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Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 2704489 C 2018/02/27

(11)(21) 2 704 489

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2010/05/13

(41) Mise à la disp. pub./Open to Public Insp.: 2010/11/13

(45) Date de délivrance/Issue Date: 2018/02/27

(30) Priorité/Priority: 2009/05/13 (US61/178029)

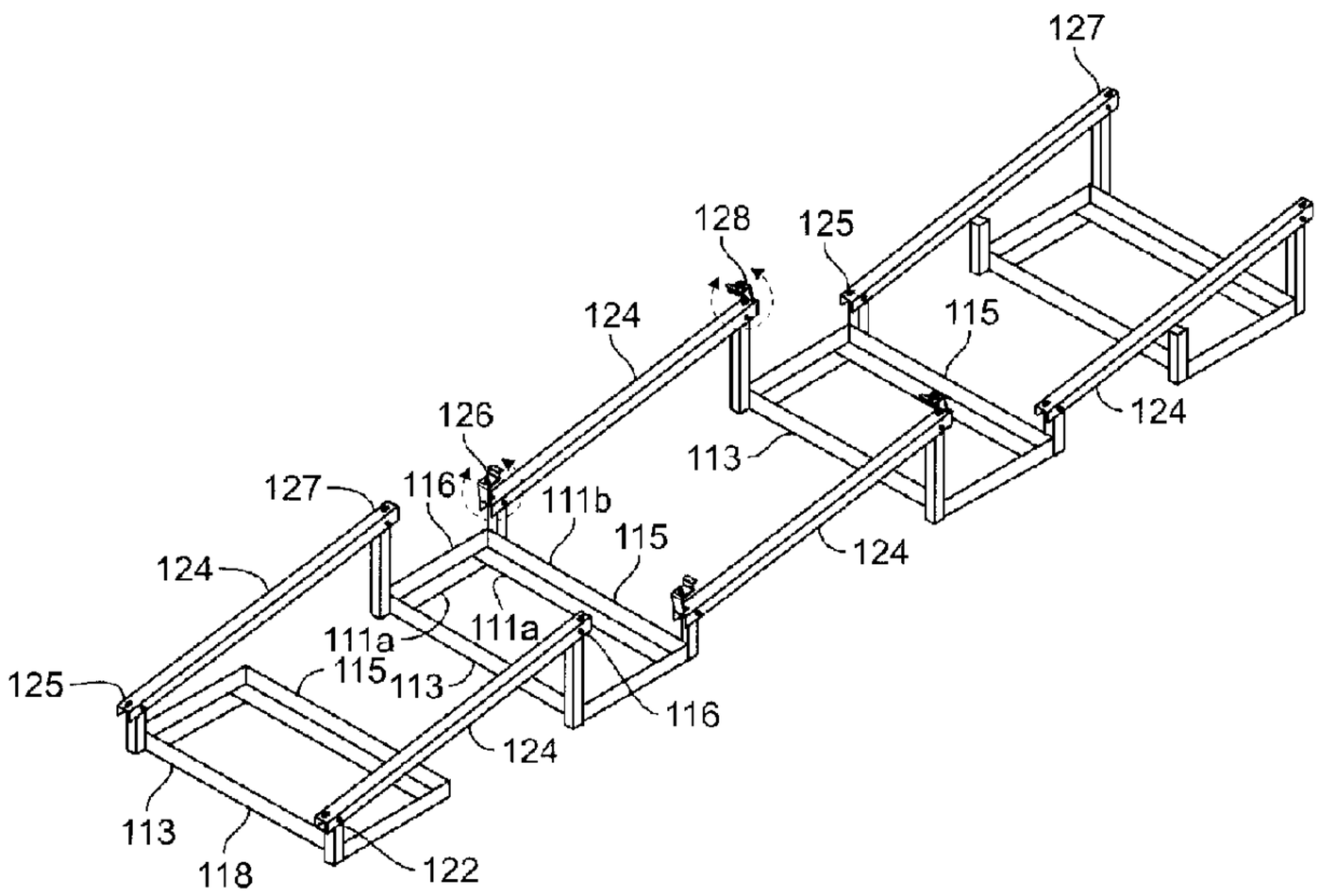
(51) Cl.Int./Int.Cl. *F16M 11/00* (2006.01), *F03G 6/00* (2006.01), *F16M 1/00* (2006.01)

(72) Inventeur/Inventor:
RIZZO, NATHAN, US

(73) Propriétaire/Owner:
DYNORAXX, INC., US

(74) Agent: BLANEY MCMURTRY LLP

(54) Titre : ASSEMBLAGE DE PANNEAUX SOLAIRES
(54) Title: SOLAR PANEL ASSEMBLY



(57) Abrégé/Abstract:
The present invention is a ballasted solar panel mounting system primarily for mounting solar panels to a roof. The mounting system reduces waste space by positioning the first and/or the last row of bases beneath the panel. This potentially provides room for an additional row of panels and generation of a greater amount of electricity per square foot of area. Additionally, the mounting system uses bases with upwardly extending posts that are integrally connected to the bases that support ballasts. Thus, all assemblies that require attaching one part of the system to another is done at an elevated level to reduce the amount of bending required by the installers. Moreover, the unique system for installing solar panels can be installed without a jig. In some instances, it can be installed with only a single reference line (e.g., chalk line). Additionally, the bases are configured to be stackable for inexpensive storage and distribution.

Abstract

The present invention is a ballasted solar panel mounting system primarily for mounting solar panels to a roof. The mounting system reduces waste space by positioning the first and/or the last row of bases beneath the panel. This potentially provides room for an additional row of panels and generation of a greater amount of electricity per square foot of area. Additionally, the mounting system uses bases with upwardly extending posts that are integrally connected to the bases that support ballasts. Thus, all assemblies that require attaching one part of the system to another is done at an elevated level to reduce the amount of bending required by the installers. Moreover, the unique system for installing solar panels can be installed without a jig. In some instances, it can be installed with only a single reference line (e.g., chalk line). Additionally, the bases are configured to be stackable for inexpensive storage and distribution.

SOLAR PANEL ASSEMBLY

Background of the Invention

Field of the Invention

[0001] This invention relates to systems for mounting solar panels and more particularly to a system for mounting photovoltaic panels.

Discussion of the Related Art

[0002] Solar energy provides the opportunity to generate electricity without consumption of fossil fuels and is considered clean technology. In recent years, the development of technology for solar thermal systems and photovoltaic systems has improved the overall viability of solar energy. Thus, the demand for solar energy has increased.

[0003] Efficiency of solar panel systems can be improved by effective installation. The direction of the solar panels relative to the sun, the angle of the solar panels relative to the horizon, the density of solar panels in a given area, as well as position of solar panels relative to other panels can have a positive or negative effect on performance of the solar powered system. Such considerations are of great importance when assembling a solar panel system on a flat roof with limited area. The ability to assemble with one additional row of solar panels without causing overlap of the solar panels in sunlight or compromising optimal positioning would be a great advantage. Moreover, it would be advantageous if panels and their support structures could be assembled to provide easy installation, reduced shipping cost and function effectively.

[0004] The present invention addresses these and other needs.

Summary of the Invention

[0005] The present invention is a ballasted solar panel mounting system primarily for mounting solar panels to a roof. The mounting system reduces waste space by positioning the first and/or the last row of bases beneath the panel. This potentially provides room for an additional row of panels and generation of a greater amount of electricity per square foot of area. Additionally, the mounting system uses bases with upwardly extending posts that are integrally connected to the bases that support ballasts. Thus, all assemblies that require attaching one part of the system to another is done at an elevated level to reduce the amount of bending required by the installers. Moreover, the unique system for installing solar panels can be installed without a

jig. In some instances, it can be installed with only a single reference line (e.g., chalk line). Additionally, the bases are configured to be stackable for inexpensive storage and distribution.

[0006] The solar panel mounting system of one embodiment comprises a first row of a plurality of generally horizontal first bases, a second row of a plurality of generally horizontal second bases, and a third row of a plurality of generally horizontal third bases. Each of the first bases, second bases and third bases have a short pair of upwardly extending posts affixed to one side of the base and a long pair of upwardly extending posts affixed to the other side. Each of the first bases, second bases and third bases are generally configured to be stacked on top of other of the first bases, second bases and third bases. When stacked, each of the bases abuts against the other of the bases and fit between the posts of the other of the bases. The respective short pair of posts and the long pair posts of each of the bases fit offset from and adjacent to the respective short pair and long pair of the other of the bases.

[0007] One row of frames is supportably affixed to solar panels. The first row of frames have a front side and a back side, wherein the front side of the one row of frames is affixed to and supported by the short pair of posts of the first row of a plurality of generally horizontal first bases. Furthermore, the back side of the one row of frames is affixed to and supported by the long pairs of the second row of second bases. Additionally, a back row of frames are supportably affixed to solar panels. The back row of frames have a front side and a back side, wherein the front side of the back row of frames is affixed to and supported by the short pair of posts of the second row of a plurality of generally horizontal second bases. Furthermore, the back side of the back row of frames is affixed to and supported by the long pair of posts of the third row of a plurality of generally horizontal second bases. The third base is positioned directly beneath the back row of frames.

[0008] In one embodiment, the present invention includes a solar panel mounting system. The solar panel mounting system includes a front base comprising a bottom surface and a top surface. The top surface receives ballast onto the surface to anchor the base without the need to fasten the base to the floor surface. The floor surface is defined as any surface that supports the solar panel mounting system. In one embodiment, the floor surface is a flat roof. The front base of the system of one embodiment further comprises an upwardly extending first pair of posts

integrally affixed to one side of the front base. By front, it is meant the base that is placed at the front of multiple rows of bases.

[0009] The system includes at least one middle base comprising a bottom surface and a top surface. The top surface receives a ballast. At least one middle base means that there can be a plurality of successive bases in the system or a plurality of rows of bases, where applicable. The number of rows is often determined by the area designated for installation with the objective to have as many rows of solar panels in the designated area. Thus, the invention is in no way limited to one, two or any number of middle bases or rows of middle bases, where applicable. The at least one middle base further comprises an upwardly extending first pair of posts integrally affixed to one side of the at least one middle base and upwardly extending second pair of posts integrally affixed to the other side opposite said one side of the at least one middle base. The system includes a back base that comprises a bottom surface and a top surface. The top surface receives a ballast. The back base further has an upwardly extending second pair posts integrally affixed to one side of the back base. Each of the second pair of posts of the at least one middle base and the back base are longer than each of the first pair of posts of the front base and the back base by a predetermined distance.

[0010] The system of one embodiment further includes a first pair of support bars. The first pair of support bars is of a predetermined length and is attached at a first end location to a top end of the first pair of posts of the front base and attached at a second end location to a top end of the second pair of posts of the at least one middle base. In one embodiment, the support bars are integrally attached which means that they are attached by a permanent means such as welding riveting or affixing with a bolt or similar fastener provided that the bolt or similar fastener cannot be removed without cutting or altering or irreversibly damaging the general physical shape of bolt or fastener. The system also includes a second pair of support bars of said predetermined length attached at a first end location to a top end of the first pair of posts of the at least one middle base and attached at a second end location to a top end of the second pair of posts of the back base. The predetermined length and the predetermined distance are selected to position the rails at a predetermined angle.

[0011] In one embodiment, the at least one middle base comprises two or more middle bases. The first pair of support bars is attached to a top end of the second pair of posts of the two

or more middle bases and the second pair of support bars is attached to a top end of a first pair of posts of the two or more middle bases.

[0012] In the system of one embodiment, each of the bottom surfaces engages a floor surface.

[0013] In the system of another embodiment, the predetermined angle is a minimum of about 10 degrees from horizontal and a maximum of about 20 degrees from horizontal.

[0014] In the system of yet another embodiment, the distance between the first pair of posts and the second pair of posts is larger than the width of the front base, middle base and back base.

[0015] Optionally, at least one support bar of the first pair of support bars and at least one support bar of the second pair of support bars support a first solar panel and a second solar panel respectively.

[0016] Typically, the at least one support bar of the first pair of support bars comprises at least one fastener to fasten the first solar panel and the at least one support bar of the second pair of support bars comprises at least one fastener to fasten the second solar panel.

[0017] In one embodiment, each of the front base, the at least one middle base and back base comprises a generally vertical perimeter wall surrounding the top surface of the each said base, wherein the top surface and the perimeter wall define a receptacle into which the ballast is received.

[0018] The first pair of posts of each of the front base and the at least one middle base and the second pair of posts of each of the back base and the at least one middle base are attached to the outer perimeter in one embodiment.

[0019] Each of the front base, the at least one middle base and the back base comprises at least one orifice configured to drain water from the respective front base, the at least one middle base and the back base in another embodiment.

[0020] The system or kit does not require fastening a part of the system to another part that is generally below the top end of the first pair of posts of the front base and the at least one middle base.

[0021] In another embodiment, the bottom surface comprises a tread surface that elevates the base and engages a floor surface. The tread surface resists slipping against the floor compared to a material from which the base is generally made. Generally, the base is made of

steel including galvanized steel, stainless steel or steel that is coated with a paint coating such as powder coating paint.

[0022] In one embodiment, the first pair of support bars and second pair of support bars are U-shaped and receive the first pair of posts and the second pair of posts into the U-shaped channel.

