig.8C illustrates another embodiment in which receiving grooves 4e are formed in the two end portions of the main slats 4, the cross section of the receiving groove 4e defined by a pair of parallel lines which expands to form a circular shape, thus defining a cylindrical recess extending along the slat at the inner end of the receiving groove. Furthermore, fastening portions 5e in the form of cylindrical ribs are formed in the two end portions of the sub-slats 5. The fastening portions 5e are slid into the grooves 4e of the main slats 4 while preventing the separation of the slats 4 and 5.

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A structure in which the main and the sub-slats 4 and 5 are generally U-shaped may employ the following connecting means without using rivets. As shown in Figs.9A to 9D, the two end portions of the main slat

4 have groove portions 4f which extend into or towards the inside of the building, with openings of the grooves facing outside of the building. Holes 4g are formed in the groove portions 4f. In addition, the two end portions of the sub-slat 5 have fastening portions 5f which project towards the inside of the building; the fastening portions include tongues 5g. The fastening portions 5f of the sub-slat 5 are inserted into the receiving groove portions 4f of the main slat 4 in such a manner that the tongues 5g fit in the holes 4g so that the main slats 4 and the sub-slats 5 are connected. The size of the elements 5g and 4g and positional relationship between the arranged elements is similar to that of the embodiment shown in Fig.7.

Thus the slats, each of which is generally U-shaped in cross section can be easily connected to each other by means which also prevent separation of the slats from each other.

Other structures may be employed in which holes and fastening portions are formed in the slats for the purpose of connecting them to each other. Fig.10A shows an arrangement in which a fastening member 5H is formed in the sub-slat 5 in which member is

constituted by a pair of opposed projecting elements formed by making an "H" shaped cut in an end of the slat to form two opposed flap elements and bending the free ends of the opposed flap elements out from the plane of the end of the slat in a direction perpendicular to the longitudinal axis of the slat. Also in this case, the displacement of the slats in the lengthwise direction of the slat as well as the separation of the slats can be assuredly prevented.

Another embodiment is shown in Fig.10B in which the two fastening portions 5f of the sub-slat 5 respectively have raised fastening members 5i which are formed by cutting and which are arranged in such a manner that one side (in this embodiment, the left side as oriented in Fig.10B) of the fastening member 5i is moderately inclined and another side is steeply inclined away from the plane of the end portion of the slat. In the embodiment shown, movement of the sub-slats 5 to the left with respect to the position of the main slat 4 is allowed after the slats 4 and 5 have been connected. As a result, an advantage can be realised in that any one of the main slats 4 and the sub-slats 5 can be removed and exchanged, if necessary. An embodiment shown in Fig.10C is arranged

in such a manner that fastening members 5j, each of which has two side portions which curve away from the plane of the end portion of the sub-slat 5, are formed in the sub-slats 5. According to this embodiment, side movement of the sub-slats 5 sideways along the longitudinal axis of the main slats 4 is allowed. Thus, any of the main slats 4 or sub-slats 5 may be removed and exchanged, if necessary. Furthermore, embodiments shown in Figs.10D and 10E are arranged in such a manner that fastening members 5k and 5l are formed which moderately expand in the three directions, that is, the two directions in the lengthwise direction of the sub-slat 5 and the direction into which the sub-slat 5 is forcibly inserted. Furthermore, only the portion of the sub-slat 5 opposite to its insertion portion into the holding groove portion 4F is expanded to form a step portion. As a result, only lengthwise movement of the sub-slat 5 with respect to the position of the main slat 4 is allowed.

A developed connecting pattern shown in Figs.11A and 11B may be employed in which the receiving grooved portions 4f, arranged similarly to the

above-described embodiments, are formed in the main slats 4. In Figures 11A and 11B, curved fastening members 4h and 4i extend from the confronting end portions of the main slats 4 to reach the middle of sub-slat 5. Adjacent fastening members 4h and 4i may be bent together to interlock with each other as shown in Figure 11B. A structure may be employed in which the shutter curtain described above has sub-slats made of an elastic material which does not possess resistance to heat and cold. However the interlocking of the fastening members 4h and 4i of the rigid main slats 4 prevents the shutter curtain breaking even if the sub-slats 5 break, are burnt off or crack. Another structure is shown in Fig. 11C in which groove portions 5m, which include fastening holes 5n, are formed in the sub-slats 5 and fastening portions 4m having fastening members 4n are provided for the main slats 4, so that they are connected in the opposite manner to the above-described embodiments. In addition, another structure is shown in Fig. 11D in which the end portions of the sub-slats 5 are further folded toward the inside portion of the building to form stepped front ends 5o to which raised fastening

members 4a formed by cutting in the main slats 4 are fastened.

