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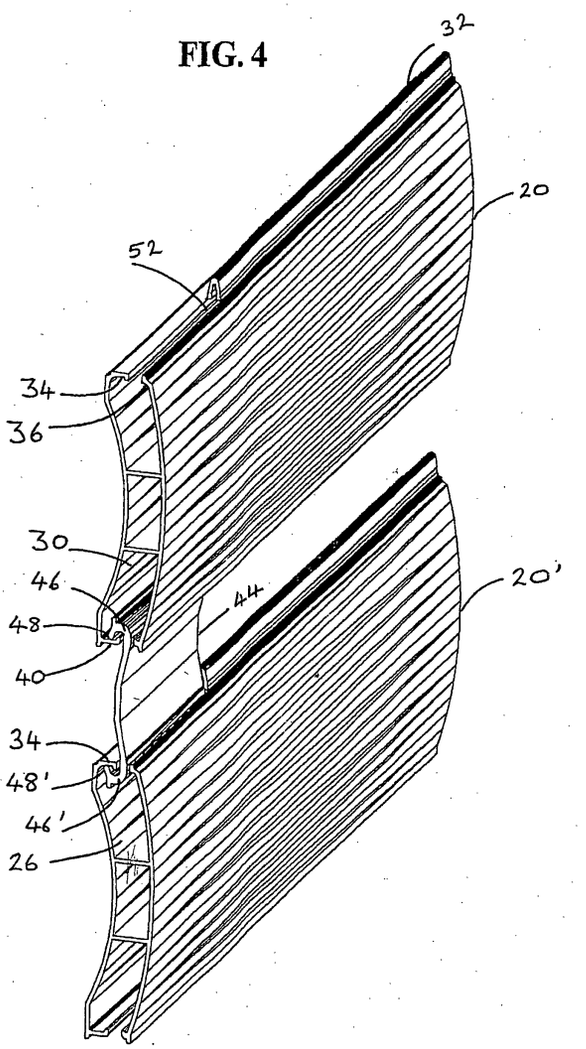
(54) Shutter device

(57) It is provided a shutter assembly for an aperture, comprising:
a plurality of adjacent elongate slats (20) coupled together to form a slat assembly, said slats (20) having: a lower edge; a lower channel (38) along the lower edge, said lower channel (38) being defined by at least one inwardly directed lower lip (40,42); an upper edge; and at least one upper channel (52) along at least part of the upper edge, said upper channel each being defined by at least one inwardly directed upper lip (34,36); wherein said slats (20) are coupled to an adjacent slat (20) in the shutter assembly by at least two coupling linkages (44), said coupling linkages (44) having upper and lower hooked heads (46,46'); and wherein said inwardly directed lips (34,36; 40,42)and said hooked heads (46,46') are mutually configured such that said upper hooked heads (46) are captured within the lower channel (38) of an adjacent slat (20) by said at least one lower lip (40,42), and said lower hooked heads (46') are captured within the at least one upper channel (52) of an adjacent slat (20) by said at least one upper lip (34,36).

FIG. 4



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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the field of roller shutters.

BACKGROUND OF THE INVENTION

[0002] Shutters for apertures such as windows and doorways serve several purposes. They provide shelter from the weather, particularly from rain, wind and the sun, and isolate the interior of buildings from the penetration of heat, dust and pollution. They can provide an opaque screen that isolate the interiors from external view and accommodate the privacy of those inside the building. They provide protection against burglary and penetration of animals, birds, insects and the like and a safety measure against the falling of children and animals or escape of animal and birds through the aperture. Most shutters allow an operator to control the degree of exposure of the aperture - they can be open, shut, or partially open.

[0003] Many different roller shutter constructions have been proposed and described in the patent literature to enable the shutter assembly to serve the foregoing functions. Each of the prior shutter constructions and descriptions have one or more disadvantages relating to the complexity and costs of construction of the couplings between adjacent slats, and the limitations to the size of the light and air spaces through the shutter assembly.

[0004] Tvina Plast, Inc. of Mishmar Hasheva, Israel, advertise a shutter designated LHT, which is stated as being the subject of Israel Patent Application No. IL 134,473. This shutter is comprised of a plurality of two types of elongate slats; between each of the regular shutter slats is a joining slat, running the entire width of the shutter, that holds the regular shutter slats together. The joining slat has air and light holes of 16 mm height and 70 mm width every 10 cm along its width. When the shutter is fully closed, the joining slat is concealed within the body of the adjacent slats immediately above and below it. However, in the partially opened position, the joining slats are exposed, thus allowing air and light to pass through the holes in the shutter.

[0005] Israel Patent No. 121,172 discloses a shutter comprised of a number of elongate slats joined together by a relatively complex network of hinge joints attached to the outer lateral edges of each slat, which increases the cost of manufacturing the shutter. Such a shutter apparatus allows gaps between adjacent slats directly related to the length of the hinge. The fact that adjacent slats are only joined at the hinge assemblies located at the outer edges of the slats causes the shutter to decrease in stability at increasing widths. The maximum practical width of a shutter assembly, such as that described in IL 121,172, whose slats are only joined at the outer edges, is in the order of 2.5 m.

[0006] Israel Patent Application No. 137,432, assigned to Kol Chen Ltd, Holon, Israel, also describes a shutter comprised of a number of elongate slats joined together at the outer lateral edges of each slat. In contrast to IL 121,172, in Israel Patent Application No. 157,432, the slats are attached via flexible links made of materials such as wire or fiber.

[0007] US Patent No. 1,852,913 to Bauer and US Patent No. 4,010,790 to Varga both describe a shutter assembly comprising a plurality of slats. Adjacent slats are connected by flat metal links with longitudinal slotted holes, which holes are engaged by pins on the adjacent slats.

[0008] UK Patent application GB 2 055 935 describes a shutter assembly comprised of a number of elongate slats coupled directly to the adjacent slat. Each slat has a lower channel opening into an interior cavity, and an upper section containing a number of openings. The upper section of each slat fits through the lower channel of the slat above it into the cavity of the upper slat. The upper section is retained in the channel of the slat above it by a coupling device, entirely contained within the cavity, fitted through the openings of the upper section. Although the openings allow light and air to pass through the shutter assembly, the size of the gaps is limited.

[0009] European Patent No. EP 0 367 212 describes a shutter assembly comprised of a number of elongate slats. The slats are joined together by a C-shaped joiner with upper and lower hooked ends that fit within lower and upper channels of the slats above and below it, respectively. The joiner runs the whole length of the slats. Light and air spaces of a restricted size are provided within the slats themselves, and no space is provided between the slats for air and light passage.

[0010] Other shutter assemblies are described in US Patents Nos. 6,076,587 to Pastor; 5,46,130 to Cheng; 3,034,574 to Gerold; 2,579,485 to Ferguson et al.; 2,047,453 to Allen; 1,966,728 to Lecluyse; 1,912,817 to Bauer; 1,893,182 to Seregi; and 514,605 to Rasmusson et al. and in European patent No. EP 0 750 094.

[0011] There is thus a need in the art for an apparatus and a method for a shutter assembly without the disadvantages relating to the complexity and costs of construction of the couplings between adjacent slats, and the limitations to the size of the light and air spaces through the shutter assembly.

[0012] The disclosure of each of the publications mentioned throughout the specification, is hereby incorporated by reference, each in its entirety.

SUMMARY OF THE INVENTION

[0013] It is an object of the present invention to overcome the drawbacks of conventional shutter assemblies for apertures, such as, but not limited to, doors and windows, and to provide an improved shutter apparatus and method of constructing the same.

[0014] In accordance with a preferred embodiment of the present invention, the shutter is comprised of a plurality of adjacent elongate slats coupled together to form a slat assembly. Preferably the slats are opaque. Adjacent slats are joined by at least two coupling linkages that act telescopically. The shutter can be completely closed with adjacent slats touching, concealing the coupling linkages within the slats, thus minimizing or eliminating light and air spaces between the slats. Alternatively, the shutter can be partially opened, with the coupling linkages exposed, opening an air and light gap between the slats. The height of the gap between the slat is determined by the height of the coupling linkage and is typically about 3 cm although both larger and smaller gaps can be formed by increasing or decreasing, respectively, the height of the coupling linkage. A gap of a few cm between slats in a shutter covering an external window of a room allows plenty of light and air into the room, what e maintaining security by preventing unauthorized access, and preventing accidents.

[0015] It is also an object of a preferred embodiment of the present invention, to provide a shutter that is simple to clean from the front. The gap between the slats allows a cleaner to insert a hand between the slats allowing the upper, lower and rear surfaces of each slat, in addition to the front surface, to be cleaned.

[0016] In a further preferred embodiment of the present invention, a user can regulate the number of gaps between the slats and hence the area of the light and air spaces in the shutter, by winding or unwinding the shutter assembly from a winding device.

[0017] In accordance with a preferred embodiment of the present invention, a shutter of up to about 4 m in width is provided. Preferably, in shutters up to about 2.5 m in width, adjacent slats are joined by only two coupling linkages. Further preferably, in a shutter of width greater than 2.5 m, three or four coupling linkages are used to join adjacent slats. It is appreciated that additional coupling linkages can be used to join adjacent slats, which would provide added stability. It is further appreciated that minimizing the number of coupling linkages between adjacent slats increases the size of the air and light spaces in the shutter.