[0023] In another embodiment, the front base is placed directly under the first pair of support bars and the back base is directly under the second pair of support bars.

[0024] In another embodiment there is a ballasted solar panel mounting kit. The kit comprises a front base having a bottom surface and a top surface. The top surface is configured to receive a ballast. The front base further comprises an upwardly extending first pair of posts integrally affixed to one side of the front base. The at least one middle base comprising a bottom surface and a top surface. The top surface is configured to receive a ballast wherein the at least one middle base further comprises an upwardly extending first pair of posts integrally affixed to one side of the at least one middle base and upwardly extending second pair of posts integrally affixed to the other side opposite said one side of the at least one middle base.

[0025] The system of one embodiment further has a back base comprising a bottom surface and a top surface, wherein the top surface is configured to receive a ballast, wherein the back base further has an upwardly extending second pair posts integrally affixed to one side of the back base, wherein each of the second pair of posts of the at lease one middle base and the back base are longer than each of the first pair of posts of the front base and the at least one middle base by a predetermined distance.

[0026] In the system of one embodiment, a first pair of support bars of a predetermined length is configured to be attached at a first end location of the first pair of support bars to a top end of the first pair of posts of the front base and attached at a second end location of the first pair of support bars to a top end of the second pair of posts of the at least one middle base. A second pair of support bars of said predetermined length is configured to be attached at a first end location of the second pair of support bars to a top end of the first pair of posts of the at least one middle base and attached at a second end location of the second pair of support bars to a top end of the second pair of posts of the back base. The predetermined length and the predetermined distance are selected to position the rails at a predetermined angle.

[0027] In one embodiment, the at least one middle base comprises two or more middle bases that are configured be attached to the first support bar at a top end of a second pair of posts of the two or more middle bases and further is configured to be attached to the second support bar at a top end of a first pair of posts of the two or more middle bases.

[0028] In another embodiment, the bottom surface is configured to engage a floor surface.

[0029] In still another embodiment, at least one of the first pair of support bars is configured to support a first solar panel and at least one of the second pair of support bars is configured to support a second solar panel respectively.

[0030] In yet another embodiment, each of the front base, the at least one middle base and the back base comprises at least one orifice configured to drain water from the base.

[0031] In one embodiment, the first support bars and second support bars are U-shaped and are configured to receive the first pair of posts and the second pair of posts into the U-shaped channel.

[0032] In another embodiment, the kit further comprises assembly instructions to place the front base beneath the first support bars and the back base beneath the second support bars.

[0033] In still another embodiment, the one or more middle bases comprise at least a first middle base and a second middle base. The first middle base is generally configured to be stacked on the second middle base such that the second middle base fits between the respective first pair of posts and second pair of posts of the first middle base and the first pair of posts and the second pair of posts of the second middle base abut against the respective first pair of posts and the second pair of posts of the first middle base before the kit is assembled or when the kit is not assembled.

[0034] In one embodiment, there is a method of mounting solar panels on a roof. The method comprises the step of providing a reference line. A first row of bases having an upwardly extending first pair of posts is provided. The first row of bases is spaced apart along the reference line.

[0035] The method additionally comprises attaching first support bars to a top ends of the first pair of posts of the first row of bases. The first support bars are attached to a first location on the support bars. At least one middle row of bases is provided. The at least one middle row has upwardly extending first pair of posts on one side of the bases of the at least one middle row

and upwardly extending second pair of posts on the other side of the bases of the at least one middle row opposite said one side. The first support bars is attached to the bases of the at least one middle row at a second location on the support bar at a top end of the second pair of posts of the bases of the at least one middle row. The first row of support bars are supported at a predetermined angle and the at least one middle row of bases are positioned without a jig or without additional measurement. The method further comprises attaching a front row of solar panels to the first row of support bars. An additional step of providing a back row of bases having upwardly extending second pair of posts on the other side of the bases of the back row opposite said one side is also part of the present invention. Second support bars are attached to the bases of the at least one middle row and the bases of the back row, wherein the bases of the at least one middle row are attached to the support bar at a first location on the support bar at a top end of the first pair of posts of the bases of the at least one middle row and the bases of the at least one back row are attached to the support bar at a second location along the support bar to a top end of the second pair of posts of the bases of the at least one middle row. The method also includes attaching a back row of solar panels to the second row of support bars.

[0036] Typically, the front row of ballasts is positioned beneath the front row of solar panels of the method of one invention. Generally, the back row of ballasts is positioned beneath the back row of solar panels.

[0037] In another embodiment, there is a method of installing a solar panel mounting system. The method comprises the steps of:

[0038] providing a front base comprising a bottom surface and a top surface, wherein the top surface is configured to receive a ballast, wherein the front base further comprises an upwardly extending first pair of posts integrally affixed to one side of the front base;

[0039] positioning behind the front base at least one middle base comprising a bottom surface and a top surface, wherein the top surface is configured to receive a ballast, wherein the at least one middle base further comprises an upwardly extending first pair of posts integrally affixed to one side of the at least one middle base and upwardly extending second pair of posts integrally affixed to the other side opposite said one side of the at least one middle base;

[0040] positioning behind the at least one middle base, a back base comprising a bottom surface and a top surface, wherein the top surface is configured to receives a ballast, wherein the back base further has an upwardly extending second pair of posts integrally affixed to one side of

the back base, wherein each of the second pair of posts of the front base, the at least one middle base and the back base are longer than each of the first pair of posts by a predetermined distance;

[0041] attaching a first pair of support bars of a predetermined length to a top end of the first pair of posts of the front base at a first end location of the first pair and at a second end location of the second pair to a top end of the second pair of posts of the at least one middle base;

[0042] attaching a second pair of support bars of said predetermined length to a top end of the first pair of posts of the at least one middle base at a first end location of the second pair and attached at a second end location of the second pair to a top end of the second pair of posts of the back base, wherein the predetermined length and the predetermined distance are selected to position the rails at a predetermined angle;

[0043] securing a first solar panel to at least one of the first pair of support bars; and

[0044] (e) securing a second solar panel to at least one of the second pair of support bars.

[0045] In one embodiment, the at least one middle base comprises two or more middle bases. The step of (a) attaching the first pair of support bars further comprises attaching the first pair of support bars to a top end of the second pair of posts of one of the two or more middle bases and the step of (b) attaching the second pair of support bars comprises attaching the second pair of support bars to a top end of the first pair of posts of one of the two or more middle bases.

[0046] In one embodiment, each of the front base, the at least one middle base and back base comprises a generally vertical perimeter wall surrounding the top surface of the each said base. The method further comprises the step of placing a ballast within the perimeter wall.

[0047] As used in the present invention, the use of one, a, or other singular designations are intended to be non-limiting and unless otherwise indicated mean one or more. The use of a specific number is likewise non-limiting and is intended to mean the number or more, unless specifically defined otherwise.

Brief Description of the Drawings

[0048] Figure 1 is a side elevated view of the solar panel mounting system of one embodiment of the present invention.

[0049] Fig. 2 is a front, sectional view of the solar panel mounting system of Fig. 1 viewed along the line of 2-2.

[0050] Fig. 3 is a side elevated view of the solar panel mounting system of an embodiment of the present invention.

[0051] Fig. 4 is a perspective view of the solar panel mounting system of one embodiment of the present invention.

[0052] Fig. 5 is a front view of multiple bases or ballast trays of one embodiment of the present invention that are arranged in a stacked formation.

[0053] Fig. 6 is an expanded view of the area shown in region A of Fig. 4.

[0054] Fig. 7 is an expanded view of the area shown in region B of Fig. 5.

[0055] Fig. 8 is a top sectional view of the solar panel mounting system of Fig. 1 viewed along the line of 8-8.

[0056] Figs. 9-13 illustrate a rooftop installation process of the solar panel assembly of one embodiment of the present invention.

Detailed Description of the Invention

[0057] The present invention is a solar panel mounting system. One example is illustrated in Figure 1 with continued reference to Fig.2. The solar panel mounting system 10 comprises a plurality of base supports or bases 12 that are arranged to support a plurality of generally horizontal panel frames or support bars 24. The support bars 24 support a solar panel 30 that are affixed to the support bar by panel clamps. The base supports 12 have a ballast tray 18 that is affixed to a pair of long arms or long posts 14 and a pair of short arms or short posts 20. The pair of long posts 14 and pair of short posts 20 extend vertically from the generally horizontal ballast tray 18. The posts are potentially of various shapes. For example the posts may be round, square, rectangular, or hexagonal. In one embodiment, the posts are tubes with a generally square or rectangular cross sectional area. The width of the posts generally corresponds to the inner dimension of the support bars 24 to be received within the support bar. Optionally, the support bars are generally U-shaped with a channel opening on the side of the posts 14 and 20 facing away from the ballast tray 18. A fixture site 16 is located at the top of the long post 14. As used herein, the terms "top" bottom" or "end" are meant to designate the part of an object relatively close to the "top", "bottom" or "end." Its meaning is relative to the context and includes anywhere within the upper $1/8^{th}$ of the entire length of the object to which reference is made. A similar fixture site 22 is located at the top of the short post 20. The fixture sites 22

and 16, in one embodiment are holes that receive a pin, rivet or nut and bolt fastener. They can be any connector that is capable of attaching two portions of a frame together. The bases 12 or ballast trays 18 are generally constructed of steel and are treated to prevent oxidization of the ballast trays. In one embodiment, the tray is painted with powder coating. In another embodiment, the tray is made of galvanized steel. In yet another embodiment, the tray is made of stainless steel.

[0058] The fixture sites 16 and 22 connect support bars 24 to the base or base support 12 by corresponding fixture sites (e.g., holes) that the support bar 24 has in its front end 25 and a back end 27. The support bar 24 is configured to support the solar panel 30 which is affixed to the support bar 24. As illustrated in Fig. 1, the support bars 24 have a cross sectional U-shape forming a channel along the length of the support bar. The top of the posts 14 and 20 are received into the channel of the U-shaped support bar. The solar panel 30 is supported by the support bars by clamps 26 and 28 that clamp the solar panel securely to the support bar 24 under a lip 31 in each of the respective clamps 26 and 28. The support bars are likewise made of steel and is treated to reduce the likelihood of rust or oxidation including galvanizing the steel or coating it with paint. Alternatively, the support bars are made of stainless steel.

[0059] The ballast tray 18 of one embodiment has a length, a width and a height. The length is greater than the width. The ballast tray has a front side 13 and a back side 15. The distance between the front side 13 and the back side 15 corresponds to the width of the ballast tray. The ballast tray has a first end 17 and a second end 19 corresponding to the length of the ballast tray. The front side 13 generally correspond to the side that has a long posts affixed thereto and the back side 13 generally corresponds to the side that has short posts affixed thereto. A person of ordinary skill in the art will recognize that the designation of "front" and "back" or "first" or "second" are for the purpose of orientation of the parts and are otherwise arbitrary and their designation can be interchanged without departing from the spirit and scope of the invention. The first end 15 and the second end of the ballast tray are arbitrary designations and can refer to either ends as oriented along the length of the ballast tray 18.

[0060] In one embodiment, the ballast tray supports one of a various type of ballasts (not shown in Figs. 1 and 2). It can be a flat bottom pan that is configured to receive sand, gravel, cement or metal weights. It is preferable that the pan does not cause water to pool in the ballast tray. With reference to Fig. 8 and continued reference to Figs 1 and 2, the ballast tray is an angle

basket made by welding together four pieces of angle iron into a rectangular frame. Each angle iron has two flat sides 11a and 11b forming a right angle. The first side 11a is perpendicular to the second side 11b. The angle irons are arranged in a generally box shape. The first side 11a of each angle iron forms a perimeter lip of the ballast tray onto which ballasts are supported. The second side 11b forms the perimeter wall of the ballast tray. The short posts 14 and the long posts 20 are welded to the second side 11b of the ballast tray. The ends of the second side are cut so that when the four angle irons are assembled in a box-like manner, each of the four sides are joined along four corner seams that are welded together by techniques that are known in the art.

[0061] The bottom of the perimeter lip is fitted with rubber treads (not shown). The treads in one embodiment have a peel off adhesive on one side that is pressed against the bottom of the second side 11a of each of the angle irons of the ballast tray 18. Alternatively, the treads can be affixed with a two sided tape or a glue adhesive according to techniques that are known in the art. The rubber treads prevent slippage and raise the basket to permit improved drainage. In one embodiment, the rubber treads are textured. In another embodiment, the rubber treads are smooth.

[0062] Optionally, the ballast tray 18 receives a weight or ballast for anchoring the solar panel system to a generally flat roof. The ballast is shaped to fit into the ballast tray. In the embodiment of Fig. 3, the ballasts are sized so that the combined area of one or more of the ballasts can be fit into the tray and anchor the tray to the ground.