5 The shutter curtain 1 thus connected is usually wound onto the take-up drum 2 in the form of a coil. A variety of accommodation methods such as that shown in Fig.12A where the shutter curtain 1 is accommodated in a coil-like accommodating rail 8 may be used. The curtain 1 may also be accommodated in a horizontal
10 accommodating rail 8A which connects with the guide rails 3 via curved rails as shown in Fig.12B. Furthermore, the direction in which the shutter curtain is moved is not limited to the vertical direction. The shutter curtain according to the
15 present invention can be oriented in a generally horizontal plane and moved laterally to open or close, that is, a so-called "horizontally-moving shutter".

20 The winding of the shutter curtain 1 onto the take-up drum 2 will now be described. The shutter curtain 1 having the slats 4 and 5 which are respectively U-shaped in cross section is wound onto the take-up drum 2 in a "forward winding state", in which the

open side of the U-shaped slats faces the take-up drum
2 (inside), and a "reverse winding state", in which
the open side faces away from the drum. The present
invention can be employed regardless of the winding
5 direction. A preferred example of the shutter curtain
1 wound in the forward winding state will now be
described.

The description will be made about the shutter curtain
10 1 arranged as shown in Fig.9, comprising in series,
main slats 4 made of the rigid material and sub-slats
5 made of the elastic material. The junctions (the
portions in which the groove portions 4f and fastening
portion 5f are fastened to each other) between the
15 generally U-shaped slats 4 and 5 are inclined in such
a manner that their front portions (end portions in
the inside portion of the building) face upward since
the arms of the U-shaped slats are not exactly
perpendicular to the base of the "U". Therefore, the
20 end portions of junctions 9 and 10 of the adjacent
slats on the inside of the building are positioned
higher than the portions of the same junctions which
are at the front of the shutter curtain as a result.
Entry of water into the junction when it rains can be

prevented since water does not flow uphill. Thus, the shutter demonstrates excellent weathering characteristics.

5 Furthermore, since the front ends (ends of the openings) of the receiving grooves 4f formed in the main slats 4 are folded to expand outward, the fastening portions 5f of the sub-slats 5 can easily be fitted within the receiving grooves 4f. In addition,
10 in a case where the sub-slats 5 are, as shown in Fig.13B, bent in the forward winding state, the sub-slats 5 are moderately curved while forming a large circular arc due to the guiding and supporting actions performed by the above-described expanded
15 portion. Therefore, the sub-slats can be smoothly elastically deformed, avoiding the problem which can arise where the front portions of the holding grooves 4f are steeply bent exceeding their elastic limit.

20 In addition, when the shutter curtain 1 is wound on to the take-up drum 2 to form a coil, the junctions 9 and 10 of the adjacent slats 4 and 5 are positioned in such a manner that their inner (end) portions are higher than their outer portions. Therefore, when the

sub-slats 5 are bent for winding onto the take-up drum 2, the end portion of the lower junction 10 is a distance D further away from the drum than the end portion of the upper junction 9. As a result, when the shutter curtain 1 is wound, the sub-slats 5 are curved and deformed in a state where the end portions of the upper junctions 9, which are the leading portion when they are wound, are abutted and supported by the take-up drum 2 (or the shutter curtain) 1 onto which the shutter curtain 1 has been wound. At this time, the end portions of the rear junctions 10 are deformed in an idle state in which they do not substantially come in contact with the take-up drum 2 or the shutter curtain. Therefore, a problem which can arise in that the end portions of the rear junctions 10 are rubbed by the take-up drum 2 or the shutter curtain 1 and thereby damage the slats 4 and 5 can be avoided.

The structure, in which the end portion of the junction 9, which is the leading portion at the time of the winding operation, is projected toward the inside portion over the end portion of the junction 10, which is the ensuing portion at the time of the winding operation, can be realised, according to an

embodiment shown in Fig.15, by simply changing the relative lengths of junctions 9 and 10.

Shutter curtains 1 are usually delivered from a manufacturing plant already wound on to the take-up drums 2. The are respectively individually wound to form coils, the diameter of each of which is made to be as small as possible before they are wound to the winding drums 2. The reason for this lies in that the volume of the coil must be reduced so as to save space. In order to prevent excessive bending of the sub-slat 5, the two junctions 9 and 10 across the sub-slat 5, which is elastically deformed, are positioned in contact with each other within their elastic deformation i.e. below the elastic limit, thus preventing further deformation of the sub-slat 5 beyond the elastic limit. As a result, when the shutter curtain is handled solely in the manufacturing plant or the installing field, the two junctions 9 and 10 across the sub-slat 5 come in contact with each other before the sub-slat 5 is curved past its elastic limit after which it would not be restorable by the application of a load.