[0018] It is a further object of a preferred embodiment of the present invention, to provide a shutter that can roll up into a tighter roll than previous shutter designs, minimizing the space required above the aperture to store the rolled up shutter.

[0019] The LHT shutter described in Israel Patent Application IL 134,473; is superficially similar to preferred embodiments of the present invention. The joining slats of this shutter, and the elongate slats themselves, have a similar, although not identical, cross-sectional profile to the coupling linkages and slats of the present invention.

[0020] However, the novel shutter of the present invention has several further advantages over the shutter of Israel Patent Application IL 134,473. Each pair of adjacent slats in the shutter of Israel Patent Application IL 134,473 is joined by a single joining slat, which contains regularly spaced air and light holes across its length. In preferred embodiments of the present invention, by contrast, pairs of adjacent slats are coupled by 2 to 4 coupling linkages, depending upon the width of the shutter. Typically in a shutter up to 2 to 2.5 m in width only 2 coupling linkages are used, whereas in shutters up until 4 m in width, 3 or 4 linkages are preferably used. The use of coupling linkages instead of coupling slats reduces the weight of the shutter from 10.3 kg per meter of the shutter of Israel Patent Application IL 134,473 to 6.6 kg per meter. This provides a substantial saving in construction material, typically aluminum. It also reduces the strength of a motor required to power movement of the shutter, and minimizes the amount work time required in preparation of the shutter, and eliminates the time required to punch the holes in the coupling slats. Furthermore, use of well spaced coupling linkages, as in preferred embodiments of the present invention, results in light and air gaps of over 100 cm in length, as compared to the gaps of 7 cm in the shutter of Israel Patent Application IL 134,473, which is an increase of over an order of magnitude.

[0021] Another advantage of a preferred embodiment of the present invention is that the production and construction of the shutter assembly is simple, which minimizes the work load and costs. A further advantage is that the shutter can be assembled on-site, and does not have to be pre-assembled in the factory.

[0022] There is thus provided, a shutter assembly for an aperture. The shutter assembly includes a plurality of adjacent elongate slats coupled together to form a slat assembly, the slats having a lower edge, a lower channel along the lower edge, the lower channel being defined by at least one inwardly directed lower lip, an upper edge, and at least one upper channel along at least part of the upper edge, the upper channel being defined by at least one inwardly directed upper lip. The slats are coupled to an adjacent slat in the shutter assembly by at least two coupling linkages, the coupling linkages having upper and lower hooked heads, and the inwardly directed lips and the hooked heads are mutually configured such that the upper hooked heads are captured within the lower channel of an adjacent slat by the at least one lower lip, and the lower hooked heads are captured within the at least one upper channel of an adjacent slat by the at least one upper lip.

[0023] There is also provided, a method of constructing a shutter assembly for an aperture. The method includes providing a plurality of adjacent elongate slats, the slats having a lower edge, a lower channel along the lower edge, the lower channel being defined by at least one inwardly directed lower lip, an upper edge, and at least one upper channel along at least part of the upper edge, the upper channel being defined by at least one inwardly directed upper lip, and coupling the slats to an adjacent slat in the shutter assembly by at least two cou-

pling linkages, the coupling linkages having upper and lower hooked heads, wherein the inwardly directed lips and the hooked heads are mutually configured such that the upper hooked heads are captured within the lower channel of an adjacent slat by the at least one lower lip, and the lower hooked heads are captured within the at least one upper channel of an adjacent slat by the at least one upper lip.

[0024] Further in accordance with a preferred embodiment of the present invention, the at least one inwardly directed lower lip includes two, facing, inwardly directed lower lips.

[0025] Still further in accordance with a preferred emobidment of the present invention, the two, facing, inwardly directed lower lips include a major lip and a minor lip.

[0026] Additionally in accordance with a preferred embodiment of the present invention, the upper hooked head includes a claw that is captured within the lower channel of an adjacent slat by the major lower lip.

[0027] Also in accordance with a preferred embodiment of the present invention, the upper hooked head also includes a tooth protruding from its outer curved edge, that is captured within the lower channel of an adjacent slat, by the minor lower lip, upon angular movement of the coupling linkage with respect to the adjacent slat.

[0028] Further in accordance with a preferred embodiment of the present invention, the at least one inwardly directed upper lip includes two, facing, inwardly directed upper lips.

[0029] Still further in accordance with a preferred embodiment of the present invention, the two, facing, inwardly directed upper lips include a major lip and a minor lip.

[0030] Additionally in accordance with a preferred embodiment of the present invention, the lower hooked head includes a claw that is captured within the upper channel of an adjacent slat by the major upper lip.

[0031] Also in accordance with a preferred embodiment of the present invention, the lower hooked head also includes a tooth protruding from its outer curved edge, that is captured within the upper channel of an adjacent slat, by the minor upper lip, upon angular movement of the coupling linkage with respect to the adjacent slat.

[0032] Further in accordance with a preferred embodiment of the present invention, the slats are coupled so as to permit linear movement towards and away from an adjacent slat in the slat assembly to vary a light and air space between adjacent slats, and angular movement with respect to an adjacent slat in the slat assembly to enable the shutter assembly to be wound or unwound from a winding device.

[0033] Still further in accordance with a preferred embodiment of the present invention, the linear movement towards an adjacent slat results in close, snug contact between the adjacent slats, therby essentially eliminating the light and air space between the contacting adjacent slats, and wherein the coupling linkages are concealed within internal cavities of the contacting adjacent slats.

[0034] Still further in accordance with a preferred embodiment of the present invention, the maximum height of the light and air space between adjacent slats is determined by the distance between the upper and lower hooked heads of the coupling linkages.

[0035] Additionally in accordance with a preferred embodiment of the present invention, each of the at least two coupling linkages between a pair of adjacent slats are the same height.

[0036] Also in accordance with a preferred embodiment of the present invention, the height of the at least two coupling linkages between a first pair of adjacent slats is not the same as the height of the at least two coupling linkages between a second pair of adjacent slats.

[0037] Further in accordance with a preferred embodiment of the present invention, the length of the upper channels is substantially the same as the width of the coupling linkages.

[0038] Still further in accordance with a preferred embodiment of the present invention, the shutter assembly also includes a winding device overlying the slat assembly for winding and unwinding the shutter assembly to a fully-closed position, a fully-opened position, and partially-opened position with respect to the aperture.

[0039] Additionally, the winding device may include a rotatable drum.

[0040] Also, the winding device may include a device selected from the group consisting of an electrical motor and a manual device.

[0041] Further, the method also includes the step of overlying the slat assembly with a winding device for winding and unwinding the shutter assembly to a fully-closed position, a fully-opened position, and partially-opened position with respect to the aperture.

[0042] Still further, the coupling linkages are not attached to the slats by a pin.

[0043] Additionally in accordance with a preferred embodiment of the present invention, the at least two coupling linkages comprise three or four or five coupling linkages.

[0044] Further in accordance with a preferred embodiment of the present invention, the slat assembly is greater than 2.5m in width.

[0045] Still further in accordance with a preferred embodiment of the present invention, the shutter assembly also includes a pair of adjacent elongate slats coupled by a single coupling linkage extending the entire length of the elongate slats.

[0046] Additionally in accordance with a preferred embodiment of the present invention, the elongate slates are substantially hollow.

[0047] Also in accordance with a preferred embodiment of the present invention, at least part of the chan-

nels is filled by an insertable element.

[0048] Further, the method also includes the step of filling at least part of the channels with an insertable element.

[0049] Still further, the method also includes the step of coupling at least two adjacent elongate slats by a single coupling linkage extending the entire length of the elongate slats.

[0050] Additionally in accordance with a preferred embodiment of the present invention, either or both of the elongate slats and the coupling linkages are made from a material selected from the group consisting of metal, wood, glass, PVC and plastic.

[0051] Also in accordance with a preferred embodiment of the present invention, the metal is aluminium.

[0052] There is further provided in accordance with another preferred embodiment of the present invention, an insert for sealing the lateral end of an elongate slat. The insert includes an exterior plate, a plug attached to the exterior plate for insertion into a cavity at the lateral edge of the slat, such that the exterior plate covers the lateral edge, and a screw-hole extending from the exterior plate within the plug, such that when a screw is wound through the exterior plate, into the screw-hole, within the plug, the plug expands within the cavity, thereby holding the plug in place within the cavity.

[0053] There is still further provided, a method for sealing the lateral end of an elongate slat. The method includes providing an elongate slat having a cavity at a lateral edge, inserting an insert including an exterior plate and a plug attached thereto into the cavity, such that the exterior plate covers the lateral edge of the slat, and inserting a screw through the exterior plate, into the plug, thus causing the plug to expand within the cavity, thereby holding the plug in place within the cavity.

[0054] Additionally in accordance with another preferred embodiment of the present invention, the elongate slat includes upper, central and lower internal cavities, and the insert includes upper, central and lower plugs attached to the exterior plate for insertion into the respective upper, central and lower cavities of the slat.

[0055] Also in accordance with another preferred embodiment of the present invention, the central plug is cone-shaped.

