

Claims

We claim:

1. A solar panel containing glass and aluminum frame, and rail containing steel, said solar panel having an upper surface terminating at opposed upper side edges, where are the frames, an underside groove with upper surface parallel to the upper side surface, and side edges terminating at said frame by inserting in a groove at the upper side of the said frame, or terminating at said frame by glued on to the upper side of the said frame. The under side of frame provided with coupling parts integrally formed with said frame. The upper side of rail provided with coupling parts integrally formed with said rail. Said coupling parts configured to cooperate by coupling with cooperative coupling parts of said frame of solar panel and rail, said coupling parts comprising a tongue and a groove configured to lock together coupled identical ones of said solar panel and identical ones of said rail in a direction perpendicular to the plane of the coupled panels when cooperative coupling parts of the solar panels and rails are engaged, said tongue and groove having respective upper and lower sides, and wherein the panel side edge provided with frame which with the groove has a locking element located outer edge and adjacent the upper side surface of the groove, and terminating at a distal upper lip edge, and a lower lip extending distally behind said distal upper lip edge in the plane of the solar panel; said coupling parts including locking elements formed integrally in one piece with said frame core, said locking elements including cooperative contact surfaces arranged to be engaged when said tongue of said rail are coupled together with their coupling parts cooperatively engaged to prevent substantial separation of coupled solar panel and rail at said edges in a direction perpendicular to the edges of the panel sides; said locking means comprising a locking element in the form of a downwardly extending protrusion located on the upper side of the groove, said cooperative contact surfaces defined respectively by said locking element, said upper surface of groove, said lower surface of groove, said other surface of groove. Upon coupling in a plane determined by the upper side of tongue in contact with the upper side surface of groove.
2. A coupling solar panel and rail according to claim 1, wherein the material of the frame, including the locking elements, is constituted of a metal material consisting of aluminum, is formed into the shape by extrusion.
3. A coupling solar panel and rail according to claim 1, wherein the material of the frame, including the locking

- elements, is constituted of a metal material consisting of steel, is formed into the shape by roll forming.
4. A coupling solar panel and rail according to claim 1, wherein the material of the frame, including the locking elements, is constituted of a composite material consisting of plastic, is formed into the shape by extrusion.
 5. A coupling solar panel and rail according to claim 1, wherein the material of the frame, including the locking elements, is constituted of a composite material consisting of Bakelite, is formed into the shape by milling.
 6. A coupling solar panel and rail according to claim 1, wherein the material of the rail, including the locking elements, is constituted of a metal material consisting of aluminum, is formed into the shape by extrusion.
 7. A coupling solar panel and rail according to claim 1, wherein the material of the rail, including the locking elements, is constituted of a metal material consisting of steel, is formed into the shape by roll forming.
 8. A coupling solar panel and rail according to claim 1, wherein the material of the rail, including the locking elements, is constituted of a composite material consisting of plastic, is formed into the shape by extrusion.
 9. A coupling solar panel and rail according to claim 1, wherein the material of the rail, including the locking elements, is constituted of a composite material consisting of Bakelite, is formed into the shape by milling.
 10. A coupling solar panel and rail according to claim 1, wherein the material of the frame of the solar panel and/or the material of rail comprises anodized aluminum selected from the group of surface anodizes.
 11. A coupling solar panel and rail according to claim 1, wherein the material of the frame of the solar panel and/or the material of rail comprises galvanized steel selected from the group of hot dipped galvanization.
 12. A coupling solar panel and rail according to claim 1, wherein the material of the frame of the solar panel and/or the material of rail comprises magni coated steel selected from the group of mangi spray and submerge coating.
 13. A coupling solar panel and rail according to claim 1, wherein the locking surface defined by the upper side of said tongue extends downwardly from the upper side of the tongue at an inclination that extends inwardly and downwardly from a proximally outer location to a distally inner location.
 14. A coupling solar panel and rail according to claim 1, wherein upper contact surface of groove is generally parallel to the plane of solar panel surface, so that they will apply minimum lateral strain on the frame of the other side and any connections in between when cooperative coupling parts of said locking means are coupled together with said contact surfaces located contiguous with each other.
 15. A coupling solar panel and rail according to claim 1, wherein the contact surface defined by said surfaces inside of said groove inwardly and parallel to solar panel surface from a under location of the said edge to a proximal location relative to the edge for glass engagement by groove or by glue.
 16. A coupling solar panel and rail according to claim 15, wherein said contact surface is substantially flat.
 17. A coupling solar panel and rail according to claim 1, wherein said coupling elements on two opposite edges of solar panel may be symmetric or may be asymmetric relative to each other.

