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(54) **SOLAR PANEL MOUNTING SYSTEM AND INSTALLATION**

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(57) **ABSTRACT**

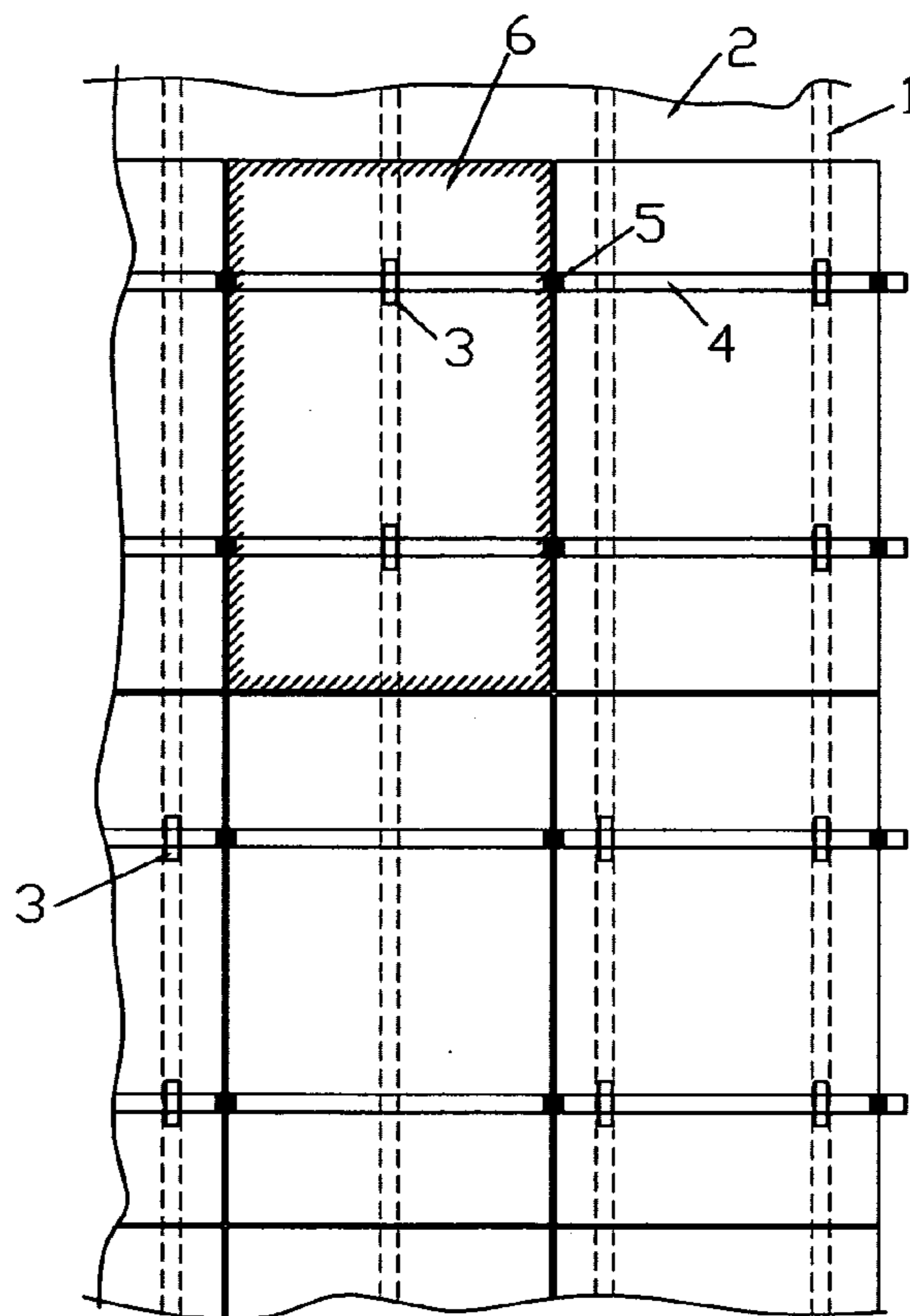
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A solar panel mounting system having a support, a railing and a clamp by utilizing all the components made with the metal structural members available in the market without resorting to a special fabrication or extrusion for saving material costs. It also saves labor for installation. The plurality of supports are screw connected to the roof rafters to accommodate the solar panels. The plurality of rails are placed on the supports and screw connected at job site. The plurality of clamps are slid inside the rail tube from the ends of rails to proper locations for tightening the solar panels by plurality of clips.