BRIEF DESCRIPTION OF THE DRAWINGS

[0056] The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

Fig. 1A is a perspective view of an elongate slat suitable for construction of a shutter assembly, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 1B is a cross-sectional view through the elongate slat of Fig. 1A, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 2 is a perspective view of two contacting elongate slats, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 3A is a cross-sectional view through a coupling linkage, suitable for connecting two elongate slats of Fig. 1, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 3B is a perspective view of an uncut length of the coupling linkage of Fig. 3A, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 4 is a perspective view of a section of two elongate slats of Fig. 1, joined together by a coupling linkage of Fig. 3, in an open position, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 5 is a perspective view of a section of two elongate slats of Fig. 1, joined together by a coupling linkage of Fig. 3, in a closed position, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 6 is a perspective view of a section of the elongate slat of Fig. 1, with the coupling linkage of Fig. 3 attached, showing angular movement of the coupling linkage with respect to the slat, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 7 is a perspective view of a shutter assembly in a closed position, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 8 is a perspective view of the shutter assembly of Fig. 7 in the closed position, with gaps between the uppermost slats, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 9 is a further, perspective view of the shutter assembly of Fig. 8, partially disassembled, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 10 is a perspective view of the shutter assembly of Fig. 7 in the closed position, with gaps between all of the slats, constructed and operative in accord-

ance with a preferred embodiment of the present invention;

Fig. 11 is a perspective view of the shutter assembly of Fig. 7 in a partially open position, constructed and operative in accordance with a preferred embodiment of the present invention; and

Fig. 12 is a perspective view of two elongate slats, joined together by a coupling linkage, showing a side-sealing insert, constructed and operative in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0057] Reference is now made to Figs. IA and 1B which are a perspective view, and a cross-sectional view, respectively, of an elongate slat suitable for construction of a shutter assembly, constructed and operative in accordance with a preferred embodiment of the present invention. Elongate slat 20 is typically hollow, and contains internal strengthening linkages 22, 24 which define upper, central and lower internal cavities 26, 28, 30, respectively. The upper edge of slat 20 is closed by two upper lips, a major lip 34 and a minor lip 36, and a ridge 32 spanning the two upper lips 34, 36. As discussed below with respect to Fig. 4, ridge 32 can be removed from sections of slat 20, thus forming an upper channel 52 defined by the upper major and minor lips 34, 36. The lower edge of slat 20 is incompletely closed by two lower lips, a major lip 40 and a minor lip 42, which define a lower channel 38. Lower internal cavity 30 is accessible through lower channel 38.

[0058] Reference is now made to Fig. 2 which is a perspective view of two contacting elongate slats 20, 20' constructed and operative in accordance with a preferred embodiment of the present invention. It will be appreciated from Fig. 2 that the upper and lower edges of the slats are mutually configured such that the lower and upper edges of two adjacent slats 20, 20' form a snug-fitting contact that restricts, and preferably essentially eliminates, light and air spaces between the two elongate slats 20, 20'. Specifically, upper major lip 34 of lower slat 20' is configured to form a close contact with lower major lip 40 of upper slat 20; upper minor lip 36 of lower slat 20' is configured to form a close contact with lower minor lip 42 of upper slat 20; and ridge 32 of lower slat 20' is configured to fit into lower channel 38 of upper slat 20.

[0059] Reference is now made to Fig. 3A which is a cross-sectional view through a coupling linkage 44, suitable for connecting two elongate slats 20, constructed and operative in accordance with a preferred embodiment of the present invention. Coupling linkage 44 contains a body section 45, and two hooked head sections 46, 46'. Preferably, head sections are 46, 46' are substantially identical. In one preferred embodiment, the length of body section 45 is about 30 mm, although it is appreciated that the length can be increased or decreased as desired. In a preferred embodiment, hooked head sections 46, 46' comprise a standard hook ending in a claw 48, 48', each with a tooth 50, 50' protruding sub-terminally from the outer curved edge of the hook.

[0060] Reference is now made to Fig. 3B which is a perspective view of an uncut length 51 of coupling linkage 44, constructed in accordance with a preferred embodiment of the present invention. Uncut length 51 of coupling linkage can be cut to the desired width of coupling linkage 44.

[0061] Reference is now made to Fig. 4 which is a perspective view of a section of two elongate slats 20, 20' joined together by coupling linkage 44, constructed and operative in accordance with a preferred embodiment of the present invention. As shown, slats 20, 20' are in an open position, separated by the length of the body 45 of coupling linkage 44. The upper hooked head section 46 of coupling linkage 44 is located within lower cavity 30 of upper slat 20. Coupling linkage 44 is unable to escape through channel 38 and is held in place by claw 48 catching on major lip 40. Similarly, lower hooked head section 46' of coupling linkage 44 is located within upper cavity 26 of lower slat 20'. Coupling linkage 44 is unable to escape through upper channel 52 and is held in place by claw 48' catching on major lip 34.

[0062] Ridge 32 has been removed from sections of slat 20, thus forming an upper channel 52 defined by the upper major and minor lips 34, 36. The amount of ridge 32 removed from slat 20 depends upon the width of coupling linkage 44, and is sufficient to allow linkage 44 to fit into channel 52. The presence of ridge 32 adjacent to channel 52 restricts the movement of coupling linkage 44 lengthways along the slat, holding it in place, and provides added stability to the slats once joined.

[0063] In Fig. 4, ridge 32 has been removed to form channel 52 at the ends of slat 20, such that slats 20, 20' can be joined by coupling linkage 44 at their ends. Alternatively, or additionally, a section of ridge 32 can be removed from the middle of slat 20, forming channel 52 at the desired location for slats 20, 20' to be joined by coupling linkage 44.

[0064] In an alternative embodiment, upper channel 52 can initially extend the entire length of elongate slat 20. Once coupling linkage 44 has been placed at the correct location in upper channel 52 along slat 20, the regions of the upper channel 52 between the coupling linkages 44, or between a coupling linkage 44 and a lateral edge of the slat 20, can be filled by an insert placed in the channel 52.

[0065] Additionally once coupling linkages 44 have been placed at the correct location in lower channel 38, the regions of channel 38 between coupling linkages 44, or between a coupling linkage 44 and a lateral edge of the slat 20, can be filled by an insert placed in the channel 38.

[0066] Reference is now made to Fig. 5 which is a perspective view of a section of elongate slats 20, 20' joined together by coupling linkage 44, constructed and operative in accordance with a preferred embodiment of the present invention. As shown, slats 20 are in a snug-fitting contact, in which the air and light space between slats 20 and 20' is essentially eliminated, as described above with reference to Fig. 2. Coupling linkage is entirely contained within lower internal cavity 30 of upper slat 20, and upper internal cavity 26 of lower slat 20'

[0067] Reference is now made to Fig. 6 which is a perspective view of a section of elongate slat 20, with hooked head section 46 of coupling linkage 44 located within lower channel 38 of slat 20, showing angular movement of coupling linkage 44 with respect to slat 20, constructed and operative in accordance with a preferred embodiment of the present invention. In order to allow a slat assembly comprising a plurality of slats connected via linkages 44, to be rolled up, the coupling linkages must allow angular movement between the slats. As shown in Fig. 6, not only does claw portion 48 of hooked head 46 catch major lower lip 40, protruding tooth 50 catches minor lower lip 42, which prevents coupling linkage 44 escaping from within cavity 30 of slat 20 via channel 38, upon angular movement of coupling linkage 44 with respect to slat 20. The lower hooked head portion 46' of linkage 44 is preferably caught within upper cavity 26 of a lower slat 20' in a similar manner.

[0068] This degree of angular movement between the slats and the coupling linkages, and hence between adjacent slats, without the linkages uncoupling from the slats, allows a shutter to roll up into a tight roll, minimizing the space required above the aperture to store the rolled up shutter.

[0069] Reference is now made to Figs. 7-11 which are perspective views of a shutter assembly, ranging from a closed position to a partially open position, constructed and operative in accordance with a preferred embodiment of the present invention. As shown, a plurality of slats 20 are joined together by a plurality of coupling linkages 44 to form a shutter assembly 54, which is typically placed over an aperture 57. Also shown are winding device 55 and a pair of guiding side-rails 56. Side rails 56 are typically attached to the internal edges of aperture 57, and enclose the lateral edges of the slat assembly, and guide the movement of the slat assembly with respect to aperture 57. Winding device 55, overlying the plurality of elongate slats 20, winds and unwindes shutter assembly 54 to a fully-closed position, a fully-opened position, and partial opened position with respect to the aperture. Winding device may be an electric device powered for example by an electric motor, or may comprise a manual device such as a pull-cord, or may comprise any other means of opening and closing shutter assembly 54 as is known in the art.

[0070] Winding device 55 opens shutter assembly 54 with respect to aperture 57 by winding slats 20 into a roll above aperture 57. As each slat 20 is rolled upwards a gap is opened between adjacent slats, 20, from the uppermost downwards.

[0071] Fig. 7 illustrates the condition wherein shutter assembly 54 is in its fully-closed position, and each of slats 20) has been moved linearly towards its adjacent slats to completely close or restrict the light and air spaces, except for the topmost slat 20a which has just been started to be wound onto the drum of winding device 55 so as to create the space 58 between it and the next underlying slat 20b. Fig. 8 illustrates the condition wherein a number of slats 20 have been wound onto winding device 55 so that air and light spaces 58 have been created between the upper slats, but the lower slats are still fully closed. Fig. 10 illustrates the condition wherein a number of further slats have been wound upwards by winding device 55, thereby creating light and air spaces 58 between each slat 20 and its adjacent slats.

[0072] Fig. 11 illustrates the condition wherein the slat assembly 54 has been further wound upwards by the winding device 55 so that the lowermost slat 20 has been raised to partially open aperture 57, whereas the slats 20 still located within aperture 57 have been separated so as to create air and light spaces therebetween. It will be appreciated that further rotation of the winding device 55 to wind up the remaining slats within aperture 57 will completely open the aperture.