[0063] The ballast tray has a height that is a minimum of 1 inch and a maximum of 4 inches and preferably is about 2.5 inches high. The lip formed by the angle iron is likewise a minimum of 1 inch and a maximum of 4 inches, preferably 2.5 inches. The ballast tray has a width that is a minimum of about 8 inches and a maximum of about 3 feet. Preferably, the ballast tray is about 1.5 feet wide. The length of the ballast tray is a minimum of about 1 foot and a maximum of about 3 feet. Preferably the length of the ballast tray is about 2.5 feet. Preferably, the length of the ballast tray 18 is aligned with the length of the solar panels 30 when installed. If the internal dimensions of the ballast tray are three feet long and 1.5 feet wide, then the ballast of one embodiment could be slightly smaller than one foot wide by 1.5 feet long so that the ballast can be inserted into and removed from the trays. However, the ballast fit snugly on the lip 11a of the ballast tray 18. Sometimes, multiple ballasts are designed to fit into the

ballast tray 18. At least one of the length or width of the ballasts correspond to the internal width of the ballast trays 18 and the sum of the other of the length or width of the ballasts correspond to the length of the internal length of the ballast trays 18 so that when the multiple ballasts are inserted into the ballast trays 18, they collectively fit into the ballast trays 18 and cannot be easily dislodged from a position above the lip 11a of the ballast trays 18.

[0064] On the front end of the ballast tray 18 is a pair of long posts 14. As illustrated from the front view of Fig. 2, the long posts 14 are attached to the front side of the ballast tray at opposite ends of the ballast tray 18.

[0065] In one embodiment, the posts 14 and 20 are a square pipe made of roll formed steel. They are preferably welded to the ballast tray. In another embodiment shown in Fig. 4, the posts 14 and 20 are a three-sided elongate structure having a U-shaped cross section. The back side 15 of the ballast tray 18 has affixed thereto short posts 20 that are aligned with and opposite the long posts 14 affixed to the front side of the ballast tray 18. The long posts 14 and the short posts 20 are affixed to the respective front side 13 and back side 15 such that another ballast tray 18 can be passed between the long posts and the short posts in a stackable manner such that the ballast tray that is stacked on top of the immediate lower ballast tray abuts against the ballast tray on the bottom.

[0066] The posts 14 and 20 of a ballast tray 18 that is stacked on top of another ballast tray 18 can be positioned adjacent to but offset from the posts of the said another ballast tray that is oriented below. In this regard, the ballast trays18 or bases 12 can be stacked efficiently for storage and shipping.

[0067] The stacking of ballast trays is illustrated with reference to Fig. 5. A second ballast tray 18B is stacked on a first ballast tray 18A. The second ballast tray 18B fits between the respective short post 14A and long post 20A on each side of the first ballast tray 18A. The second short leg 14B abuts against the first short leg 14A. The second long leg 20B abuts against the first long leg 20A. In this manner, the second ballast tray 18B is oriented immediately above and slightly offset the first ballast tray by a distance generally equal to the width of the short and long posts 14A and 20A. The third ballast tray 18C fits between the respective second short posts 14B and second long posts 20B on each side of the second ballast tray 18B. The third short leg 14C abuts against the second short leg 14B. The third long leg 20C abuts against the second long leg 20B. In this manner, the third ballast tray 18C is oriented

immediately above and slightly offset the second ballast tray 18B by a distance generally equal to the width of the second short post 14B and the second long posts 20B.

[0068] A fourth ballast tray 18 D is shown lowered onto the third ballast tray 18C by direction arrow 50. The fourth ballast tray 18D fits between the respective third short posts 14C and third long posts 20C on each side of the third ballast tray 18C. The fourth short leg 14D, when lowered into position will abut against the third short leg 14C. The fourth long leg 20D will abut against the third long leg 20C. In this manner, the fourth ballast tray 18D will be oriented immediately above and slightly offset the third ballast tray 18C by a distance generally equal to the width of the third short post 14C and the third long posts 20C.

[0069] Returning to Figs. 1 and 2, the support bar 24 is attached to the attachment points 16 and 22 of a long post of one ballast tray 18 at the back side 27 of the support bar 24 and a short post 20 of another ballast tray 18 at the front side 25 of the support bar 24. In one embodiment, the long posts 14 and short posts 20 cooperate to position the solar panel at an angle that is a minimum of 5 degrees and a maximum of 40 degrees from horizontal. Preferably the angle is a minimum of 5 degrees and a maximum of 30 degrees. In one preferred embodiment, the angle is preferably about 10 degrees from horizontal or 100 degrees from vertical. While a higher angle may intercept the sunlight at a more efficient angle, the panels at a higher angle tend to block the sunlight of the panel behind the previous panel. Thus, a lower angle facilitates placing the panels as close as possible together for maximum efficiency. Accordingly, in one embodiment, the long post is made of a 1 ½ inch square metal tube or bar and has a length of about 1' 1 7/16". The short posts are, likewise, made of 1 ½ inch tube or bar and have a length of about 6 7/8".

[0070] The panels can be arranged in rows aligned along length of the panels 30 and ballast trays 18 as illustrated in Fig. 2. A ballast tray 18 that supports a support bar 24 or pair of bars 24 (not visible in Fig. 2) on one extremity of a row of panels is an end ballast tray 18. The support bars 24 that is supported by the ballast tray it supports is an end frame and the solar panel that it supports is an end panel 30. The end ballast tray 18 is affixed to the end pair of support bars 24 so that the end ballast tray 18 is oriented beneath the respective end panel 30. Every other ballast tray 18 that is not located on the end is attached to the respective ends of the ballast tray so that the panels fit as closely together as possible.

[0071] The present invention is a solar panel mounting system 110 of an embodiment illustrated in Fig. 3 with reference to Fig. 4. The solar panel mounting system 110 comprises a plurality of base supports or bases 112f, 112m, 112b that are arranged to support a plurality of generally horizontal panel frames or support bars 124. In one embodiment, base 112f is a base that is configured to be received in the front row of a solar panel assembly and has only a short post 120. The base 112m is a middle positioned base and has both short posts 120 and long posts 114. The base 112b refers to a base that is positioned in the back row. Only the long posts 120 are connected to the support bars 124. Thus, short posts 120 are optional on 112b.

[0072] In one embodiment, a pair of support bars 124 supports a solar panel (not shown in Figs. 3 and 4). The panel is attached to each support bar 124 by a pair of panel clamps 126 and 128. The base supports 112 have a ballast tray 118 that is affixed to a pair of long arms or long posts 114 and a pair of short arms or short posts 120. The pair of long posts 114 and pair of short posts 120 extend vertically from the generally horizontal ballast tray 118. The posts 114 and 120 are potentially of various shapes. For example the posts 114 and 120 may have a cross sectional shape that is round, square, rectangular, or hexagonal. In one embodiment, the posts 114 or 120 are tubes with a generally square or rectangular cross sectional area. The width of the posts 114 and 120 generally correspond to the inner dimension of the support bars 124 to be received within the support bars 124. In one embodiment the posts 114 and 120 have a generally U-shaped cross-section with the opening in the U-shaped channel facing away from the ballast tray to which the posts are affixed.

[0073] The support bars 124 are generally U-shaped with a channel opening on the side directed towards the posts 114 and 120 into which the top end of the posts 114 and 120 are received. A fixture site 116 is located at the top of the long post 114. A similar fixture site 122 is located at the top of the short post 120. The fixture sites 122 and 116, in one embodiment, are holes that receive a pin or bolt. The means for connecting the posts 114 and 120 to the support bars 124 can be any connector that is capable of attaching two portions of a frame together.

[0074] The fixture sites 116 and 122 connect support bars 124 to the base 112 by corresponding fixture sites (e.g. holes) that the support bar 124 has in its front end 125 and a back end 127. The support bar 124 is configured to support the solar panel which is affixed to the support bar 124. As illustrated in Fig. 3 and 4, the support bars 124 have a cross sectional U-shape forming a channel along the length of the support bars 124. The top of the posts 114 and

120 are received into the channel of the U-shaped support bar. The solar panel is supported by the support bars 124 by clamps 126 and 128 that clamp the solar panel securely to the support bar 124 under a lip 131 (of Figs. 6 and 7) in each of the respective clamps 126 and 128.

[0075] With reference to Figs 6, the front clamp 126 is described. The support bar 124 is attached to the short post 114 by a nut and bolt fastener 133. The clamp 126 is attached to the support bar 124 by a bolt mechanism 132. The bolt 132 passes through a hole in the clamp surface 136 and a slot 134 in the support bar. In one embodiment, the bolt is a carriage bolt that is securely received into the slot 134 to prevent the bolt 132 from turning when its corresponding nut 138 is tightened. The slot 134 allows the bolt 132 to slide in the direction of the length of the support rail 124 a distance that is a minimum of 0.5 inches and a maximum of about 4 inches (preferably about 1 to 1.5 inches). The function of this slot 134 is to facilitate better fitting of the solar panel caused by unevenness in the surface to which the solar panel assembly 110 is mounted. The unevenness (although vertical in nature) causes slight horizontal misalignment that is rectified by some variance in the placement of the longitudinal placement of the panel.

[0076] The clamp 126 has a vertical height that corresponds to the thickness of the solar panel 130. The vertical height is the sum of spacers 135 and 137. The panel is placed under lip 131. The clamp 126 is then tightened by turning nut 138 in a tightening direction.

[0077] With reference to Fig 7, the front clamp 126 is described. The support bar is attached to the long post 120 by a nut and bolt fastener 133. The clamp 126 is attached to the support bar 124 by a bolt mechanism 132. The bolt 132 passes through a hole in the clamp surface 136 and a slot 134 in the support bar. In one embodiment, the bolt is a carriage bolt that is securely received into the slot to prevent the bolt 132 from turning when its corresponding nut 138 is tightened. The slot 134 allows the bolt 132 to slide in the direction of the length of the support rail 124 a distance that is a minimum of 0.5 inches and a maximum of about 3 inches (preferably about 2 inches). The function of this slot 134 is to facilitate better fitting of the solar panel caused by unevenness in the surface to which the solar panel assembly 110 is mounted. The unevenness (although vertical in nature) causes slight horizontal misalignment that is rectified by some variance in the placement of the longitudinal placement of the panel.

[0078] The clamp 126 has a vertical height that corresponds to the thickness of the solar panel 130. The vertical height is the sum of spacer 135 and 137. The panel is placed under lip 131. The clamp 126 is then tightened by turning nut 138 in a tightening direction.

[0079] The ballast tray 118 of one embodiment has a length, a width and a height. The length is greater than the width. The ballast tray has a front side 113 and a back side 115 the distance between the front side and the back side corresponds to the width of the ballast tray 118. The ballast tray 118 has a first end 117 and a second end 119 corresponding to the length of the ballast tray 118. The front side 113 generally correspond to the side that has a long posts 120 affixed thereto and the back side 113 generally corresponds to the side that has short posts 114 affixed thereto.

[0080] In one embodiment, the ballast tray 118 is an angle basket made by welding together four pieces of angle iron into a rectangular frame. With reference to Fig. 4 and Fig. 8, each angle iron has two flat sides 111a and 111b forming a right angle. The first side 111a is perpendicular to the second side 111b. The angle irons are arranged in a generally box shape. The first side 111a of each angle iron forms a perimeter lip of the ballast tray onto which ballasts are supported. The second side 111b forms the perimeter wall of the ballast tray. The short posts 114 and the long posts 120 are welded to the second side 111b of the ballast tray. The ends of the second side 111b are cut so that when the four angle irons are assembled in a box-like manner, each of the four sides are joined along four corner seams that are welded together by techniques that are known in the art.

[0081] The bottom of the perimeter lip is fitted with rubber treads (not shown). The treads in one embodiment have a peel off adhesive on one side that is pressed against the bottom of the second side 111a of each of the angle irons of the ballast tray 118. Alternatively, the treads can be affixed with a two sided tape or a glue adhesive according to techniques that are known in the art. The rubber treads prevent slippage and slightly raise the basket to permit improved drainage. In one embodiment the rubber treads are textured. In another embodiment, the rubber treads are smooth.

[0082] Optionally, the ballast tray or ballast tray 118 receives a weight or ballast for anchoring the solar panel system to a generally flat roof. The ballast is shaped to fit into the ballast tray. The ballasts are sized so that the combined area of one or more of the ballasts can be fit into the tray and anchor the tray to the ground.

[0083] The ballast tray has a height that is a minimum of 1 inch and a maximum of 4 inches and preferably is about 2.5 inches high. The lip formed by the angle iron is likewise a minimum of 1 inch and a maximum of 4 inches, preferably 2.5 inches. The ballast tray has a

width that is a minimum of about 8 inches and a maximum of about 3 feet. Preferably, the ballast tray is about 1.5 feet wide. The length of the ballast tray is a minimum of about 1 foot and a maximum of about 3 feet. Preferably the length of the ballast tray is about 2.5 feet. Preferably, the length of the ballast tray 18 is aligned with the length of the solar panels when installed. If the internal dimensions of the ballast tray are three feet long and 1.5 feet wide, then the ballast of one embodiment could be slightly smaller than one foot wide by 1.5 feet long so that the ballast can be inserted into and removed from the trays. However, the ballast fit snugly on the lip 111a of the ballast tray 118. Sometimes, multiple ballasts are designed to fit into the ballast tray 118. At least one of the length or width of the ballasts correspond to the internal width of the ballast trays 118 and the sum of the other of the length or width of the ballasts correspond to the length of the internal length of the ballast trays 118 so that when the multiple ballasts are inserted into the ballast trays 118, they collectively fit into the ballast trays 118 and cannot be easily dislodged from a position above the lip 111a of the ballast trays 118.