As a result, the sub-slat 5 can be protected from damage.

When the shutter curtain 1 is wound onto the take-up
5 drum, the end portion of the junction 9 comes into
contact with the take-up drum 2 or the shutter curtain
1 which has been wound onto the drum 2. Thus, there is
a danger that they might be damaged. Accordingly,
junctions 9 and 10 are arranged in such a manner that
10 their inner front portions are rounded by folding back
the plate to prevent damage. In order to further
improve the function of the damage prevention, a
structure shown in Fig.17A may be employed in which
the inner end portion has a generally rounded shape in
15 cross section of a relatively large diameter. Another
structure shown in Fig.17B may be employed in which a
cover 11 is fitted over the junction 9. In this case,
it is not necessary to fit the cover 11 over the whole
length of the junction 9 and it is only fitted over
20 the end portion. If the take-up drum 2 has a large
diameter the ensuing junction 10 will also come in
contact with the wound shutter curtain 1. In this
case, a cover 11 may be also fitted to junction 10.
Another embodiment is shown in Fig.17C in which a

cover 12 extends from junction 9 to reach junction 10. Furthermore, another embodiment is shown in Fig. 17D in which an extension portion 4p is formed by extending the end portion of the main slat 4 to cover the junction 10.

Furthermore, if the structure in which the slats 4 and 5 are in the form of the U-shape facing side is arranged in such a manner that the outer surfaces of all the slats 4 and 5 form a flat plane when they are extended as shown in Figs. 4F, 4Q and 4S an advantage can be realised in that the flat plane thus realised can be used as a smooth surface on which a desired picture or advertisement can be drawn.

In the embodiments shown in Figs. 9 and 13B the outer surface of the sub-slat 5 is closer to the take-up drum 2 than the surface of the main slat 4. In this case, when the surfaces of the sub-slats 5 are curved in order to wind the shutter curtain 1 to the take-up drum 2, the surfaces expand outward because the sub-slats 5 become bent. However, because the surfaces of the main slats 4 project further outwards than sub-slats 5 this compensates for the above-described

expansion of the sub-slats. Therefore the problem of the sub-slats 5 becoming damaged by coming into contact with an overlapped slat, can be avoided. Therefore, the appearance of the shutter can be maintained satisfactorily for a long time since winding and unwinding the shutter curtain should not damage the slats. The above-described structure is extremely effective as a measure taken to overcome a problem in which the strength of the sub-slat 5 is inevitably insufficient with respect to the strength of the main slat 4 because the sub-slat 5 must be elastically deformed. Another structure is suggested in which the sub-slats 5 are projected outward over the main slats 4. Although no significant advantage cannot be obtained from this, the present invention may be applied to that above-described structure.

Furthermore, when the shutter curtain 1 is wound to the take-up drum 2, the shutter curtain 1, which has been wound, will try to restore itself to its original state, that is, the flat-surface state due to the restoring force in the sub-slats 5 because the sub-slats 5 are elastically deformed when wound. Therefore, there is a danger that the diameter of the

wound shutter curtain 1 will expand to be relatively large. To avoid this, the following structure may be employed: the elastical restoring force of the sub-slats 5, when they are elastically deformed when they are wound to the take-up drum 2, is arranged to be substantially the same or smaller than the rewinding force of the shutter curtain 1 due to the dead weight of the shutter curtain 1 which has to be rewound from the take-up drum 2. As a result, when the shutter curtain 1 is wound to the take-up drum 2, the rewinding force due to the dead weight of the rewound shutter curtain 1 becomes the same or larger than the elastical restoring force of the sub-slats 5. Therefore, the undesirable restoration of the sub-slats 5 in the portion of the shutter curtain 1 which has been wound to the take-up drum 2 can be prevented. As a result, the problem of the excessive expansion of the diameter of the coiled shutter curtain 1 due to loosening of the wound shutter curtain 1 can be avoided..