[0073] In Figure 9, the side-rails 56 are shown, for exemplary purposes, separated from the edges of the plurality of elongate slats 20.

[0074] Reference is now made to Fig. 12 which is a perspective view of two elongate slats 20, joined together by coupling linkage 44, with a side-sealing insert 59, constructed and operative in accordance with another preferred embodiment of the present invention. Insert 59 comprises an exterior plate 60 which is designed to seal the lateral edges of the elongate slats 20. The plug section of insert 59 is trifurcated into upper, central and lower plugs 63, 64, 65 that fit laterally within the upper, central and lower cavities 26, 28, 30 of slat 20, respectively.

[0075] Central plug 64 preferably is conical. Opposite central plug 64, the exterior plate 60 of insert 59 preferably contains a hole 61 for a screw 62. Once insert 59 has been fitted laterally into the lateral edge of slat 20, screwing of screw 62 into conical plug 64 causes an expansion of plug 64 within central cavity 28. This expansion forces the exterior of plug 64 tightly against the walls of cavity 28, which holds insert 59 firmly in place inside the lateral edge of slat 20.

[0076] It is appreciated that various features of the invention which are, for clarity, described in the contexts of separate embodiments may also be provided in combination in a single embodiment. Conversely, various features of the invention which are, for brevity, described in the context of a single embodiment may also be provided separately or in any suitable subcombination.

[0077] It will be appreciated by persons skilled in the

art that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention includes both combinations and subcombinations of various features-described herinabove as well as variations and modifications thereto which would occur to a person of skill in the art upon reading the above description and which are not in the prior art.

Claims

1. A shutter assembly for an aperture, comprising:

a plurality of adjacent elongate slats coupled together to form a slat assembly, said slats having: a lower edge; a lower channel along the lower edge, said lower channel being defined by at least one inwardly directed lower lip; an upper edge; and at least one upper channel along at least part of the upper edge, said upper channel each being defined by at least one inwardly directed upper lip; wherein said slats are coupled to an adjacent slat in the shutter assembly by at least two coupling linkages, said coupling linkages having upper and lower hooked heads; and wherein said inwardly directed lips and said hooked heads are mutually configured such that said upper hooked heads are captured within the lower channel of an adjacent slat by said at least one lower lip, and said lower hooked heads are captured within the at least one upper channel of an adjacent slat by said at least one upper lip.

2. A shutter assembly according to claim 1 wherein said at least one inwardly directed lower lip comprises two facing, inwardly directed lower lips.

3. A shutter assembly according to claim 2 wherein said two, facing, inwardly directed lower lips comprise a major lip and a minor lip.

4. A shutter assembly according to claim 3 wherein said upper hooked head comprises a claw that is captured within the lower channel of an adjacent slat by said major lower lip.

5. A shutter assembly according to claim 4 wherein said upper hooked head also comprises a tooth protruding subterminally from its outer curved edge, that is captured within the lower channel of an adjacent slat, by said minor lower lip, upon angular movement of the coupling linkage with respect to the adjacent slat.

6. A shutter assembly according to one or several claims 1 to 5 wherein said at least- one inwardly directed upper lip comprises two, facing, inwardly directed upper lips.

7. A shutter assembly according to claim 6 wherein said two, facing, inwardly directed upper lips comprise a major lip and a minor lip.

8. A shutter assembly according to claim 7 wherein said lower hooked head comprises a claw that is captured withinthe upper channel of an adjacent slat by said major upper lip.

9. A shutter assembly according to claim 8 wherein said lower hooked head also comprises a tooth protruding subterminally from its outer curved edge, that is captured within the upper channel of an adjacent slat, by said minor upper lip, upon angular movement of the coupling linkage with respect to the adjacent slat.

10. A shutter assembly according to one or several claims 1 to 9 wherein the length of the upper channels is substantially the same as the width of the coupling linkages.

11. A shutter assembly according to one or several claims 1 to 10 wherein said slats are coupled so as to permit:

a) linear movement towards and away from an adjacent slat in the slat assembly to vary a light and air space between adjacent slats; and
b) angular movement with respect to an adjacent slat in the slat assembly to enable the shutter assembly to be wound or unwound by a winding device.

12. A shutter assembly according to claim 11 wherein said linear movement towards an adjacent slat results in snug contact between the adjacent slats, thereby essentially eliminating the light and air space between said contacting adjacent slats, and wherein the coupling linkages are concealed within internal cavities of said contacting adjacent slats.

13. A shutter assembly according to claim 12 wherein the maximum height of the light and air space between adjacent slats is determined by the distance between the upper and lower hooked heads of the coupling linkages.

14. A shutter assembly according to one or several claims 1 to 13 wherein each of the at least two coupling linkages between a pair of adjacent slats are of the same height.

15. A shutter assembly according to one or several claims 1 to 14 wherein the height of the at least two

coupling linkages between a first pair of adjacent slats is not the same as the height of the at least two coupling linkages between a second pair of adjacent slats.

16. A shutter assembly iccording to one or several claims 1 to 15 wherein said at least two coupling linkages comprise three coupling linkages.

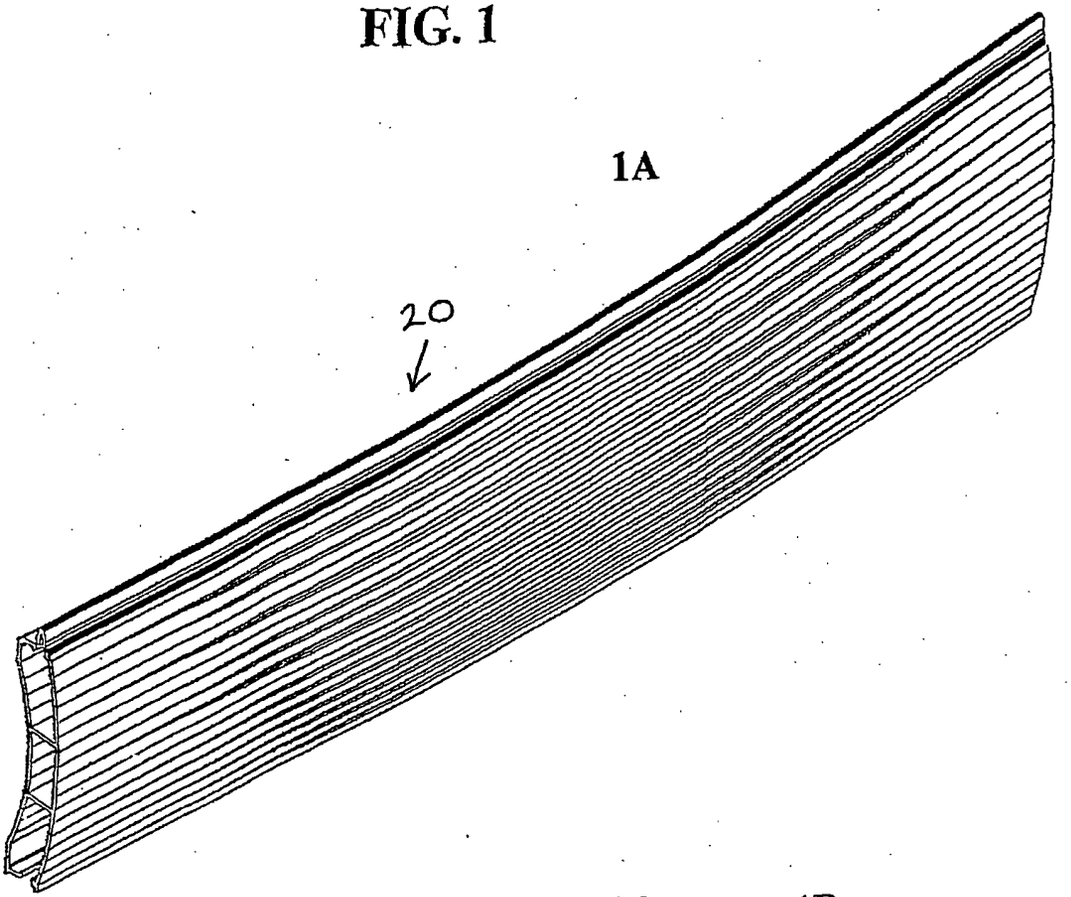
17. A shutter assembly according to one or several claims 1 to 16, and also comprising a pair of adjacent elongate slats coupled by a single coupling linkage extending the entire length of the elongate slats.

18. An insert for sealing the lateral end of an elongate slat, said insert comprising: an exterior plate; a plug, attached to the exterior plate, for insertion into a cavity at the lateral edge of the slat, such that said exterior plate covers said lateral edge, and a screw hole extending from the exterior plate within said plug, such that when a screw is wound through the exterior plate, into said screw hole within the plug, said plug expands within the cavity, thereby holding said plug in place within said cavity.

19. An insert according to claim 18, wherein said elongate slat comprises upper, central and lower internal cavities; and said insert comprises upper, central and lower plugs attached to the exterior plate, for insertion into the respective upper, central and lower cavities of the slat.