[0084] On the front end of the ballast tray 118 is a pair of long posts 114. However, the designations are intended to be non-limiting and arbitrary. As illustrated from the front view of Fig. 2, the long posts 114 are attached to the front side of the ballast tray at opposite ends of the ballast tray 118.

[0085] In one embodiment, the posts 114 and 120 are a square pipe made of roll formed steel. They are preferably welded to the ballast tray. In another embodiment shown in Fig. 4, the posts 114 and 120 are a three-sided elongate structure having a U-shaped cross section. The back side 115 of the ballast tray 118 has affixed thereto short posts 120 that are aligned with and opposite the long posts 114 affixed to the front side of the ballast tray 118. The long posts 114 and the short posts 120 are affixed to the respective front side 113 and back side 115 such that another ballast tray 118 can be passed between the long posts and the short posts in a stackable manner such that the ballast tray that is stacked on top of the immediate lower ballast tray abuts against the ballast tray on the bottom.

[0086] The posts 114 and 120 of a ballast tray 118 that is stacked on top of another ballast tray 118 can be positioned adjacent to but offset from the posts of the said another ballast tray that is oriented below. In this regard, the ballast trays 118 can be stacked efficiently for storage and shipping.

[0087] The support bar 124 is attached to the attachment points 116 and 122 of a long post of one ballast tray 118 at the back side 127 of the support bar 124 and a short post 120 of another ballast tray 118 at the front side 125 of the support bar 124. In one embodiment, the long posts 114 and short posts 120 cooperate to position the solar panel at an angle that is a minimum of 5 degrees and a maximum of 40 degrees from horizontal. Preferably the angle is a minimum of 5 degrees and a maximum of 30 degrees. In one preferred embodiment, the angle is preferably about 10 degrees from horizontal or 100 degrees from vertical. While a higher angle may intercept the sunlight at a more efficient angle, the panels at a higher angle tend to block the sunlight of the panel behind the previous panel. Thus, a lower angle facilitates placing the panels as close as possible together for maximum efficiency. Accordingly, in one embodiment, the long post is made of a 1 ½ inch square metal tube or bar and has a length of about 1' 1 7/16". The short posts are, likewise, made of 1 ½ inch tube or bar and have a length of about 6 7/8".

[0088] The panels 130 can be arranged in rows aligned along length of the panels 130 and ballast trays 118 as illustrated in Fig. 2. A ballast tray 118 that supports a support bar 124 or pair of bars 124 (not visible in Fig. 2) on one extremity of a row of panels is an end ballast tray 118. The support bars 124 that are supported by the ballast tray 118, it supports is an end frame and the solar panel that it supports is an end panel 130. The end ballast tray 118 is affixed to the end pair of support bars 124 so that the end ballast tray 118 is oriented beneath the respective end panel 130. Every other ballast tray 118 that is not located on the end is attached to the respective ends of the ballast tray so that the panels fit as closely together as possible.

[0089] The panels 30 are arranged from front to back as shown in Fig. 1. The first row of panels 30 is supported by the short posts 14of a row of ballast trays 18. The ballast trays 18 are oriented in front of the first row of panels 30 in the embodiment shown in Fig. 1. In another embodiment illustrated in Fig. 3, the long posts 120 are removed from the first row of ballast trays 118 and the bas is reversed so that the short post 114 supports the support bar 124 and the ballast trays 118 of the first row are oriented beneath the first row of panels 130. The back side of the panel 130 is supported by a long post 120 from a second row of ballast trays 118 which in turn support a second row of panels 130 by the short posts 114 of the second row of ballast trays 118. This pattern continues until the last row of panels is supported by long posts 120 of a last row of ballast trays 118. However, the orientation of the last row of ballast trays is reversed so that the last row of ballast trays 118 are directly beneath the last row of solar panels 130.

[0090] With reference to Fig. 9, a panel assembly is planned for a floor surface that is in one embodiment a rooftop 108. A front base 112f is placed in position and is aligned with a reference line along the front of the base and a second reference line along the side of the base. A middle base 112m (shown partially cut away) is aligned behind the front base along the second reference line (not shown). A support bar 124 is affixed to a support bar by bolting the attachment points 122 and 116 of the respective front base 112f and middle base 112m to corresponding holes in the respective ends 125 and 127 of the support bar. A second support bar does not need to be attached to the opposite side of the front base 112f and the middle base 112m.

[0091] Now with reference to Fig. 10, a row of front bases 112f are aligned along the first reference line. A second row of bases 112m (shown partially cut away) is aligned behind the front row of bases 112. Pairs of support bars 124 are attached to the respective pairs of the short rods of the front row 112f and the long rods 114 of the second row of bases 112m.

[0092] With reference to Fig. 11, a first row of bases 112f and a second row of bases 112m (shown in partial) are assembled with support rails 124 extending therebetween as described above. Panels 130 are placed upon the rails 124 and are secured as described above with reference to Figs. 6 and 7. In one embodiment, each solar panel 130 is supported by one rail from two different bases 112f and 112m placed side by side. Thus, the solar panels 130 span the space between side by side bases. This arrangement results in greater stability due to the overall interconnectedness of the system.

[0093] With reference to Fig. 12, a column of bases 112m are aligned with their long rod 114 towards the front base 112f and their short rods 120 towards the back. The column of bases 112f, 112m and 112b can be aligned by the second reference line. Each base 112m between the front row of bases 112f and the back row of bases 112b on this end row is attached by at least one support bar 124 to the base in front of it and a second support bar 124 to the base in back of it. The last base (or back base) 112b in the column has the short rod 120 oriented towards the front row 112f and the long rod 114 oriented towards the back. The back base 112b is nonetheless connected by the long bar 114 so that the back base 112b is placed under the solar panel 130 when it is affixed.

[0094] As shown in Fig. 13, this pattern is continued to complete the successive rows and columns of bases 112f, 112m and 112b. The solar panels 130 are attached to the support bars

124 that extend between each base. Thus, each solar panel 130 is connected to at least two rows of bases and two columns of bases for a total of four bases affixed to each panel. This interconnectedness between the solar panels 130 and the bases 112f, 112m and 112b contributes to the stability and storm resistance the overall system. Solar panels 130 and corresponding bases can be removed where roof obstructions 140 such as heating, ventilation and air conditioning units are located. The bases immediately in front of an obstruction 140 can be oriented in the same manner of a back row base 112b. The bases immediately behind the obstructions 140 use front bases 112f with only a pair of small rods 120 attached thereto so that the front base 112f can be oriented beneath the solar panel that it supports. This reduces trip hazards in the areas surrounding the obstructions.

Claims

What is claimed is:

1. A solar panel mounting system, comprising:

a front base comprising a bottom surface and a top surface, wherein the top surface receives a ballast, wherein the front base further comprises an upwardly extending first pair of posts integrally affixed to one side of the front base;

at least one middle base comprising a bottom surface and a top surface, wherein the top surface receives a ballast, wherein the at least one middle base further comprises an upwardly extending first pair of posts integrally affixed to one side of the at least one middle base and upwardly extending second pair of posts integrally affixed to the other side opposite said one side of the at least one middle base;

a back base comprising a bottom surface and a top surface, wherein the top surface receives a ballast, wherein the back base further has an upwardly extending second pair posts integrally affixed to one side of the back base, wherein each of the second pair of posts of the at least one middle base and the back base are longer than each of the first pair of posts of the front base and the back base by a predetermined distance;

a first pair of support bars, wherein the first pair of support bars is of a predetermined length and is attached at a first end location to a top end of the first pair of posts of the front base and attached at a second end location to a top end of the second pair of posts of the at least one middle base;

a second pair of support bars of said predetermined length attached at a first end location to a top end of the first pair of posts of the at least one middle base and attached at a second end location to a top end of the second pair of posts of the back base;

wherein the first pair of support bars and second pair of support bars are U-shaped and receive the first pair of posts and the second pair of posts into a U-shaped channel; and

wherein each of front base, middle base and back base are generally configured to be stacked on top of the other bases before assembly of the system and the predetermined length and the predetermined distance are selected to position the rails at a predetermined angle.

2. The system of claim 1, wherein the at least one middle base comprises two or more middle bases, wherein the first pair of support bars are attached to a top end of the second pair of posts of the two or more middle bases and the second pair of support bars are attached to a top end of a first pair of posts of the two or more middle bases.

3. The system of claim 1, wherein each of the bottom surfaces engage a floor surface.

4. The system of claim 1, wherein the predetermined angle is a minimum of about degrees from horizontal and a maximum of about 20 degrees from horizontal.

5. The system of claim 1, wherein the distance between the first pair of posts and the second pair of posts is larger than the width of the front base, middle base and back base.

6. The system of claim 1, wherein at least one support bar of the first pair of support bars and at least one support bar of the second pair of support bars support a first solar panel and a second solar panel respectively.

7. The system of claim 6, wherein the at least one support bar of the first pair of support bars comprises at least one fastener to fasten the first solar panel and the at least one support bar of the second pair of support bars comprises at least one fastener to fasten the second solar panel.

8. The system of claim 1, wherein each of the front base, the at least one middle base and back base comprises a generally vertical perimeter wall surrounding the top surface of the each said base, wherein the top surface and the perimeter wall define a receptacle into which the ballast is received.

9. The system of claim 1, wherein the first pair of posts of each of the front base and the at least one middle base and the second pair of posts of each of the back base and the at least one middle base are attached to the outer perimeter.

10. The system of claim 1, wherein each of the front base, the at least one middle base and the back base comprises at least one orifice configured to drain water from the respective front base, the at least one middle base and the back base.

11. The system of claim 1, wherein the system does not require fastening a part of the system to another part that is generally below the top end of the first pair of posts of the front base and the at least one middle base.

12. The system of claim 1, wherein the bottom surface comprises a tread surface that elevates the base and engages a floor surface, wherein the tread surface resists slipping against the floor compared to a material.

13. The system of claim 1, wherein the front base is placed directly under the first pair of support bars and the back base is directly under the second pair of support bars.

14. A solar panel mounting kit, comprising:

a front base having a bottom surface and a top surface, wherein the top surface is configured to receive a ballast, wherein the front base further comprises an upwardly extending first pair of posts integrally affixed to one side of the front base;

at least one middle base comprising a bottom surface and a top surface, wherein the top surface is configured to receive a ballast wherein the at least one middle base further comprises an upwardly extending first pair of posts integrally affixed to one side of the at least one middle base and upwardly extending second pair of posts integrally affixed to the other side opposite said one side of the at least one middle base;

a back base comprising a bottom surface and a top surface, wherein the top surface is configured to receive a ballast, wherein the back base further has an upwardly extending second pair posts integrally affixed to one side of the back base, wherein each of the second pair of posts of the at least one middle base and the back base are longer than each of the first pair of posts of the front base and the at least one middle base by a predetermined distance;

a first pair of support bars of a predetermined length configured to be attached at a first end location of the first pair of support bars to a top end of the first pair of posts of the front base and attached at a second end location of the first pair of support bars to a top end of the second pair of posts of the at least one middle base;

a second pair of support bars of said predetermined length configured to be attached at a first end location of the second pair of support bars to a top end of the first pair of posts of the at least one middle base and attached at a second end location of the second pair of support bars to a top end of the second pair of posts of the back base;

wherein the first support bars and second support bars are U-shaped and are configured to receive the first pair of posts and the second pair of posts into the U-shaped channel; and

wherein each of front base, middle base and back base are generally configured to be stacked on top of the other bases before assembly of the system and the predetermined length and the predetermined distance are selected to position the rails at a predetermined angle.

15. The kit of claim 14, wherein the at least one middle base comprises two or more middle bases that are configured be attached to the first support bar at a top end of a second pair of posts of the two or more middle bases and further is configured to be attached to the second support bar at a top end of a first pair of posts of the two or more middle bases.

16. The kit of claim 14, wherein the bottom surface is configured to engage a floor surface.

17. The kit of claim 14, wherein the predetermined angle is a minimum of 10 degrees from horizontal and a maximum of 20 degrees from horizontal.

18. The kit of claim 14, wherein at least one of the first pair of support bars is configured to support a first solar panel and at least one of the second pair of support bars is configured to support a second solar panel respectively.

19. The kit of claim 14, wherein each of the front base, the at least one middle base and the back base comprises at least one orifice configured to drain water from the base.

20. The kit of claim 14, further comprising assembly instructions to place the front base beneath the first support bars and the back base beneath the second support bars.

21. The kit of claim 14, wherein the one or more middle bases comprises at least a first middle base and a second middle base, wherein the first middle base is generally configured to be stacked on the second middle base such that the second middle base fits between the respective first pair of posts and second pair of posts of the first middle base and the first pair of

posts and the second pair of posts of the second middle base abut against the respective first pair of posts and the second pair of posts of the first middle base before the kit is assembled.