18. A coupling solar panel and rail according to claim 1, wherein said coupling elements on two opposite side of rail may be symmetric or may be asymmetric relative to each other.
19. A coupling solar panel and rail according to claim 1, wherein said coupling element is under the engaged glass or glasses.
20. A coupling solar panel and rail according to claim 1, wherein said tongue may be on frame side.
21. A coupling solar panel and rail according to claim 1, wherein said tongue may be on rail side.
22. A coupling solar panel and rail according to claim 1, wherein said tongue has distance from upper side to lower side larger than distance from upper surface to lower surface of groove.
23. A coupling solar panel and rail according to claim 17, wherein at least one of the coupling parts comprises an elastically yieldable portion which, when tongue and groove of said solar panel and rail are coupled, is at least partially deformed within its elastic yield range to produce said tension force.
24. A coupling solar panel and rail according to claim 1, wherein said tongue has distance from outer side to edge of inner side less than distance from locking element to inner surface of groove.
25. A coupling solar panel and rail according to claim 1, wherein said tongue has a guiding surface downwardly angle similar to the angle of coupling locking element of said groove.
26. A coupling solar panel and rail according to claim 1, wherein said groove has a guiding surface on said outer side of locking element downwardly angle equal or similar to the angle of guiding surface of said coupling tongue.
27. A coupling solar panel and rail according to claim 1 wherein the tongue and groove have a shape such that in coupled condition of tongue and groove of said solar panel and rail there are provided chambers defined by a space between a lower surface of the downwardly guiding surface of said tongue and an adjacent upper surface of the groove, as well as by a space between a curvature of said tongue of a larger radius and lower inside corner of said groove with a smaller radius, said chambers being located on the tip side of said tongue and inner side of groove.
28. A coupling solar panel and rail according to claim 1, wherein the coupling parts are dimensioned to provide a coupling free-from-play in all panel/rail separation and/or drifting directions in a plane extending perpendicular to the said side edges when frame of said panel are coupled together with rail.
29. A coupling solar panel and rail according to claim 1, wherein coupled the tongue and groove are configured such that when said solar panel is coupled together with said rail, upon exertion of a pressure on top or on bottom of said coupled solar panel and rail react to the pressure to support the upper surface of groove when pressure from top, and react to press lower surface of groove when pressure from bottom, such as wind pressure.
30. A coupling solar panel and rail according to claims 1, wherein a space is provided between the tip of tongue of said rail and said inner surface of said coupling groove.

31. A coupling solar panel and rail according to claim 1, wherein at least the contact surface defined by the tip of said tongue comprises a circular surface.
32. A coupling solar panel and rail according to claim 1, wherein at least the contact lower surface of said groove defined by the tip of said tongue by the tip itself.
33. A coupling solar panel and rail according to claim 1, wherein said locking tongue and groove are configured and dimensioned such that when frames of two sides of said solar panel are coupled in the identical rail with their opposite upper side edges on the same plane of solar panel surface, said frames of opposite sides of solar panels exert minimum tension force upon each other tending to isolate movement and/or vibration upon each other, particularly in lateral direction.
34. A coupling solar panel and rail according to claim 33, wherein at least one of the coupling parts comprises an elastically yieldable portion which, when said panel and said rail are coupled, is at least partially deformed within its elastic yield range to produce said tension force.
35. A coupling solar panel and rail according to claim 34, wherein the elastically yieldable portion comprises at least said upper lip at an area thereof located on the proximal side of the contact surface portion, and wherein said upper lip is constituted solely of said frame material.
36. A coupling solar panel and rail according to claim 34, wherein the elastically yieldable portion includes the lower side of the groove.
37. A coupling solar panel and rail according to claim 1, wherein the coupling parts are configured such that frame of said solar panel and said rail can be selectively coupled either by laterally sliding and snapping the cooperative coupling parts together or by turning one relative to the other with their cooperative coupling parts partially engaged, whereby additional ones of said solar panel can be sequentially coupled to previously coupled rail, and additional ones of said rail can be sequentially coupled to previously coupled solar panel, by laterally sliding each additional panel into a previously coupled rail, and laterally sliding each additional rail into a previously coupled panel, or by relative turning motions of an additional one relative to the other.
38. A coupling solar panel and rail according to claim 1, wherein the coupling parts are configured such that frame of said solar panel and said rail can be coupled by sliding along the solar panel edge and engage the coupling parts together, whereby additional ones of said solar panel can be sequentially coupled to previously coupled rail, and additional ones of said rail can be sequentially coupled to previously coupled solar panel.
39. A coupling solar panel and rail according to claim 1, wherein the panel has a total width between its left upper side edge and its right upper side edge, and the distance between the left side edge of the panel to the right side edge of the panel is smaller than or equal to the total width of the solar panel.
40. A coupling solar panel and rail according to claim 1, wherein the total thickness of the solar panel is approximately