20. An insert according to claim 18 or 19, wherein said central plug is cone-shaped.

FIG. 1



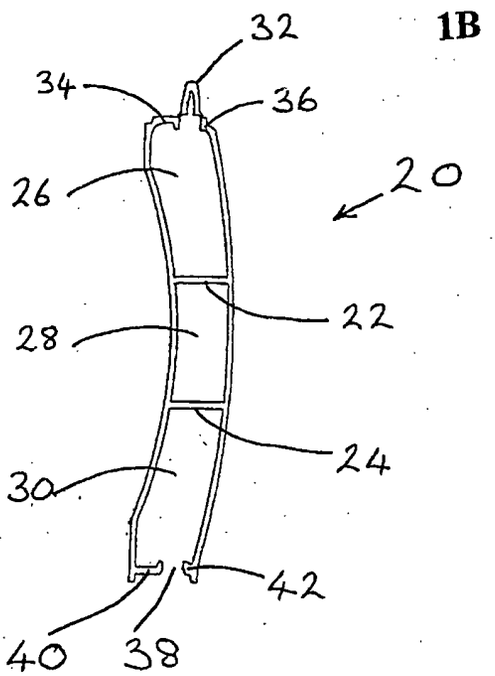


FIG. 2

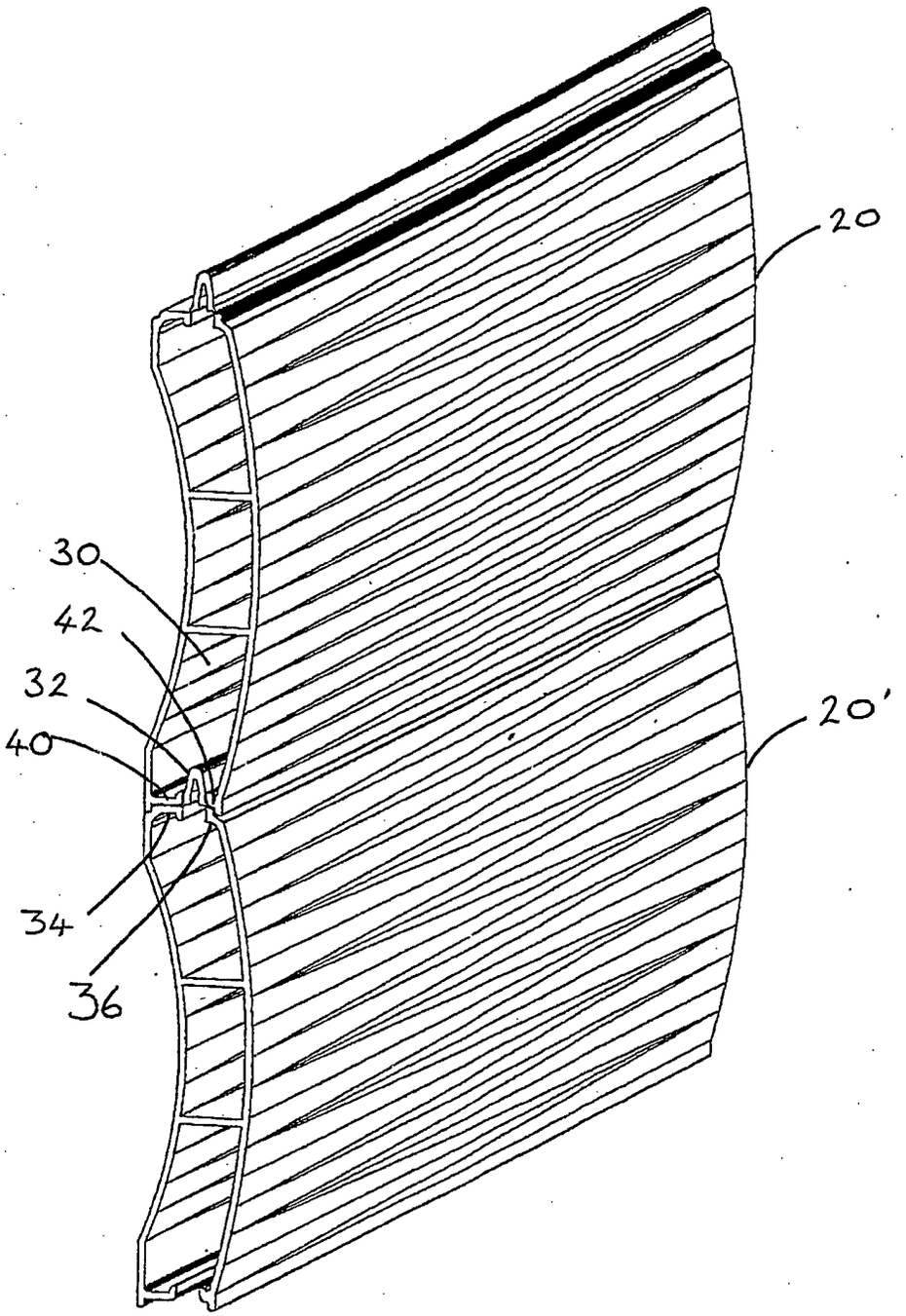
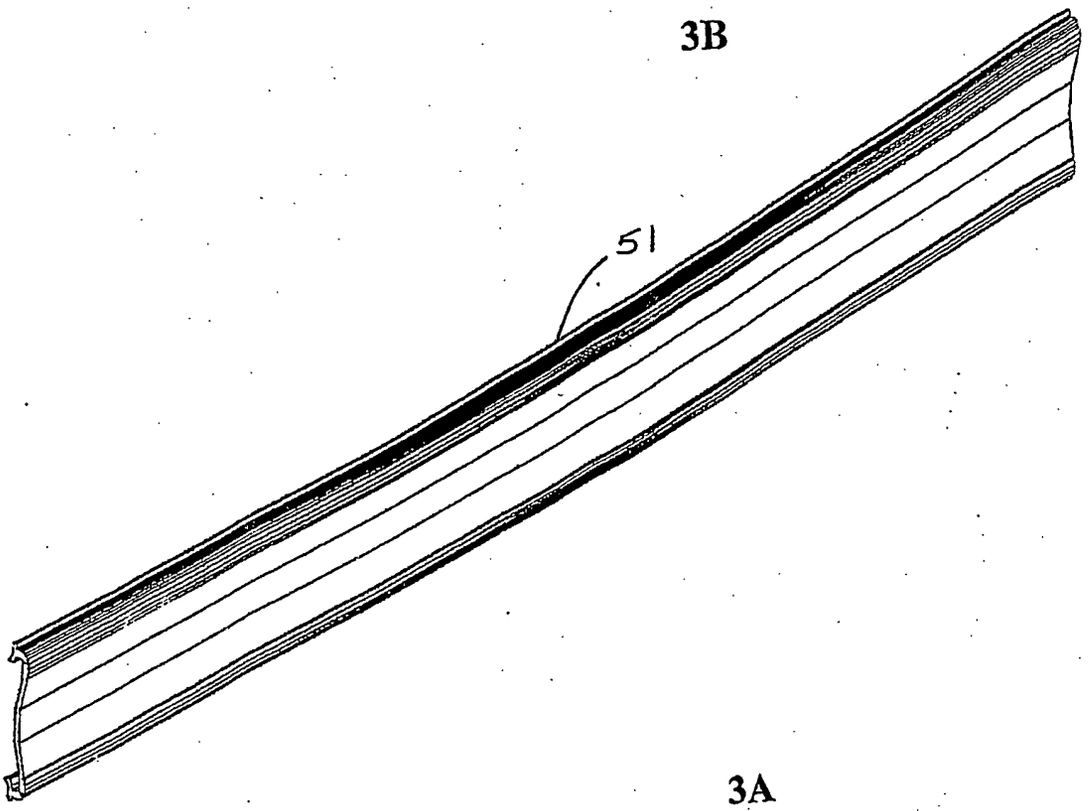