Another means for preventing the expansion of the diameter of the coiled shutter curtain will now be described. The sub-slats 5 are shaped as shown in

Fig.18A so that the arms of the "U" shape tend to converge as if the slats had been forward wound in the case where the shutter curtain 1 is indeed to be wound forward. The sub-slats 5 as shown in Fig.18B are
5 shaped so that the arms of the "U" shape diverge as if the slats had already been reverse wound in a case where the shutter curtain 1 is to be reverse wound. When the shutter curtain 1 is unwound from the take-up drum 2, the sub-slats 5 are elastically deformed due
10 to the weight of the shutter curtain 1 which has been rewound. As a result, the attitude or shape of the sub-slats is corrected and due to the weight of the shutter curtain a flat surface is realised. According to the structure thus-constituted, the problems of an
15 excessive expansion of the coil diameter due to the restoring force of the sub-slats when the shutter curtain 1 is wound can be prevented. Furthermore, winding of the shutter curtain 1 can be smoothly performed during winding of the shutter curtain 1
20 performed against the dead weight of the rewound shutter curtain 1.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been changed in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

CLAIMS

1. A shutter curtain for a building opening comprising:

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a plurality of main slats made of a rigid material;
and a plurality of sub-slats made of a relatively
elastic material, said main slats and sub-slats
having a slat surface to constitute the shutter
curtain;

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wherein the end portions of each main slat and each
sub-slat are bent to one side of the surface of
said shutter curtain and the bent portions of said
slats are connected integrally with each other to
form said shutter curtain;

15

said main slats and sub-slats being in
juxtaposition whereby on winding onto a take-up
drum said shutter curtain forms a coil-like shape
due to elastic deformation of said sub-slats.

20

2. A shutter curtain according to claim 1 wherein the
bent end portions of said main slats and/or said sub-
slats are further folded, thereby improving the strength
of the connection between main slats and sub-slats.

25



3. A shutter curtain according to claim 1 wherein at least one end portion is further folded to define a receiving groove into which the adjacent bent end portion is fastened.

5

4. A shutter curtain for a building opening comprising:

a plurality of main slats made of a rigid material;
and a plurality of sub-slats made of a relatively
elastic material, said main slats and sub-slats
each having a slat surface to constitute the
shutter curtain;

wherein the end portions of said each main slat are
folded twice to form grooved receiving portions
parallel to the slat surface, which receiving
portions each define a recess into which the end
portion of each adjacent sub-slat is fastened to
form said shutter curtain;

20

said main slats and sub-slats being in
juxtaposition whereby on winding onto a take-up
drum said shutter curtain forms a coil-like shape
due to elastic deformation of said sub-slats.

25

5. A shutter curtain for a building opening comprising:



a plurality of main slats made of a rigid material;
and a plurality of sub-slats made of a relatively
elastic material, said main slats and sub-slats
each having a slat surface to constitute the
5 shutter curtain;

wherein the end portions of said main slats and
said sub-slats are fastened to each other by a
flat-lock-seam method whereby end portions of
10 adjacent slats are folded in opposite directions,
thereby facilitating connection by the insertion of
each respective folded portion into the recess
formed under the neighbouring folded portion; said
main slats and said sub-slats being in
15 juxtaposition whereby on winding onto a take-up
drum said shutter curtain forms a coil-like shape
due to elastic deformation of said sub-slats.

6. A shutter curtain as previously claimed wherein
20 adjacent slats are rivetted together.

7. A shutter curtain for a building as claimed in claims
1 to 3, wherein the cross section of at least either said
main slats or said sub-slats is generally U-shaped.

25

8. A shutter curtain for a building as claimed in claims
1 to 3, wherein the cross section of at least either said



main slats or said sub-slats is generally Σ -shaped.

9. A shutter curtain for a building as claimed in claims 1 to 6, wherein the cross section of at least either said
5 main slats or said sub-slats is substantially semi-circular in shape.

10. A shutter curtain for a shutter for a building as claimed in claims 1 to 6, wherein the cross section of
10 the surface of at least the main slats or the sub-slats is a generally wavy shape.

11. A shutter curtain for a shutter for a building as claimed in claims 1 to 6, wherein at least one of the
15 slat surfaces has a zigzag shape in cross section.

12. A shutter curtain for a building as claimed in claims 1 to 6, wherein at least one of the slat surfaces defines at series of projections and recesses.

20

13. A shutter curtain for a building as claimed in claims 1 to 6, wherein either a main slat or a sub-slat is hollow.

25 14. A shutter curtain claimed in claims 1 to 3, wherein two end portions of each of said main slats and said sub-slats project generally towards the inside of the



building, said main slats and said sub-slats being U-shaped in cross section thereby having recessed portions in between projecting end portions of said main slats and said sub-slats, and one or more of said recessed portions
5 is filled with heat insulating material.

15. A shutter curtain for a shutter for a building as claimed in claim 14 wherein the heat insulating material is an elastic material.
10

16. A shutter curtain for a building as claimed in claims 1 to 6, wherein the sub-slats surfaces are curved to conform to an attitude realised when said sub-slats are wound onto the take-up drum.