22. A method of mounting solar panels on a roof comprising:

providing a reference line;

providing a first row of bases having an upwardly extending first pair of posts, wherein the first row of bases are spaced apart along the reference line;

attaching first support bars to a top ends of the first pair of posts of the first row of bases, wherein the first support bars are attached to a first location on the support bars;

providing at least one middle row of bases having upwardly extending first pair of posts on one side of the bases of the at least one middle row and upwardly extending second pair of posts on the other side of the bases of the at least one middle row opposite said one side;

attaching the first support bars to the bases of the at least one middle row at a second location on the support bar at a top end of the second pair of posts of the bases of the at least one middle row, wherein the first row of support bars are supported at a predetermined angle and the at least one middle row of bases are positioned without a jig or without additional measurement;

attaching a front row of solar panels to the first row of support bars;

providing a back row of bases having upwardly extending second pair of posts on the other side of the bases of the back row opposite said one side;

attaching second support bars to the bases of the at least one middle row and the bases of the back row, wherein the bases of the at least one middle row are attached to the support bar at a first location on the support bar at a top end of the first pair of posts of the bases of the at least one middle row and the bases of the at least one back row are attached to the support bar at a second location along the support bar to a top end of the second pair of posts of the bases of the at least one middle row; and

attaching a back row of solar panels to the second row of support bars;

wherein the first support bars and second support bars are U-shaped and receive the first pair of posts and the second pair of posts into the U-shaped channel.

23. The method of claim 22, wherein the front row of ballasts are positioned beneath the front row of solar panels.

24. The method of claim 22, wherein the back row of ballasts are positioned beneath the back row of solar panels.

25. A solar panel mounting system, comprising:

a first row of a plurality of generally horizontal first bases;

a second row of a plurality of generally horizontal second bases;

a third row of a plurality of generally horizontal third bases;

wherein each of the first bases, second bases and third bases have a short pair of upwardly extending posts affixed to one side of the base and a long pair of upwardly extending posts affixed to the other side, and wherein each of the first bases, second bases and third bases are generally configured to be stacked on top of other of the first bases, second bases and third bases, such that the each of the bases abut against the other of the bases and the respective short pair of posts and the long pair posts of each of the bases fit offset from and adjacent to the respective short pair and long pair of the other of the bases;

a one row of frames supportably affixed to solar panels, the first row of frames have a front side and a back side; wherein the front side of the one row of frames is affixed to and supported by the short pair of posts of the first row of a plurality of generally horizontal first bases, and wherein the back side of the one row of frames is affixed to and supported by the long pairs of the second row of second bases;

a back row of frames supportably affixed to solar panels, the back row of frames have a front side and a back side; wherein the front side of the back row of frames is affixed to and supported by the short pair of posts of the second row of a plurality of generally horizontal second bases, and wherein the back side of the back row of frames is affixed to and supported by the long pair of posts of the third row of a plurality of generally horizontal second bases, wherein the third base is positioned directly beneath the back row of frames and wherein the first support bars and second support bars are U-shaped and receive the first pair of posts and the second pair of posts into the U-shaped channel.

26. A method of installing a solar panel mounting system, comprising:

providing a front base comprising a bottom surface and a top surface, wherein the top surface is configured to receive a ballast, wherein the front base further comprises an upwardly extending first pair of posts integrally affixed to one side of the front base and upwardly extending second pair of posts integrally affixed to the other side opposite said one side;

positioning behind the front base at least one middle base comprising a bottom surface and a top surface, wherein the top surface is configured to receive a ballast, wherein the at least one middle base further comprises an upwardly extending first pair of posts integrally affixed to one side of the at least one middle base and upwardly extending second pair of posts integrally affixed to the other side opposite said one side of the at least one middle base;

positioning behind the at least one middle base, a back base comprising a bottom surface and a top surface, wherein the top surface is configured to receives a ballast, wherein the back base further comprises an upwardly extending first pair of posts integrally affixed to one side of the back base and upwardly extending second pair of posts integrally affixed to the other side, wherein each of the upwardly extending second pair of posts of the front base, the at least one middle base and the back base are longer than each of the first pair of posts by a predetermined distance;

attaching a first pair of support bars of a predetermined length to a top end of the first pair of posts of the front base at a first end location of the first pair and at a second end location of the second pair to a top end of the second pair of posts of the at least one middle base;

attaching a second pair of support bars of said predetermined length to a top end of the first pair of posts of the at least one middle base at a first end location of the second pair and attached at a second end location of the second pair to a top end of the second pair of posts of the back base, wherein the predetermined length and the predetermined distance are selected to position the rails at a predetermined angle;

securing a first solar panel to at least one of the first pair of support bars; and securing a second solar panel to at least one of the second pair of support bars;

wherein the first support bars and second support bars are U-shaped and receive the first pair of posts and the second pair of posts into the U-shaped channel

27. The method of claim 26, wherein the at least one middle base comprises two or more middle bases, wherein the step of attaching the first pair of support bars further comprises attaching the first pair of support bars to a top end of the second pair of posts of one of the two or more middle bases and the step of attaching the second pair of support bars comprises attaching the second pair of support bars to a top end of the first pair of posts of one of the two or more middle bases.

28. The method of claim 26, wherein the bottom surface engages a floor surface.

29. The method of claim 26, wherein the first pair of posts and the second pair of posts are attached to the outer surface of the base.

30. The method of claim 26, wherein the distance between the first pair of posts and the second pair of posts of the middle base is larger than the width of the middle base.

31. The method of claim 26, wherein at least one of the first pair of support bars support a first solar panel and at least one of the second pair of support bars support a second solar panel.

32. The method of claim 26, wherein the first pair of support bars and the second pair of support bars comprise at least one fastener to fasten the first solar panel and the second solar panel.

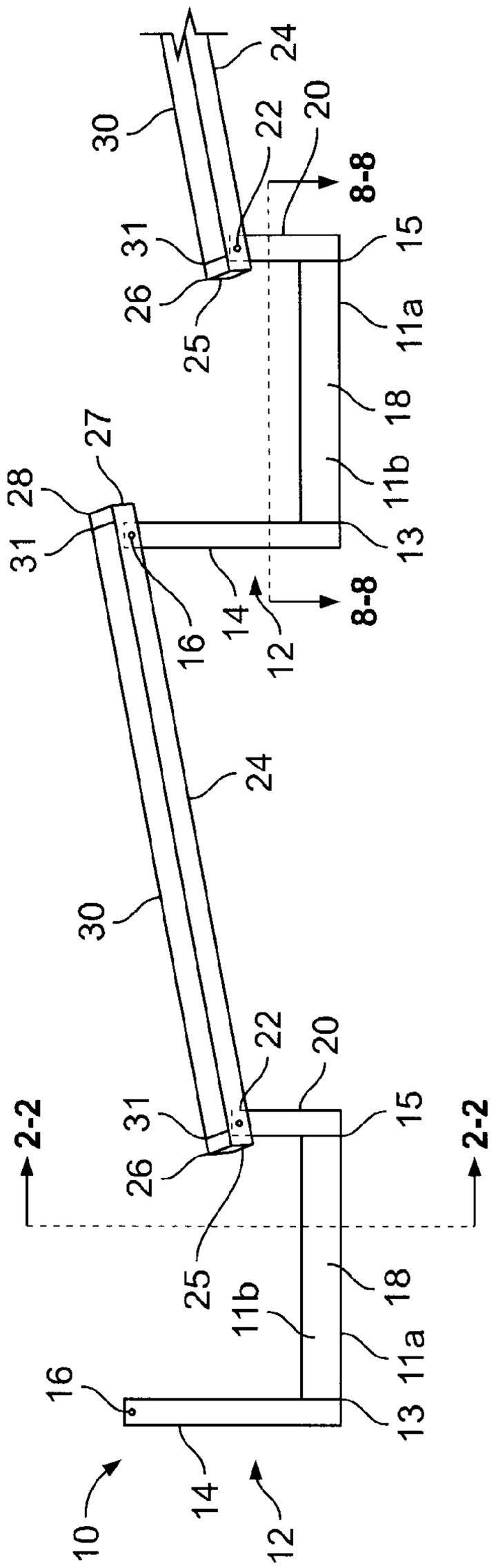
33. The method of claim 26, wherein front base, middle base and back base are joined by the first pair of support bars and the second pair of support bars to form a column of at least two solar panels that are spaced apart by a predetermined distance that is defined in part by the distance between the first support bar and the second support bar of the at least one middle panel.

34. The method of claim 26, wherein each of the front base, the at least one middle base and back base comprises a generally vertical perimeter wall surrounding the top surface of the each said base, the method further comprising placing ballast within the perimeter wall.

35. The method of claim 26, wherein each of the front base, the at least one middle base and the back base comprises at least one orifice configured to drain water from the base.

36. The method of claim 26, wherein the bottom surface comprises a tread surface that elevates the base and engages the floor surface.

37. The method of claim 26, wherein the front base is beneath the first pair of support bars and the back base is beneath the second pair of support bars.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11a
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18
11b
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8-8
24
30
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31
15
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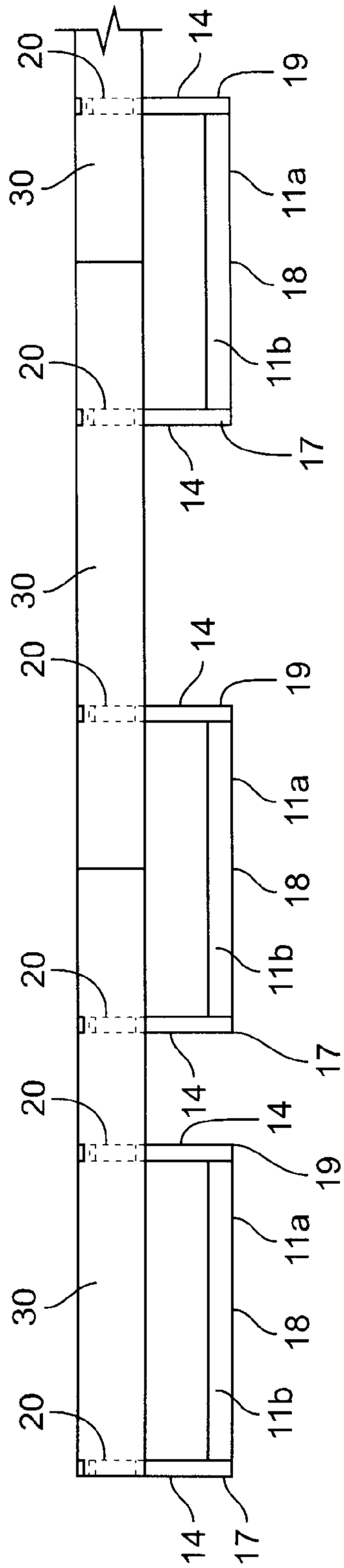
2-2
25
18
11b
11a
16
13
10
14
12

FIG. 1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14
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11a
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11b
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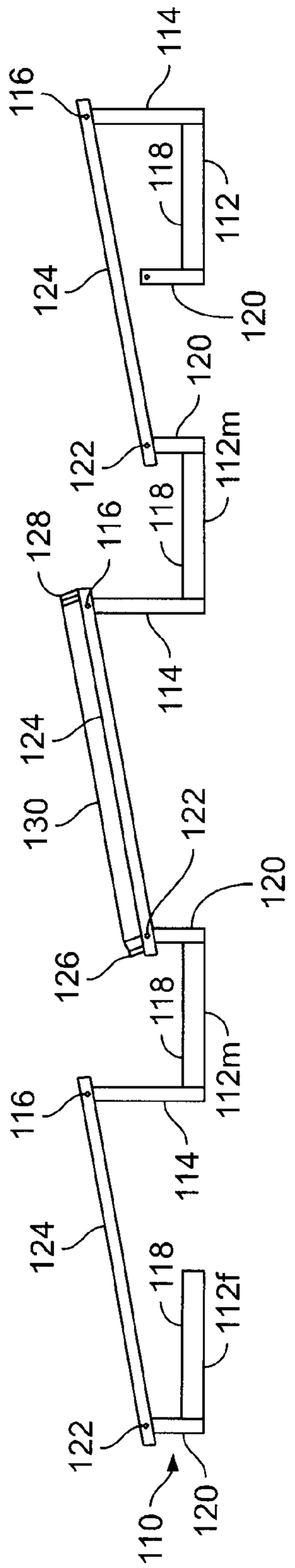
14
17