FIG. 3

3B



3A

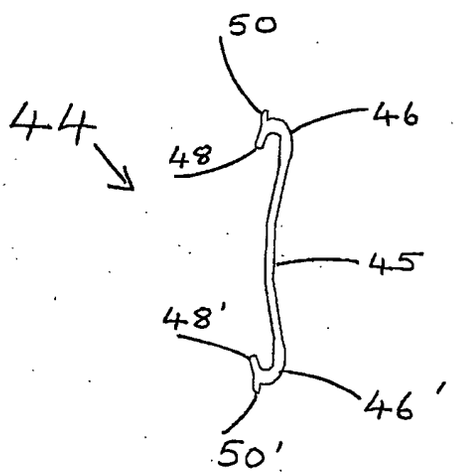


FIG. 4

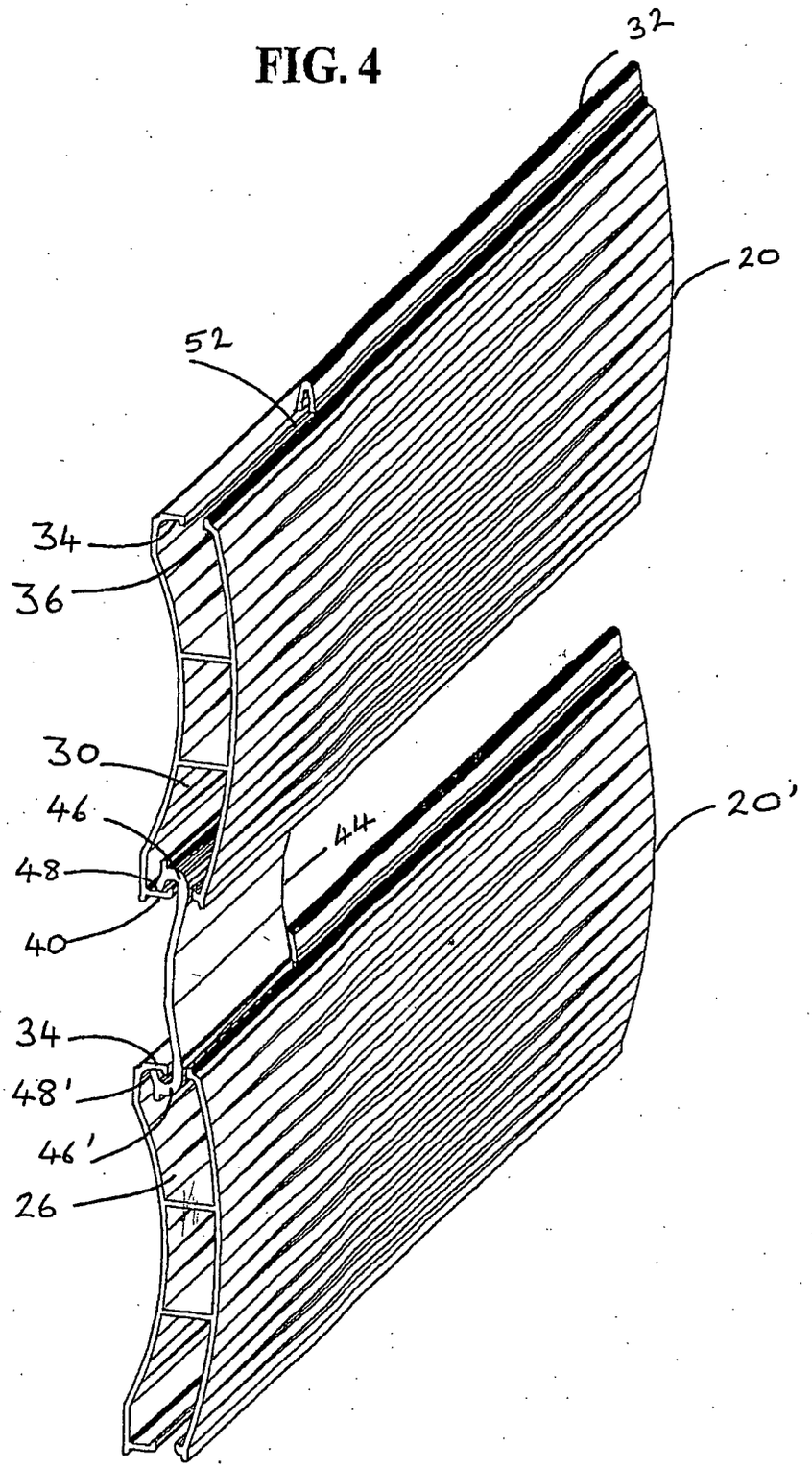


FIG. 5

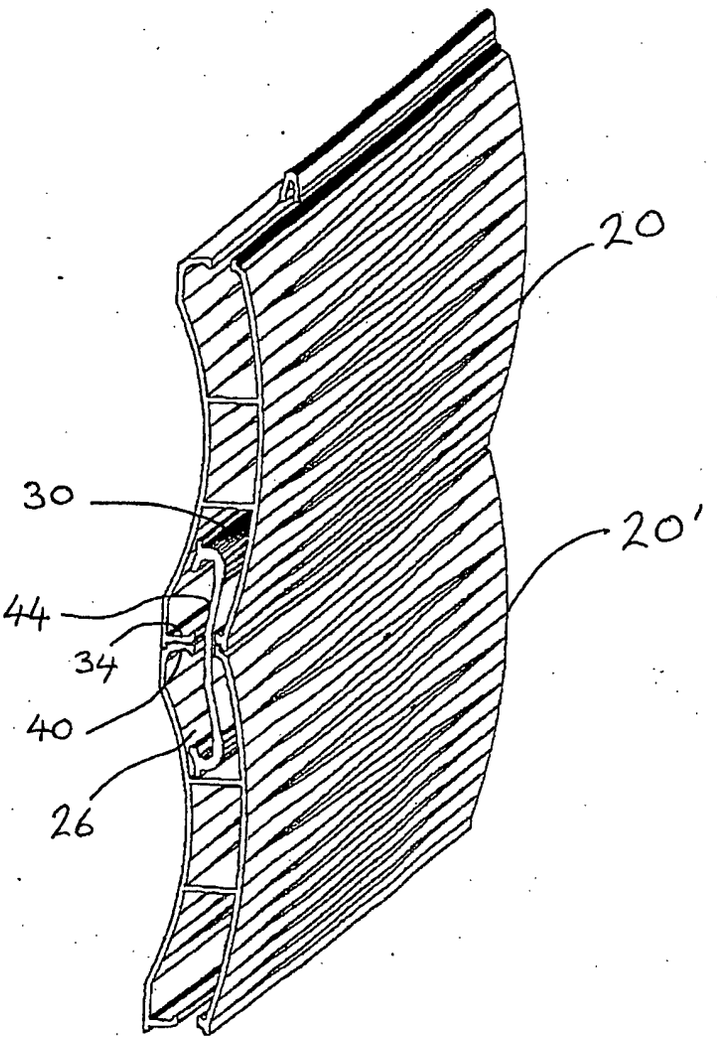