1 cm to 6 cm.

41. A coupling solar panel and rail according to claim 40, wherein the total thickness of the solar panel is at least 1 cm.
42. A coupling solar panel and rail according to claim 1, wherein the solar panel is elongated with said opposed pair of side edges located along its longer sides, and wherein said coupling parts of said frames extend along said side edges.
43. A coupling solar panel and rail according to claim 1, wherein the solar panel may selectively to include two opposed pairs of side edges, or only to include one pair of said edges, and said coupling parts extend in cooperative pairs along all four side edges, or along two said edges.
44. A coupling solar panel and rail according to claim 43, wherein the cooperative coupling parts of at least two opposed edges are configured and dimensioned such that said solar panel and said rail can be selectively coupled by shifting them laterally towards each other approximately in a plane including the panels and rail to engage their coupling parts or by a relative turning movement between the panel and rail with the coupling parts partially engaged, or sliding along the edge.
45. A coupling solar panel and rail according to claim 1, wherein a coupling tongue on the rail, points either downward and inward or upward and outward.
46. A coupling solar panel and rail according to claim 1, wherein a coupling tongue on the frame, points either upward and inward or downward and outward.
47. A coupling solar panel and rail according to claim 1, wherein the locking elements are snap type elements that are configured so as to snap together when cooperative locking elements of said panel and of said rail are coupled together.
48. A coupling solar panel and rail according to claim 1, wherein the tongue is downwardly flat.
49. A coupling solar panel and rail according to claim 1, wherein the lower side of the tongue of said rail is convexly curved, as by the circle at the tip of said tongue.
50. A coupling solar panel and rail according to claim 49, wherein said convexly curved tongue lower side has a uniform radius.
51. A coupling solar panel and rail according to claim 49, wherein said convexly curved tongue lower side has a uniform radius, extends along substantially the circle until point upward.
52. A coupling solar panel and rail according to claim 49, wherein said convexly curved lower side of the tongue is configured and dimensioned such that the tongue can be freely inserted into a complementary groove of said panel by turning one relative to the other about the upper edge of the panel in which the groove is located and while the cooperative coupling parts are partially engaged.
53. A coupling solar panel and rail according to claim 1, wherein an upper surface of the groove of said solar panel is

flat and is configured to define a guidance surface for guiding the coupling parts of the tongue of said rail into engagement with each other when said one of said solar panel is rotated relative to said rail with their coupling parts partially engaged.