FIG. 2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122
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128
116
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112m
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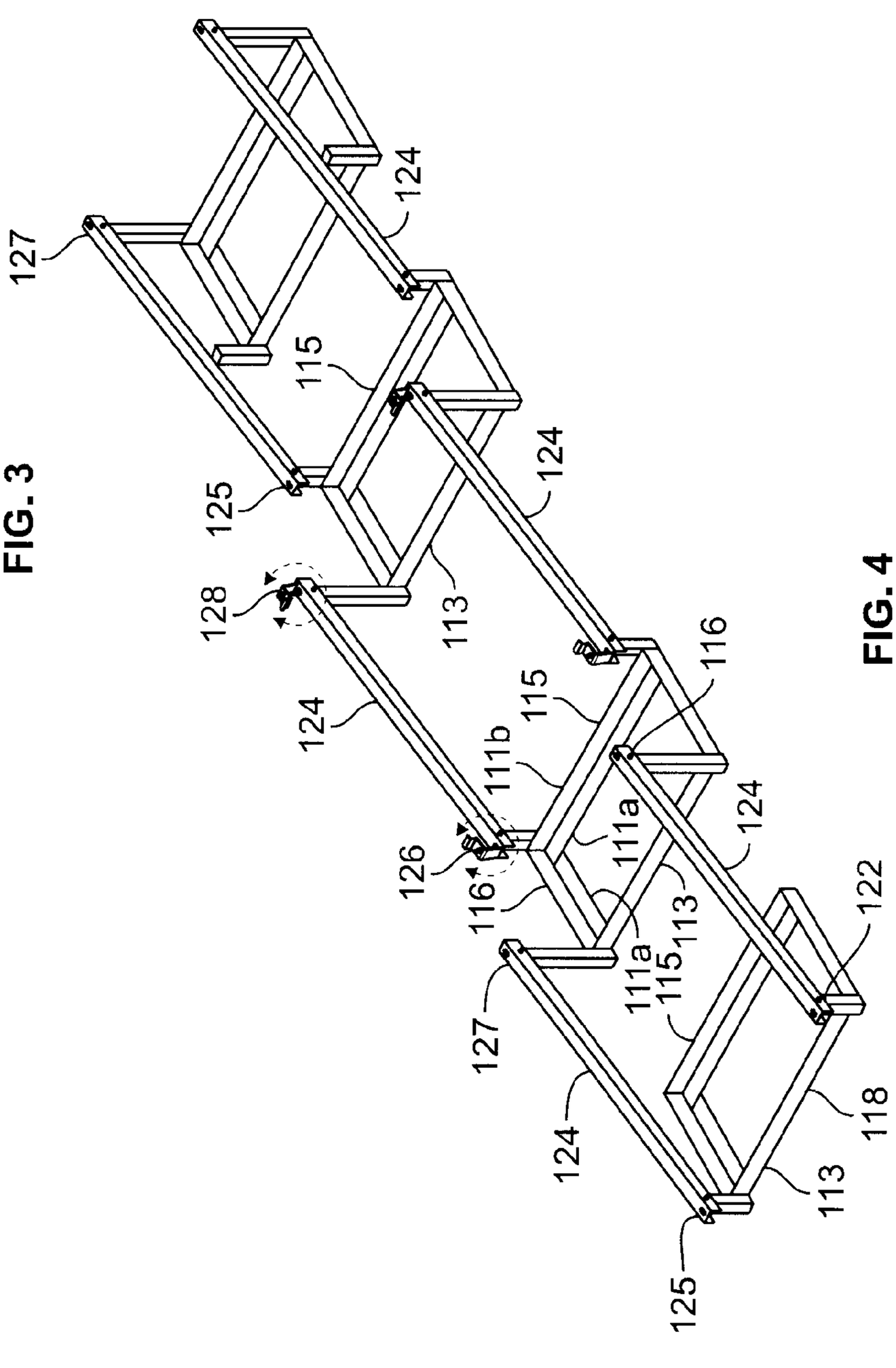
126
118
112m
116
114
124
118
112f
122
110
120

FIG. 3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122
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111a
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118
113
125

FIG. 4

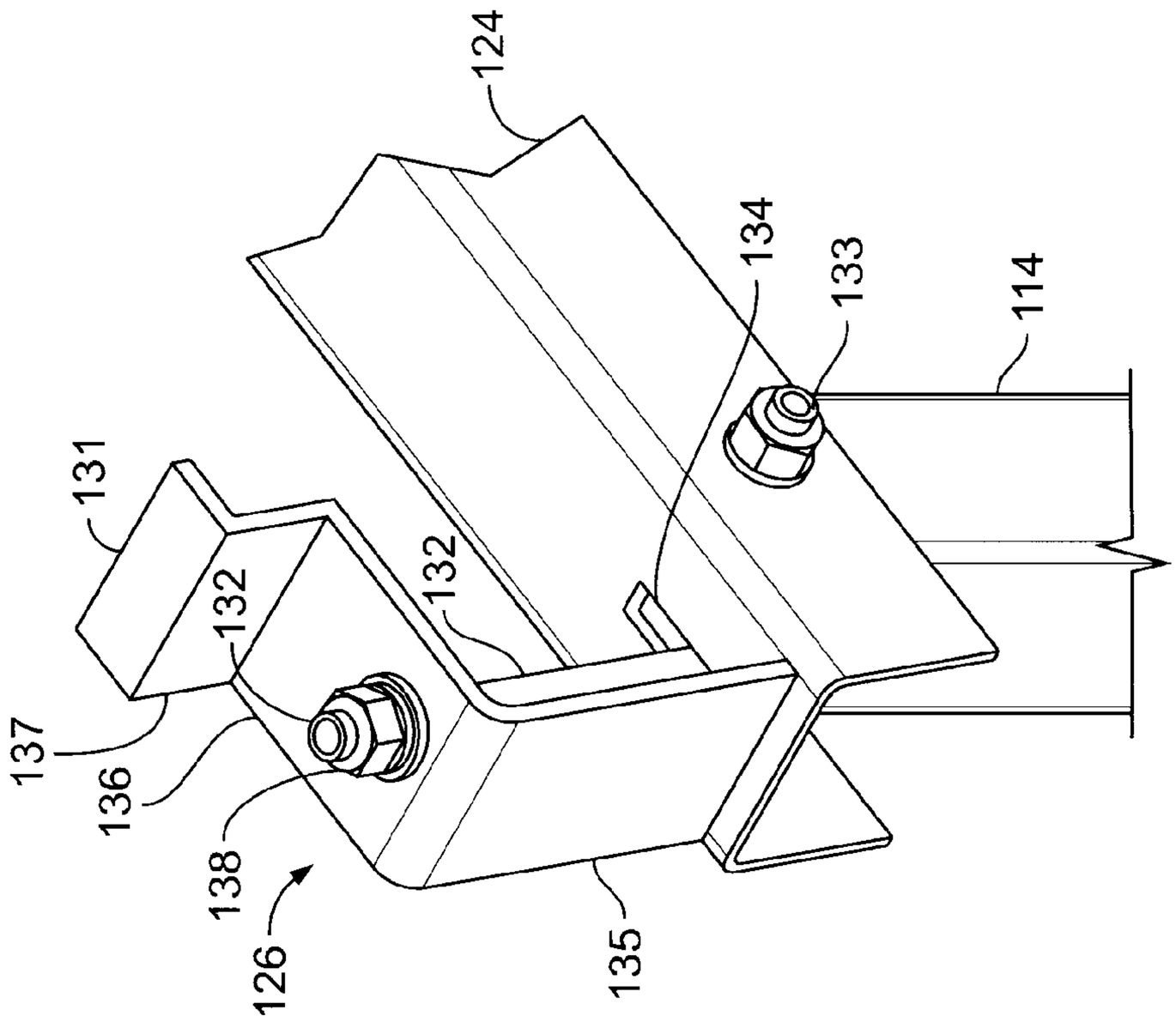
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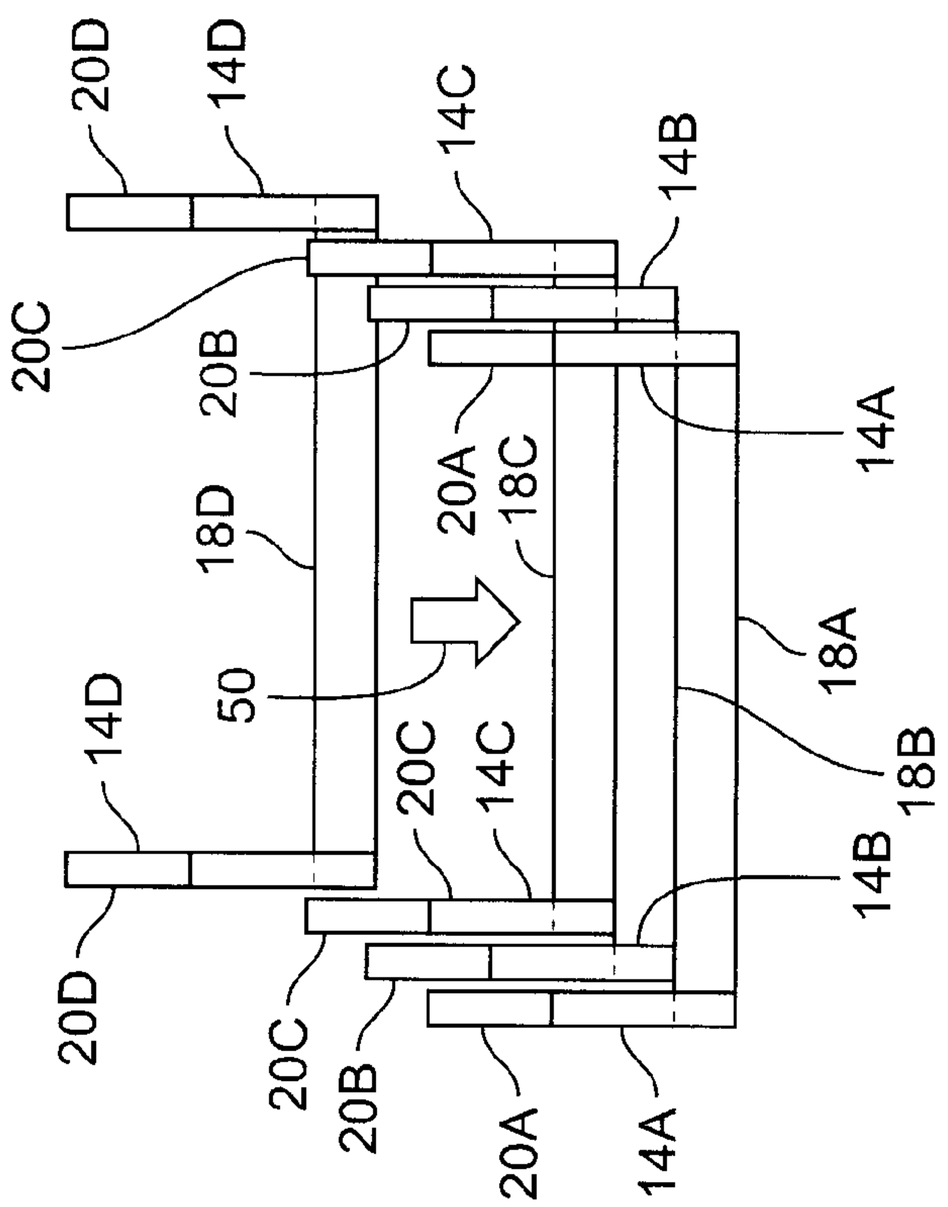
FIG. 6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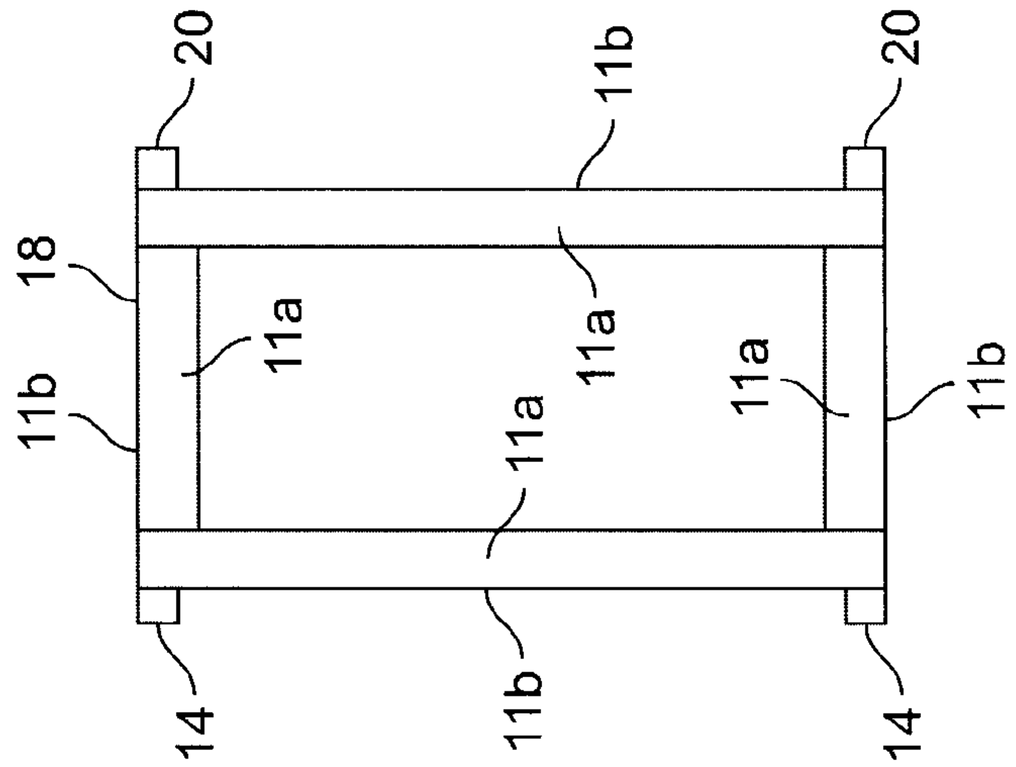
14D
14C
14B
20C
20B
20A
14A
18D
18C
50
18A
18B
14D
20C
14C
20D
20C
20B
20A
14A

FIG. 5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11a
11a
11a
11b
11b
11a
14
11b
14