FIG. 6

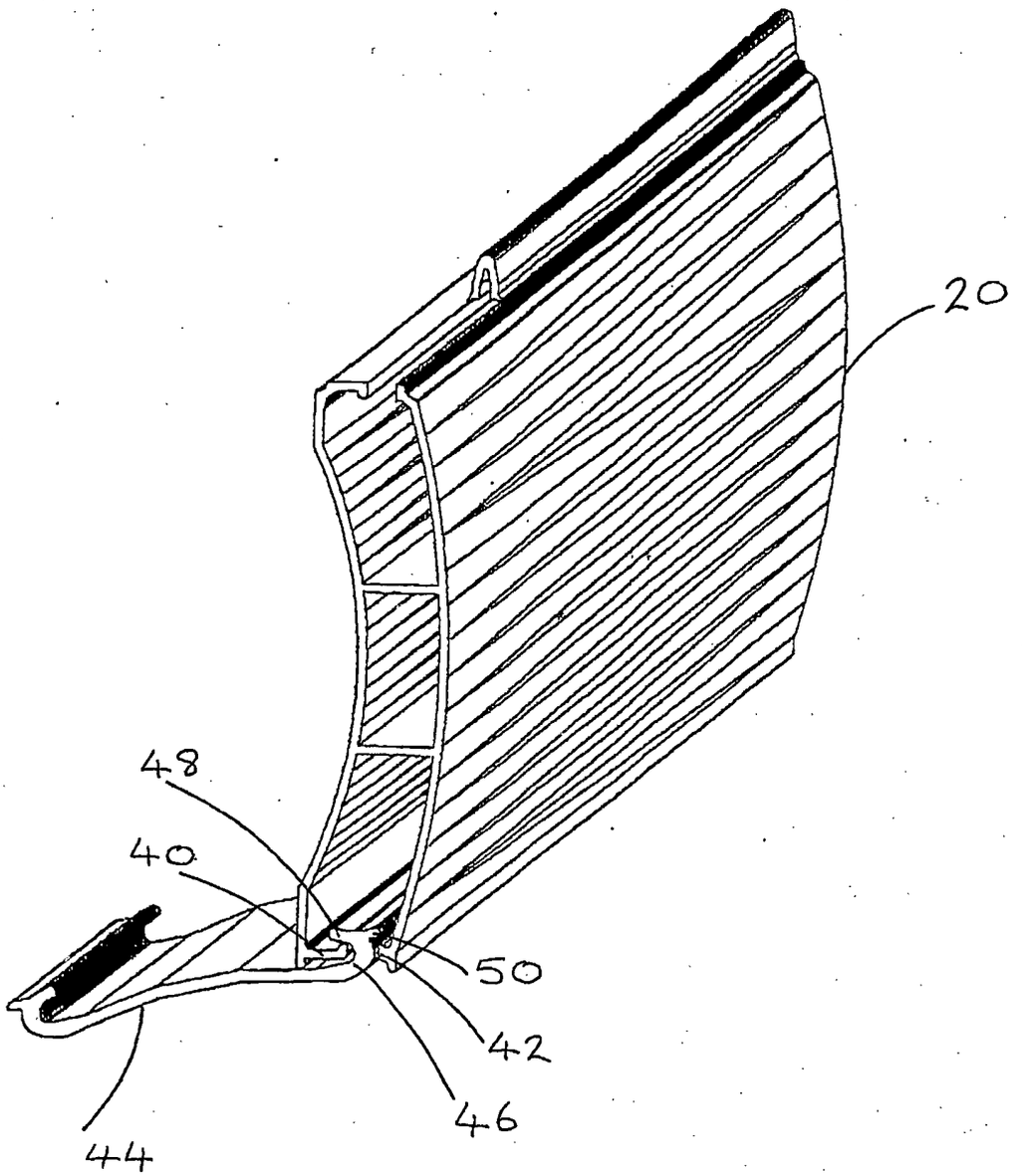


FIG. 7

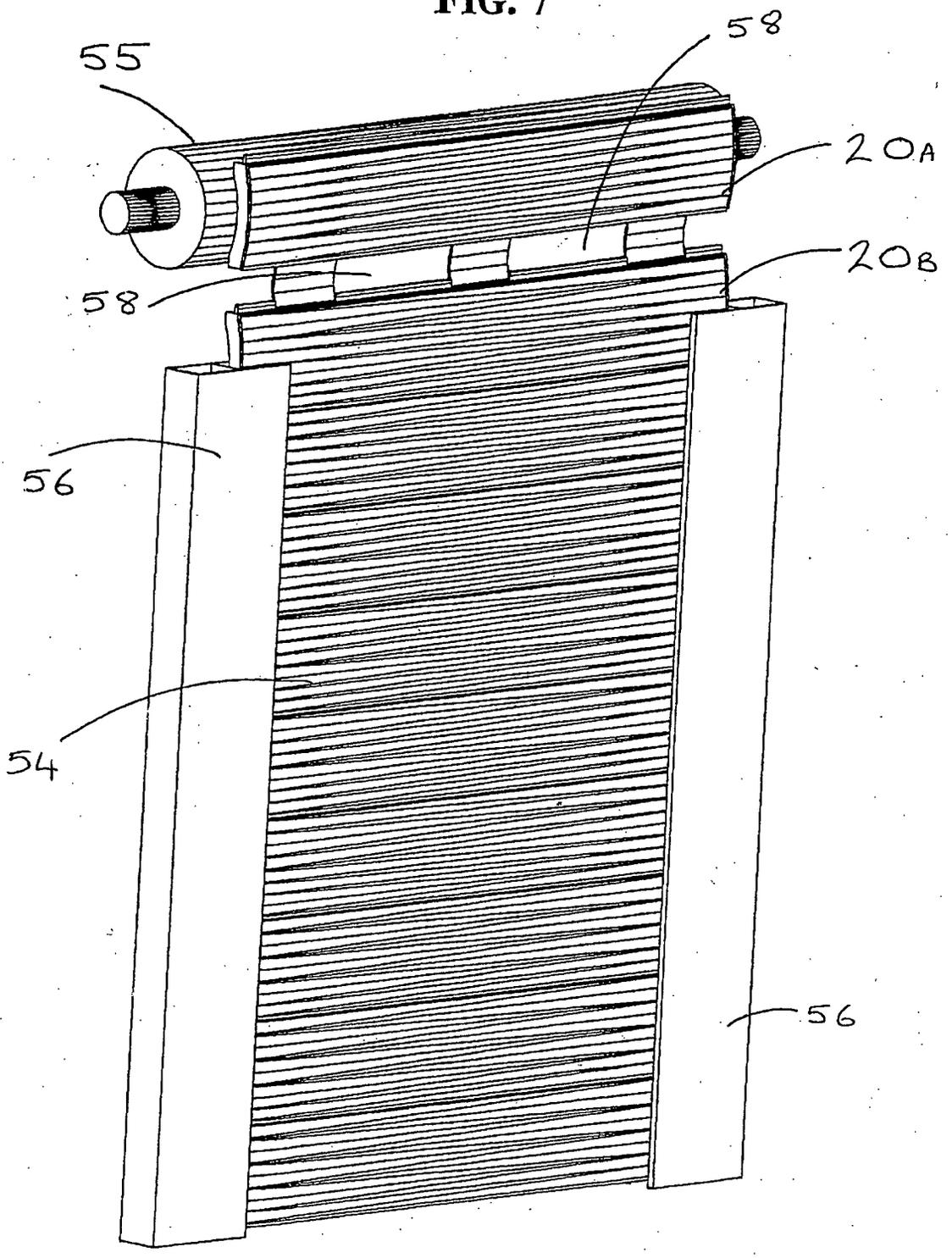


FIG. 8

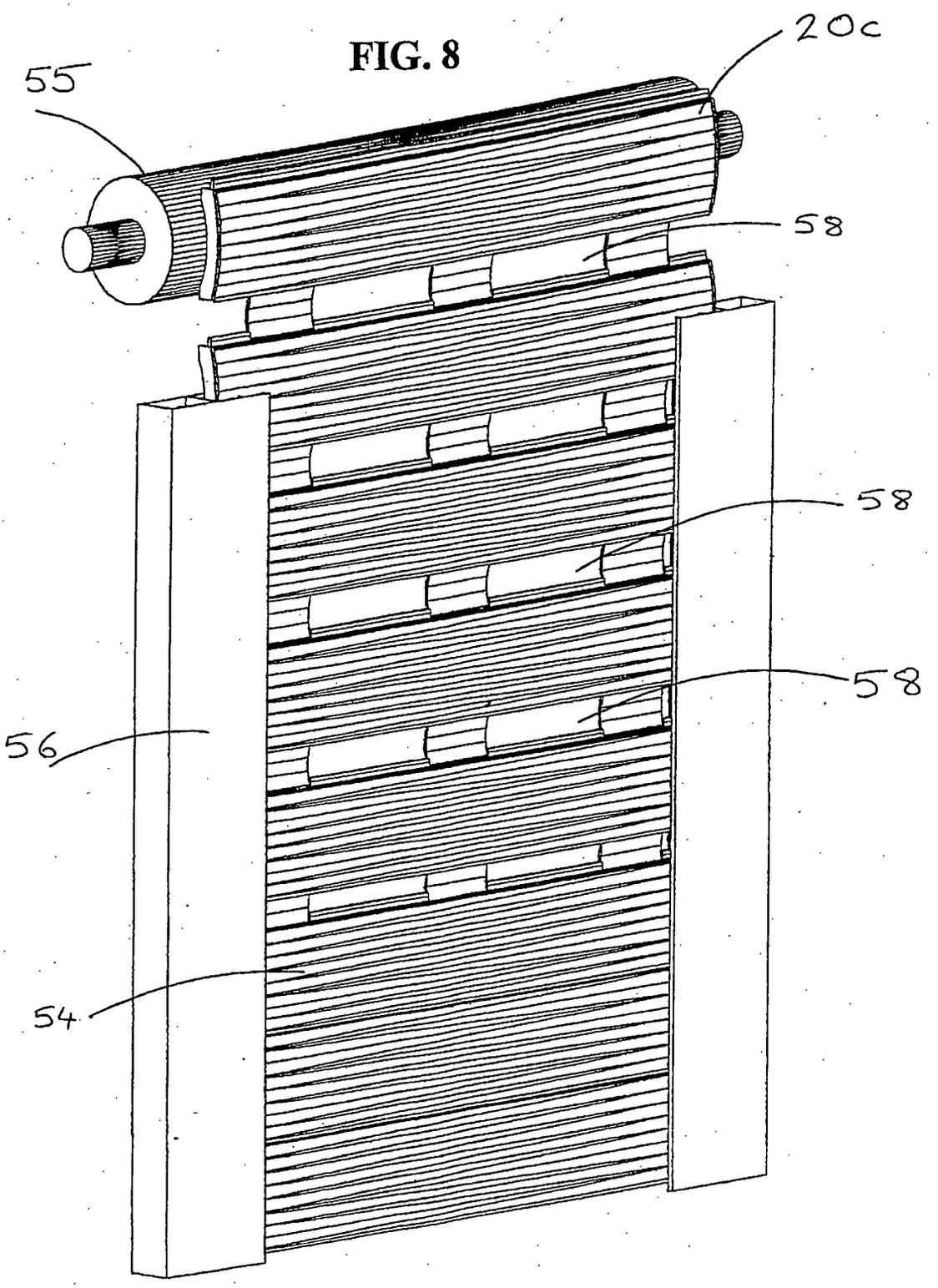