15 17. A shutter curtain as previously claimed which is opened and closed by winding onto and un-winding from respectively, a take-up drum.

20 18. A shutter curtain as claimed in claim 17 wherein the elastic restoring force of said sub-slats in the wound state is substantially the same as or smaller than the force due to the weight of the curtain.

25 19. A shutter curtain for a building as claimed in claim 1, wherein the end portions of adjacent slats are bent to alternate sides of the surface of said shutter



curtain, and the bent portions of said slats are connected in series.

20. A shutter curtain for a building as claimed in claim
5 3, wherein two end portions of one of the adjacent slats
have portions defining receiving grooves projecting
toward the inside of the building wherein openings of
those grooves face outside of the building and wherein
projecting fastening portions formed toward the inside
10 of the building in the two end portions of another slat
are push fitted within said receiving grooves so as to
form a body comprising a series of connected slats.

21. A shutter curtain for a building as claimed in claim
15 20, wherein said main slats and said sub-slats are
alternately connected, and the two end portions of said
main slats are provided with said receiving grooves and
wherein projecting fastening portions of the two end
portions of said sub-slats are forcibly fitted within
20 said grooves.

22. A shutter curtain for a building as claimed in
claims 20 or 21, wherein the front portion of said
fastening portions is bent to expand outward.
25

23. A shutter curtain for a building as claimed in claim
20, wherein a front portion of the junction of said



connected portion is curved.

24. A shutter curtain for a building as claimed in claim 20, wherein the main slats and the sub-slats are alternately connected, and where the two end portions of said sub-slats are provided with said receiving grooves and wherein the two end portions of said main slats are provided with said projecting fastening portions which are push fitted within said receiving grooves.

10

25. A shutter curtain as claimed in claims 20 to 24 wherein the surfaces of said adjacent slats form a flat surface.

15 26. A shutter for a building as claimed in claims 20 to 25 wherein the surfaces of the sub-slats are offset such that they are closer to said take-up drum than the surfaces of adjacent main slats when said curtain is in the wound up state.

20

27. A shutter curtain for a building as claimed in claims 20 to 26 wherein a protective cover is fastened to the junctions of adjacent slats.

25 28. A shutter curtain as claimed in claim 27, wherein said cover is fastened to one of two adjacent junctions and extends to cover the other adjacent junction.



29. A shutter curtain as claimed in claims 20 to 28 wherein the two junctions corresponding to each sub-slat are inclined such that when said shutter curtain is wound to said take-up drum, the leading junction alone contacts
5 the drum or coiled shutter surface.

30. A shutter curtain as claimed in claims 20 to 29, wherein the two junctions corresponding to each sub-slat are adapted to come into contact with each other during
10 winding onto said take-up drum whilst they are within their elastic deformation limit, thereby to prevent further deformation of said sub-slats.

31. A shutter curtain as claimed in claims 20 to 30,
15 wherein adjacent slats are connected by a series of fastening members having expanding surfaces formed in said fastening portions by cutting and pressing, wherein said fastening members are positioned in fastening holes formed in the surface of said receiving grooves, by push
20 fitting.

32. A shutter curtain as claimed in claim 31, wherein said fastening members have four sides and are formed in said fastening portions such that any one side in the
25 lengthwise direction of said sub-slat is moderately expanded so as not to be positioned in said fastening hole and the three other sides are expanded to form a



step so as to be positioned in said fastening hole.

33. A shutter curtain as claimed in claim 32, wherein said fastening members are formed in said fastening portions such that two sides are moderately expanded so as not to be positioned in said fastening hole and the two end sides parallel to the direction in which said fastening portion is forcibly inserted are expanded to form a step.

10

34. A shutter curtain for a building as claimed in claim 32, wherein the fastening members are formed in such a manner that three sides are expanded moderately so as not to be positioned in said fastening hole and only the side opposite to said insertion direction is expanded to form a step.

15

35. A shutter curtain for a building as claimed in any preceding claim, wherein said shutter curtain is guided by a vertically disposed guide rail so as to open or close an opening.

20

36. A shutter curtain as claimed in claim 35, wherein the junctions of said main slats and said sub-slats are inclined such that their innermost portion facing inside the building is positioned higher relative to the outermost portion of that junction.

25



37. A shutter curtain according to claims 1 to 34, wherein said shutter curtain is guided by horizontally disposed guide rails so as to laterally open or close an opening.

5

38. A shutter curtain for a building substantially as hereinbefore described with reference to the drawings.

39. A shutter curtain for a building substantially as
10 hereinbefore described and as shown in any of the figures
of the drawings.