FIG. 8

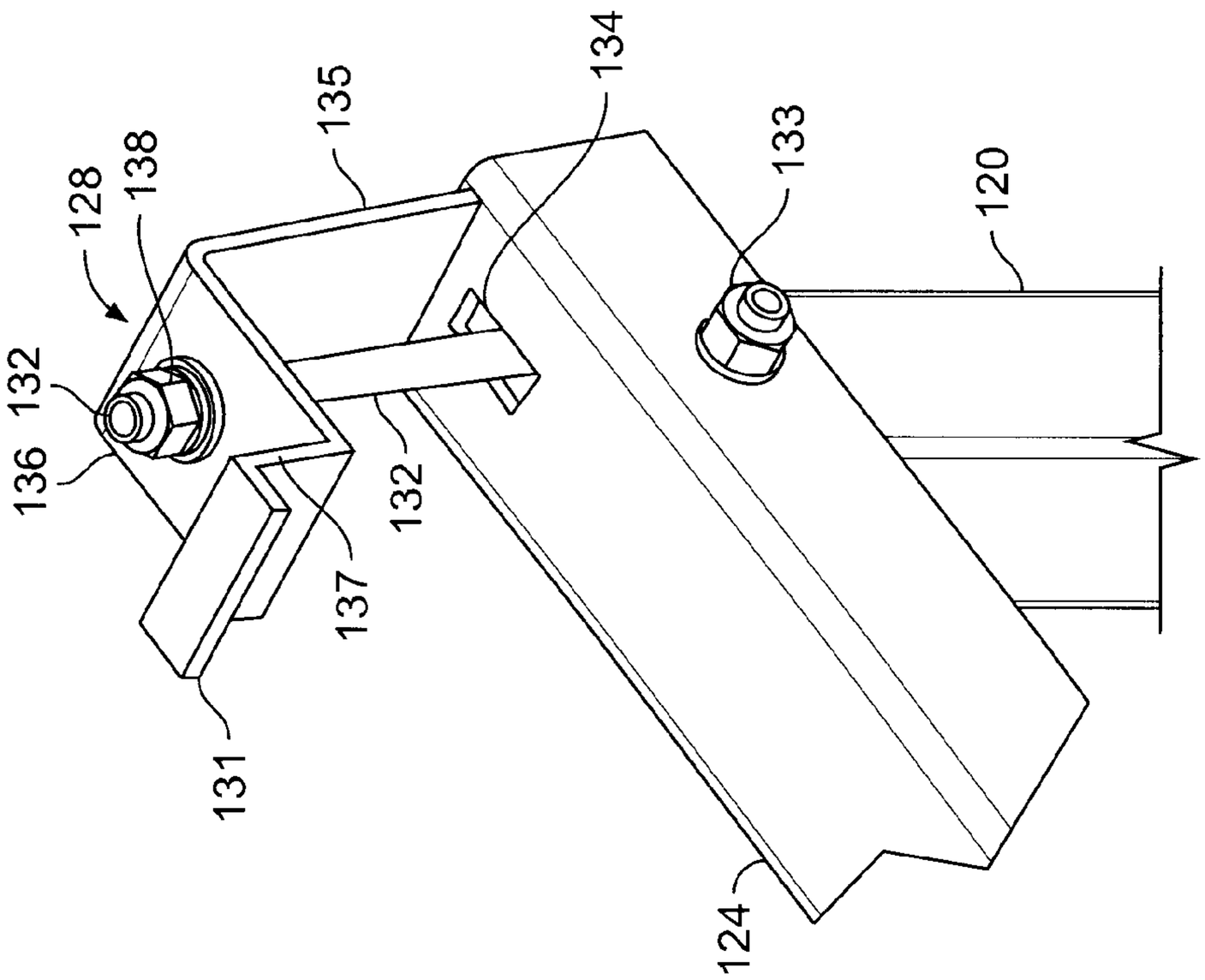
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FIG. 7