FIG. 9

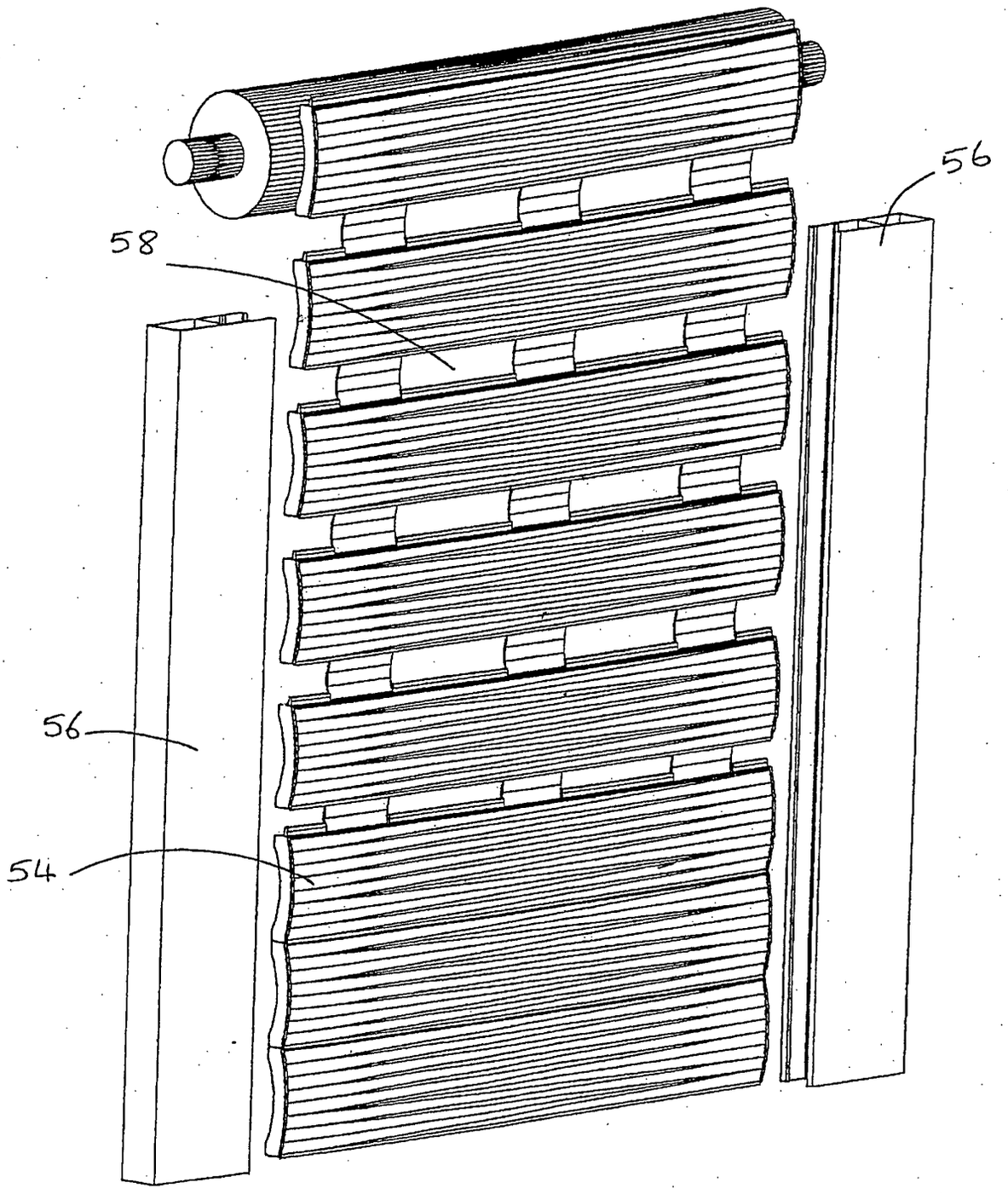


FIG. 10

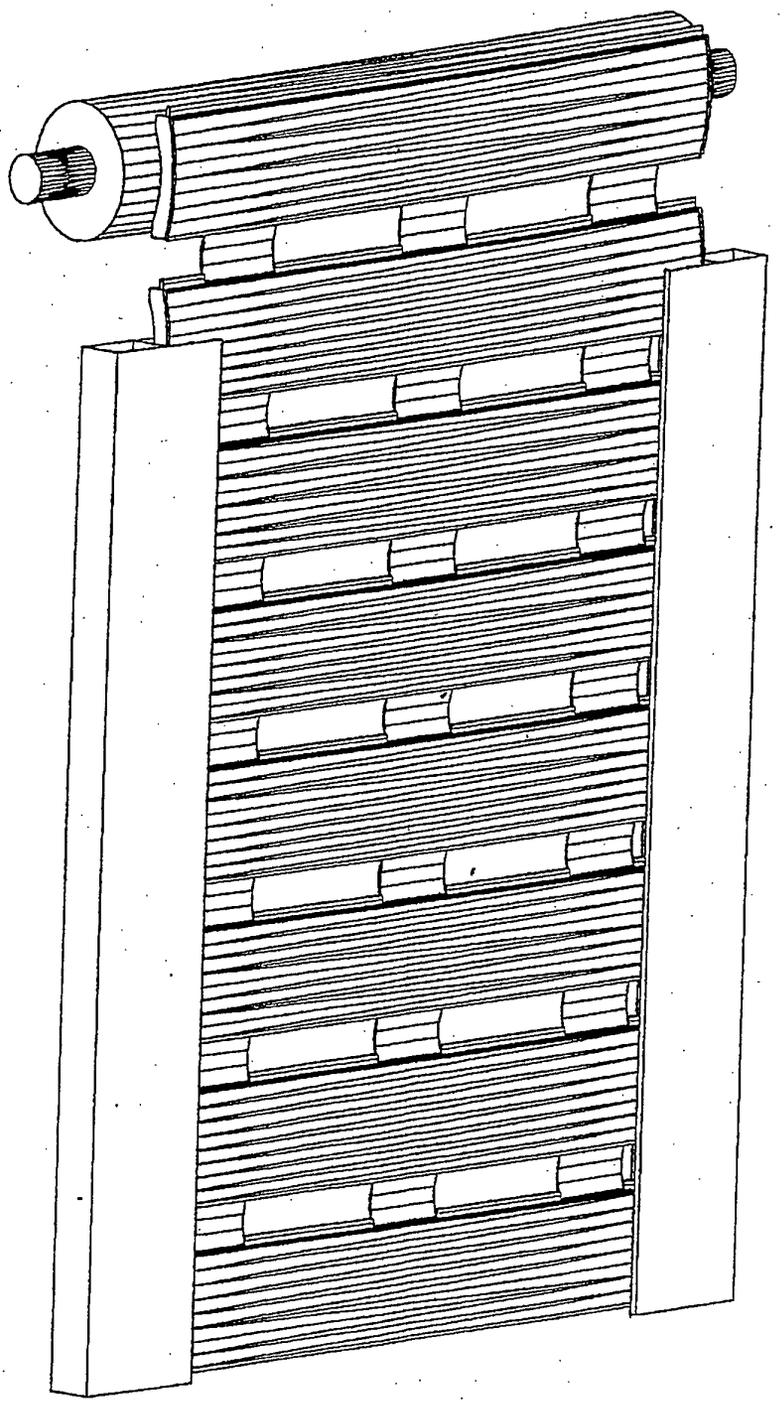


FIG. 11

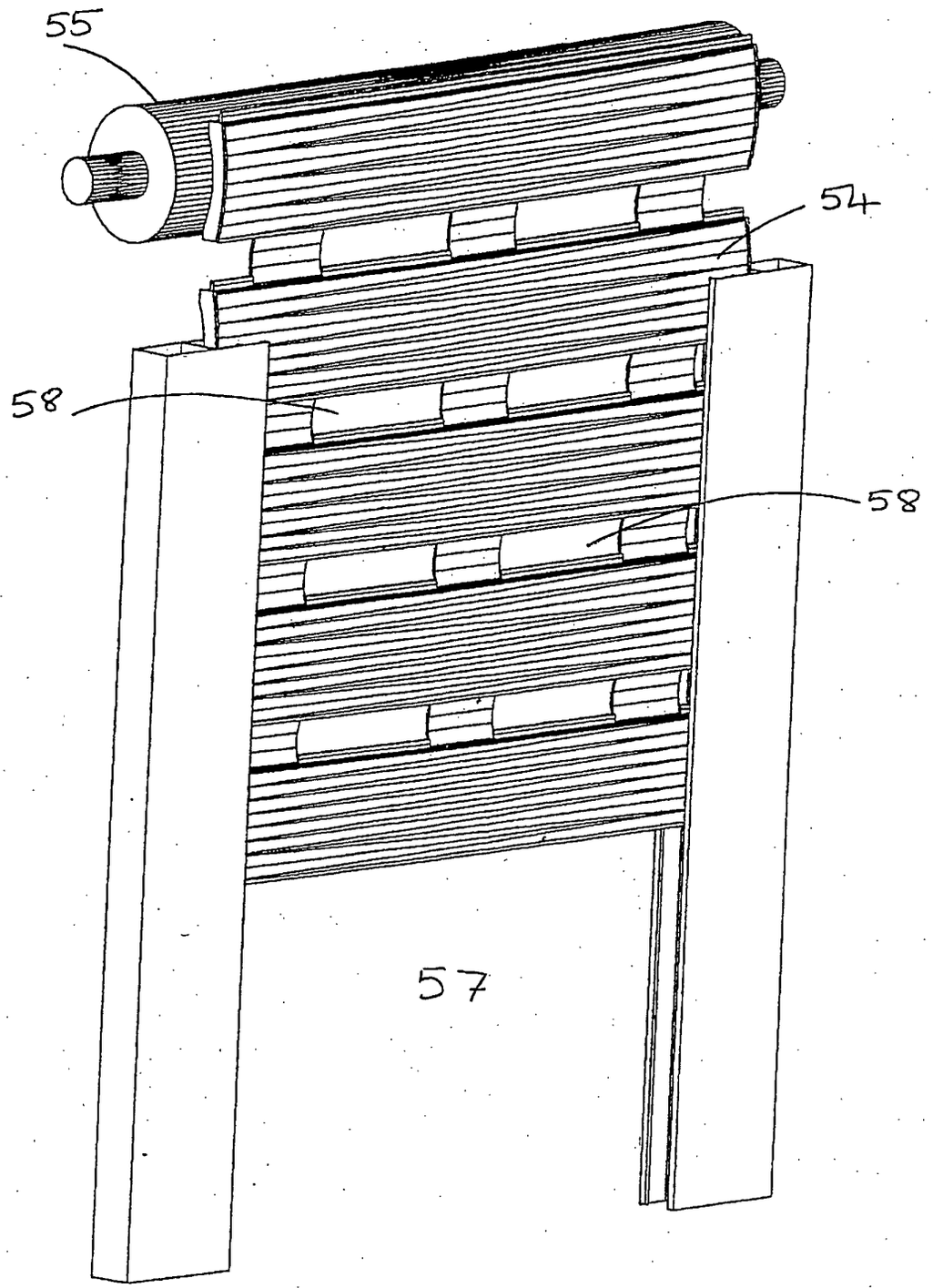


FIG. 12