54. A coupling solar panel and rail according to claim 1, wherein when one of said panel is coupled together with the cooperative locking surfaces coupled together, spaces defining dust chambers are provided between substantially all laterally opposed sides of the coupled solar panels and rails.
55. A coupling solar panel and rail according to claim 1, wherein the configuration of the tongue and the groove of by laterally moving the solar panel towards rail or by laterally moving rail towards solar panel in approximately a plane including the solar panels starting from positions at which the panel and rail are completely separated from each other.
56. A coupling solar panel and rail according to claim 55, wherein the upper side of the groove of said panel above the upper lip and the upper side of the tongue of said rail are arranged and configured such that the solar panel is guided towards cooperative engagement with the tongue when the panels are moved laterally towards each other and approximately upon first contact between said panel and said rail.
57. A coupling solar panel and rail according to claim 1, wherein the distal end of the lower lip of said tongue of said rail is provided with a sloped ramp surface, said ramp surface configured such that when the groove of said panel is moved laterally towards the tongue of said rail approximately in a plane including the panel and rail to cause engagement of cooperative coupling parts of the panels, the protrusion of said groove is guided over the distal outer end of the lower lip by said ramp as the groove traverses said distal outer end of the lower lip.
58. A coupling solar panel and rail according to claim 1, wherein one or both the said contact surfaces of said groove may have slop ranging from 0 to 45 degrees.
59. A coupling solar panel and rail according to claim 1, wherein said tongue upper side and said groove upper side define engaging abutment surfaces that contact each other when said panel and said rail are coupled together with a tongue of rail located in a cooperative groove of a panel, said surfaces extending parallel with a plane including the upper solar panel surface, and wherein said abutment surfaces are arranged to guide and maintain said upper side edges in alignment with each other so the upper solar panel surfaces are held in alignment.
60. A coupling solar panel and rail according to claim 1, wherein the lower lip of groove is less resistant to deformation than the upper lip.
61. A coupling solar panel and rail according to claim 1, wherein the upper lip has a chamfered lower edge.
62. A coupling solar panel and rail according to claim 1, wherein the lower lip has a chamfered upper edge.
63. A coupling solar panel and rail according to claim 1, wherein the contact surface of locking element of said groove of said solar panel is upwardly concave curved with each surface located on a radius centered at the respective

opposite lower corner of groove of said panel, said radii of said tongue and of said groove being from 0 to 4 mm different in length from each other.

64. A coupling solar panel and rail according to claim 1, wherein when said solar panel and said rail are coupled, said distance from further most tip of tongue to the inner surface of groove ranges from 0 mm to 8 mm.
65. A coupling solar panel and rail according to claim 1, wherein the lower lip of the tongue has a lower side located in the same plane as the underside of the groove and the upper lip of the tongue has an upper side that is located in the same plane as the upper surface of the groove.
66. A coupling solar panel and rail according to claim 1, wherein said tongue and groove are dimensioned and configured such that ones of said solar panel and said rail can be coupled together from a position where the cooperative coupling parts of the solar panel and rail are partially engaged by turning one relative to the other and vice versa, and with said turning movement centered at the lower corner of groove of said solar panels, and such that during the turning movement the tongue of said rail can freely slide into the groove of the said solar panel.
67. A coupling solar panel and rail according to claim 1, wherein the locking elements have rounded edges.
68. A coupling solar panel and rail according to claim 1, wherein the panel has a pair of opposed short sides and a pair of opposed longer sides and wherein the locking means are provided either on all four sides or on two opposed sides.
69. A coupling solar panel and rail according claim 1, wherein the tongue and the groove each have a profile susceptible to forming by extrusion.
70. A coupling solar panel and rail according claim 1, wherein the tongue and the groove each have a profile susceptible to forming by roll forming.
71. A coupling solar panel and rail according claim 1, wherein the tongue and the groove each have a profile susceptible to forming by milling.
72. A coupling solar panel and rail according claim 1, wherein the solar panel glass is selectively inserted in a groove located at the upper side of frame or glued on an upper surface of said frame. The groove for glass insertion is located at upper side of frame wherein the groove for coupling with rail is located at lower side of frame.
73. A coupling solar panel and rail according claim 1, wherein the solar panel has either single glass or double glasses.
74. A coupling solar panel and rail according to claim 1, wherein the frame of said solar panel is surface treated, and said surface treatment include galvanization, plating, painting, anodizing, spraying.
75. A coupling solar panel and rail according to claim 1, wherein the said rail is surface treated, and said surface treatment include galvanization, plating, painting, anodizing, spraying.
76. A coupling solar panel and rail according to claim 1, wherein the coupling parts are configured so that the panel

can be coupled to rail with their cooperative coupling parts engaged and locked against lateral and vertical separation without glue or bolt, whereby the panel and rail can be freely disassembled and recoupled.

77. A coupling solar panel and rail according to claim 1, wherein the said solar panel composed of frame and glass, wherein either the solar cells are attached on the glass or manufactured on the glass.
78. A coupling solar panel and rail according to claim 77, wherein the said solar cells attached or grown on glass include crystal solar cells and thin film solar cells.
79. A coupling solar panel and rail according to claim 78, wherein the said crystal solar cells attached on glass include crystal silicon solar cells, compound solar cells and perovskite solar cells.
80. A coupling solar panel and rail according to claim 78, wherein the said thin film solar cells grown on glass include thin film silicon solar cells, thin film TdCe solar cells, thin film GaAs solar cells.