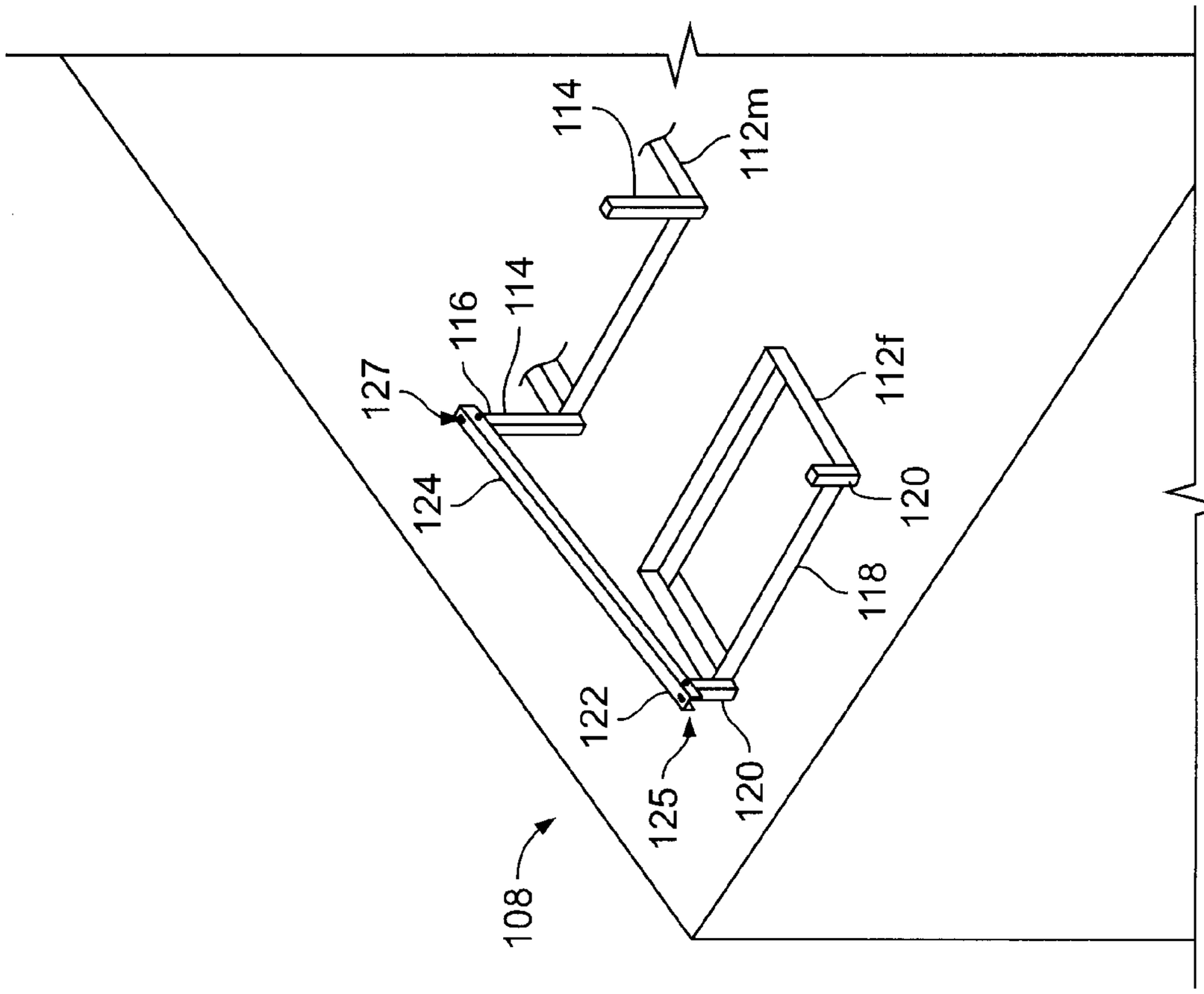


FIG. 9

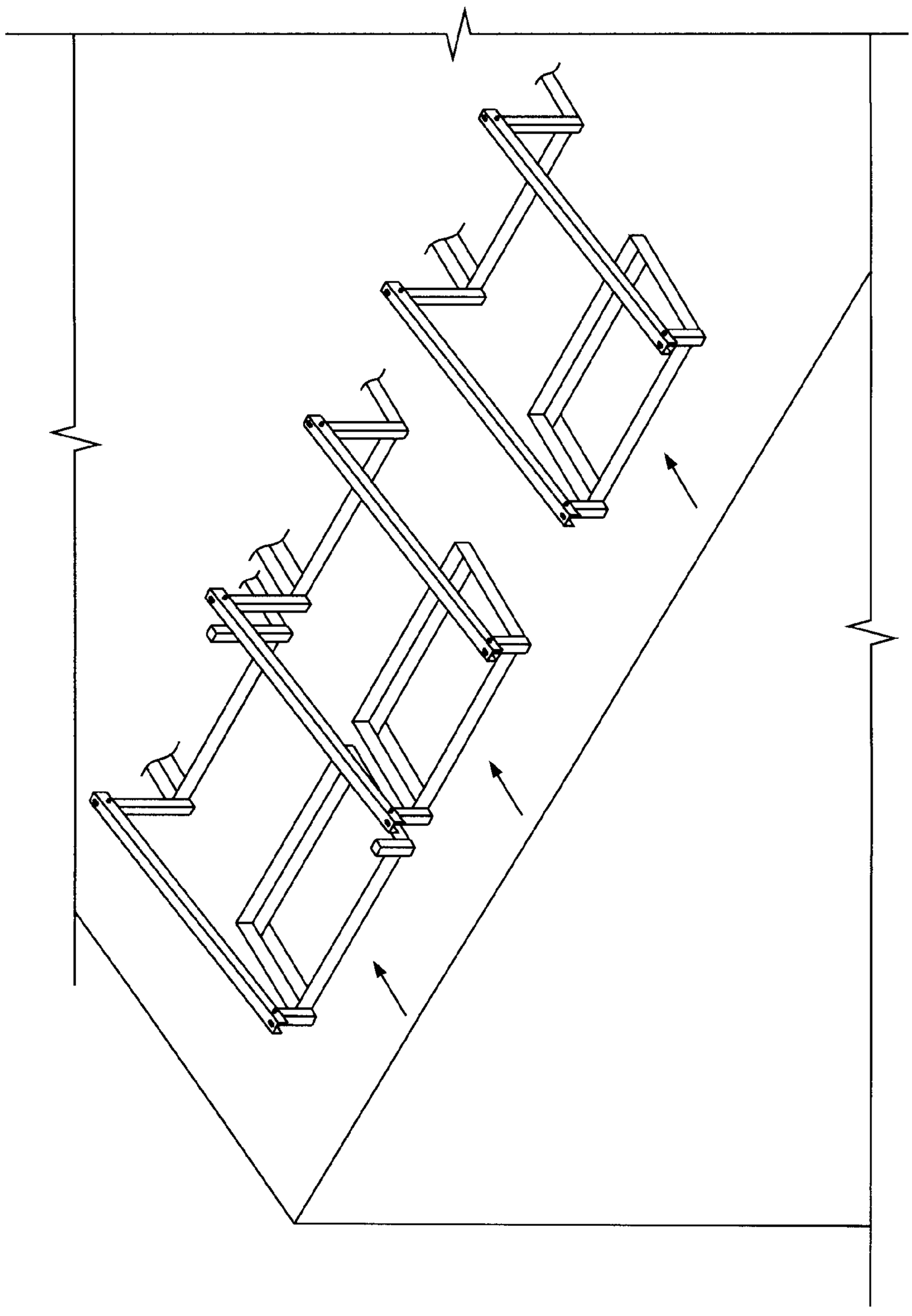


FIG. 10

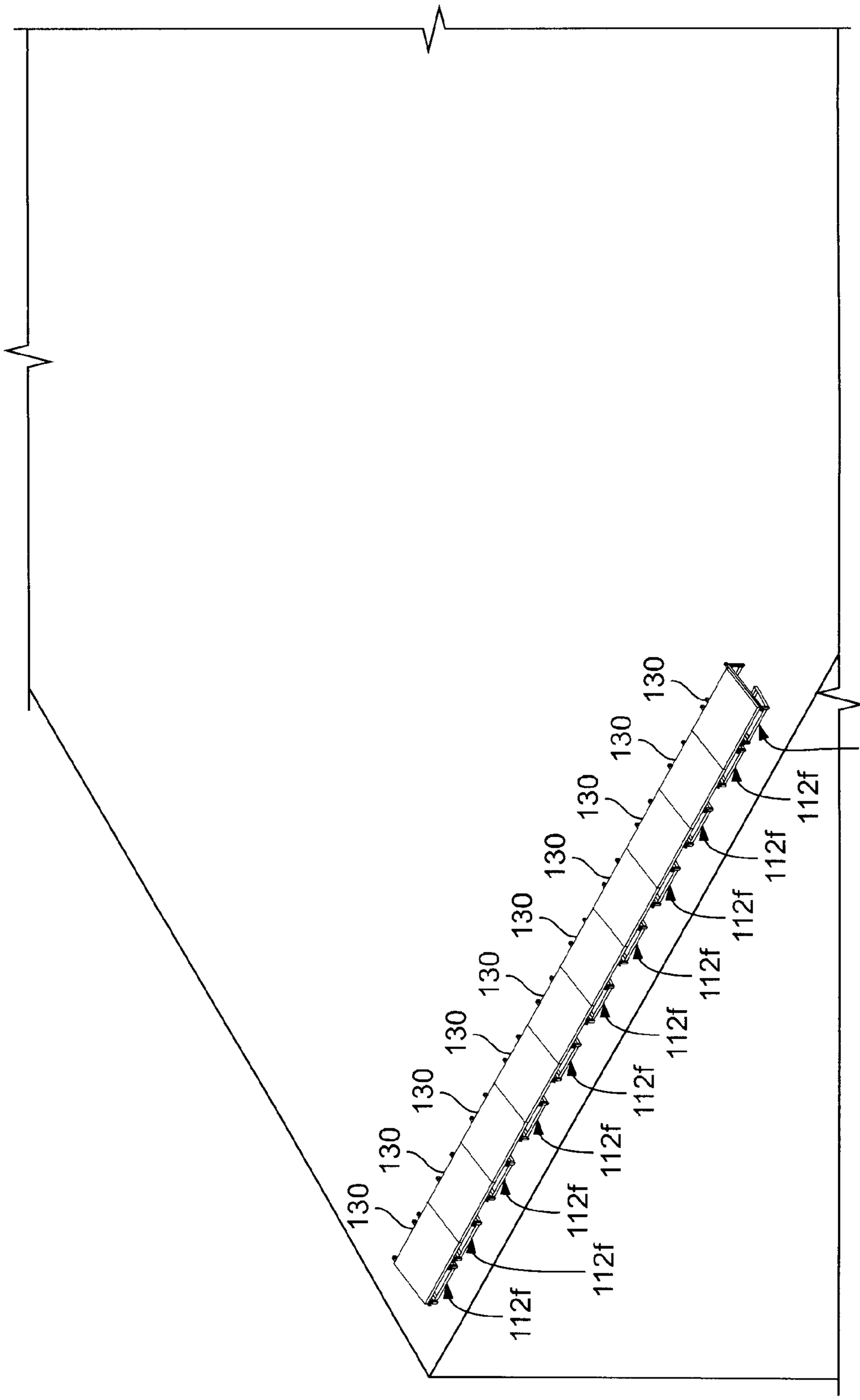


FIG. 11

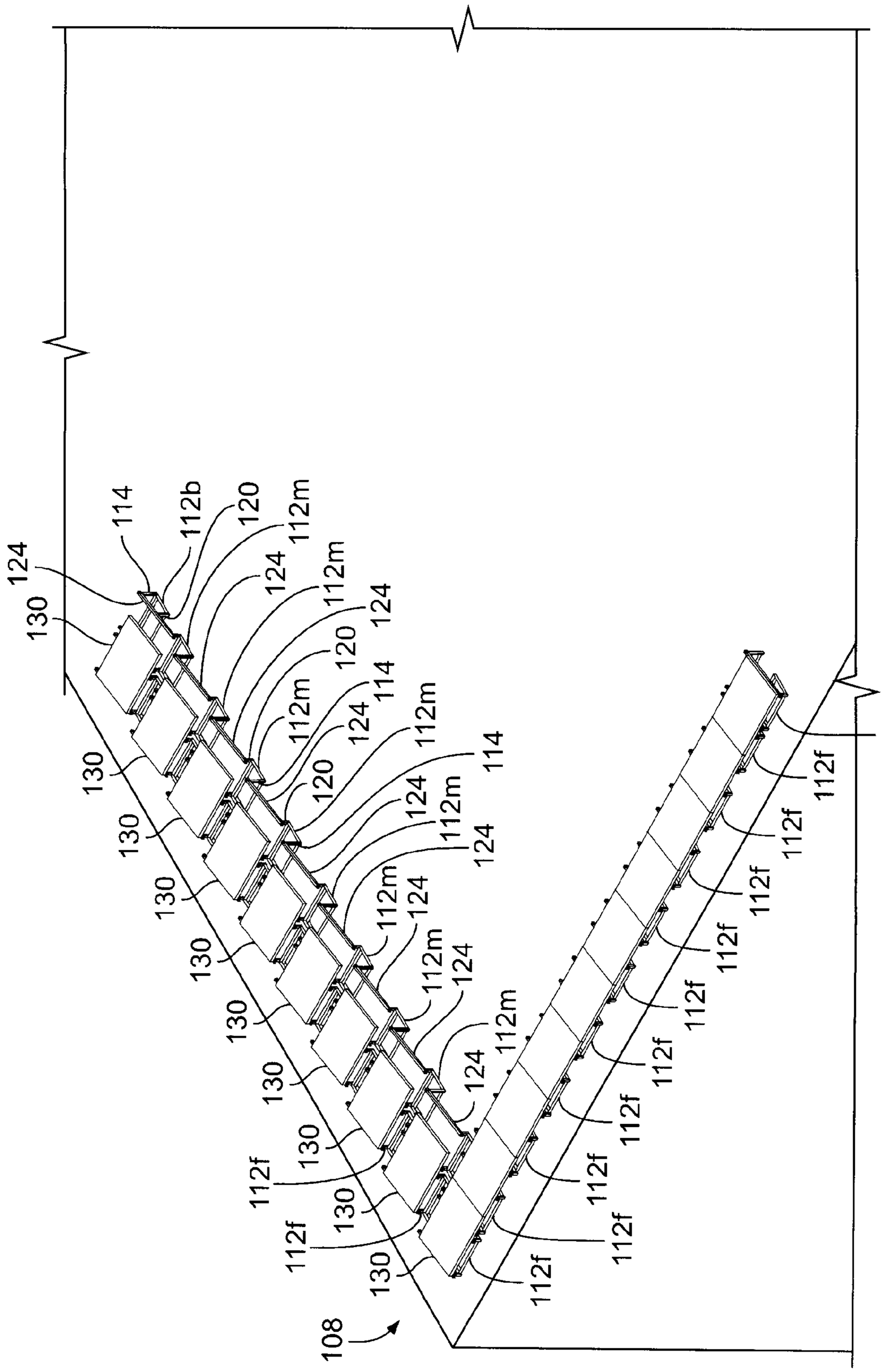
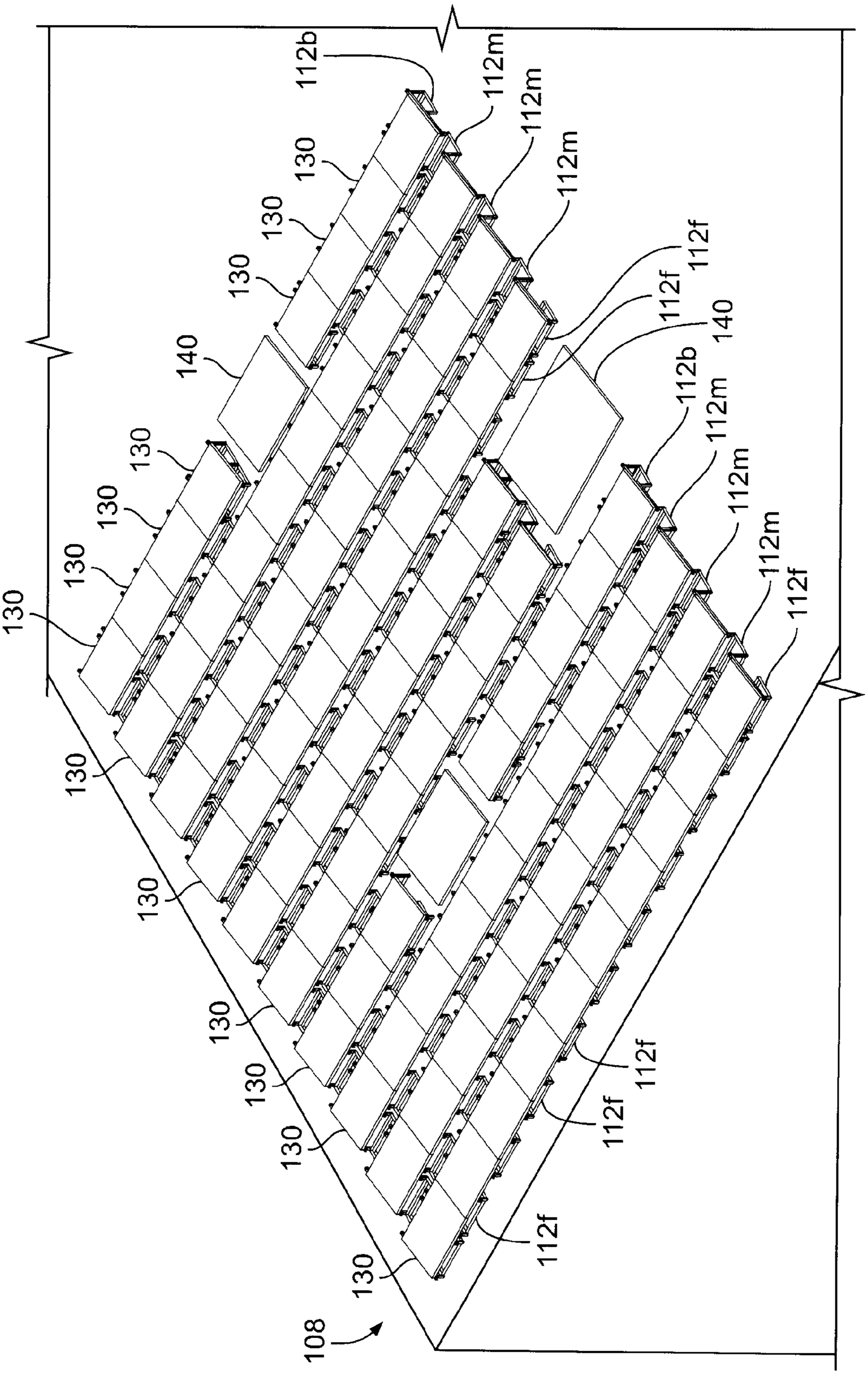


FIG. 12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112f
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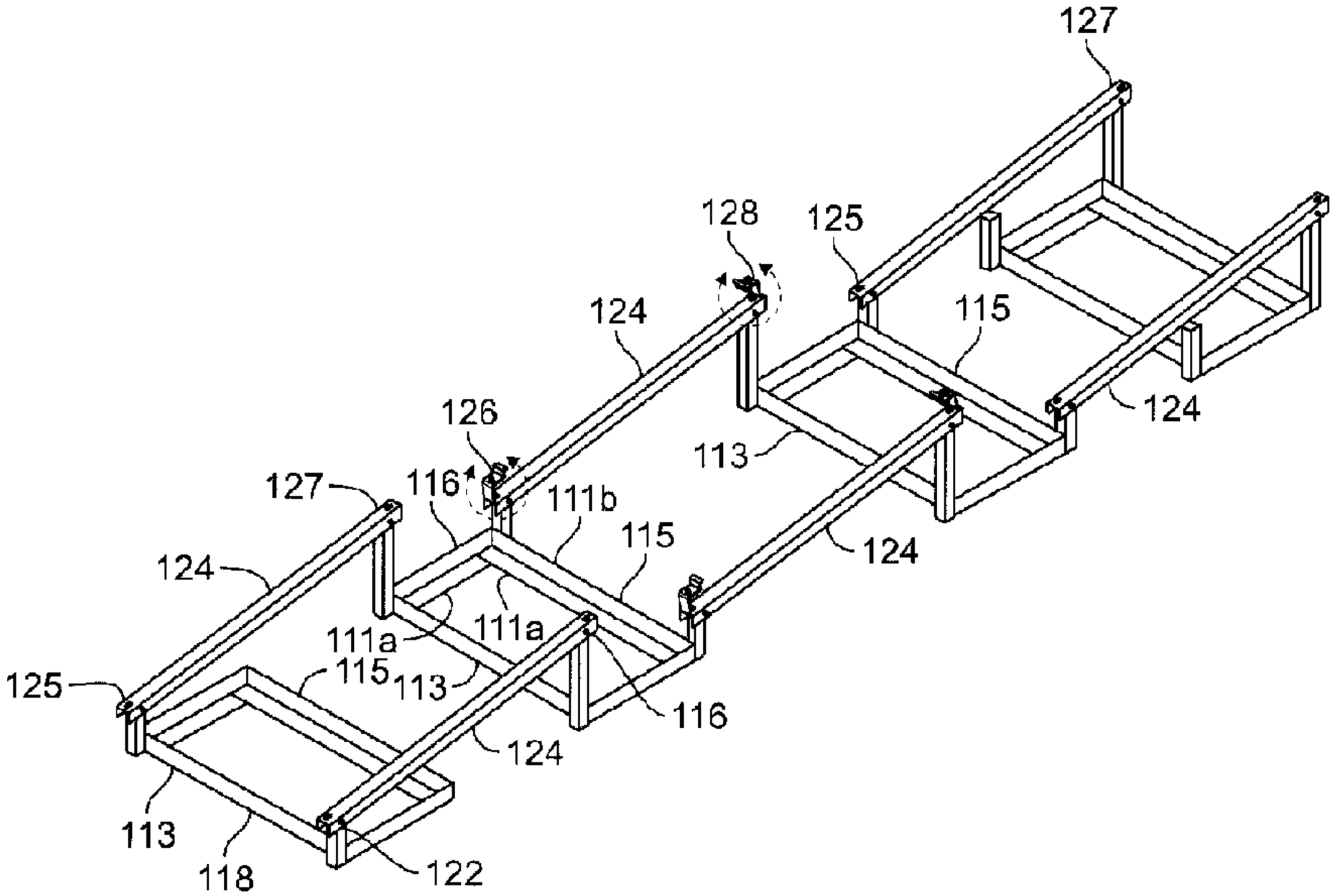
112f
112f
112f
108

FIG. 13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