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PARTIAL SOLAR PANEL PLAN AND MOUNTING LOCATIONS

- 1. RAFTER
- 2. ROOFING AND SHEATHING
- 3. SUPPORT
- 4. RAIL
- 5. CLAMP
- 6. SOLAR PANEL

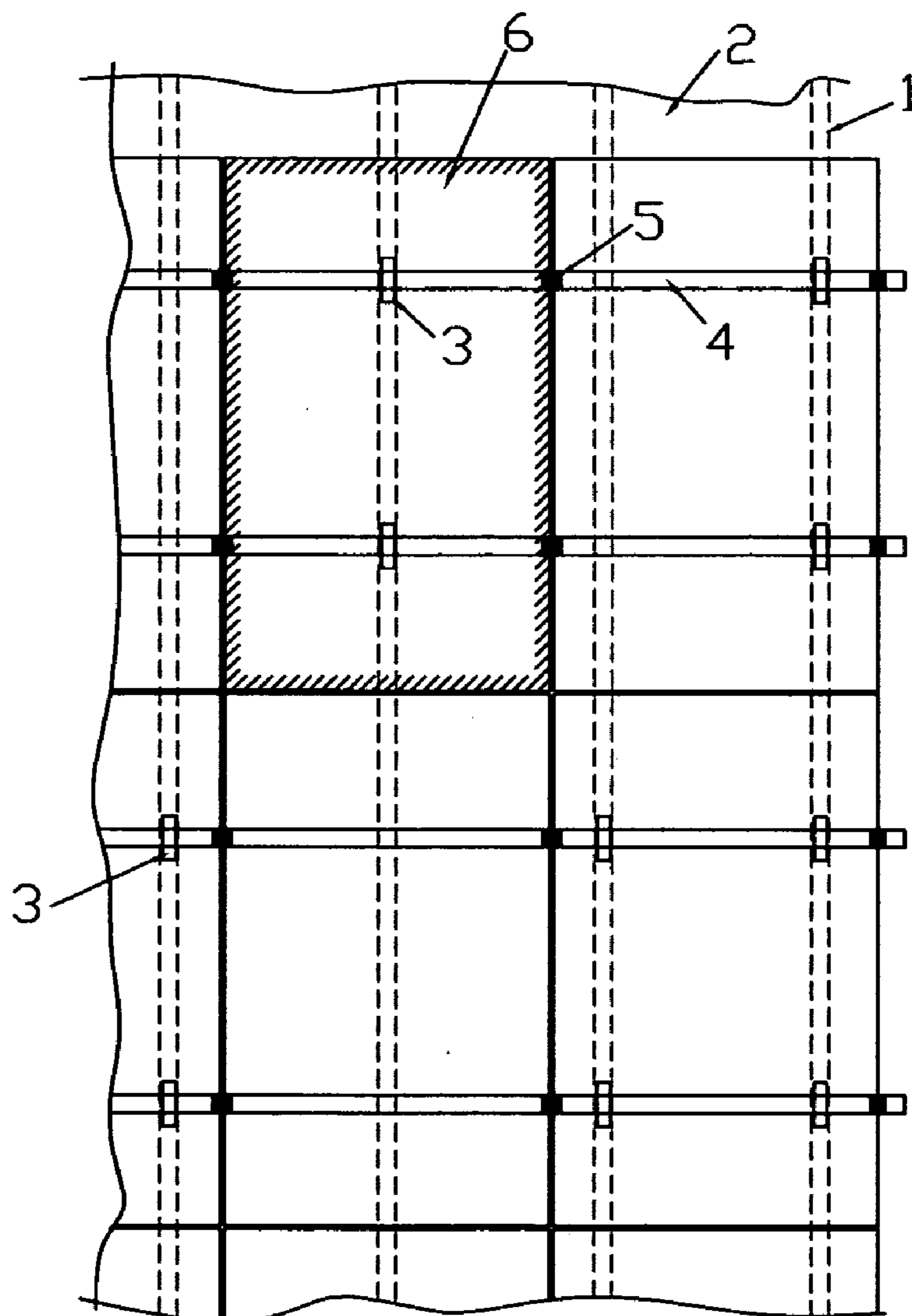


FIG 1, PARTIAL SOLAR PANEL PLAN AND MOUNTING LOCATIONS

- 1. RAFTER
- 2. ROOFING AND SHEATHING
- 3. SUPPORT
- 4. RAIL
- 5. CLAMP
- 6. SOLAR PANEL

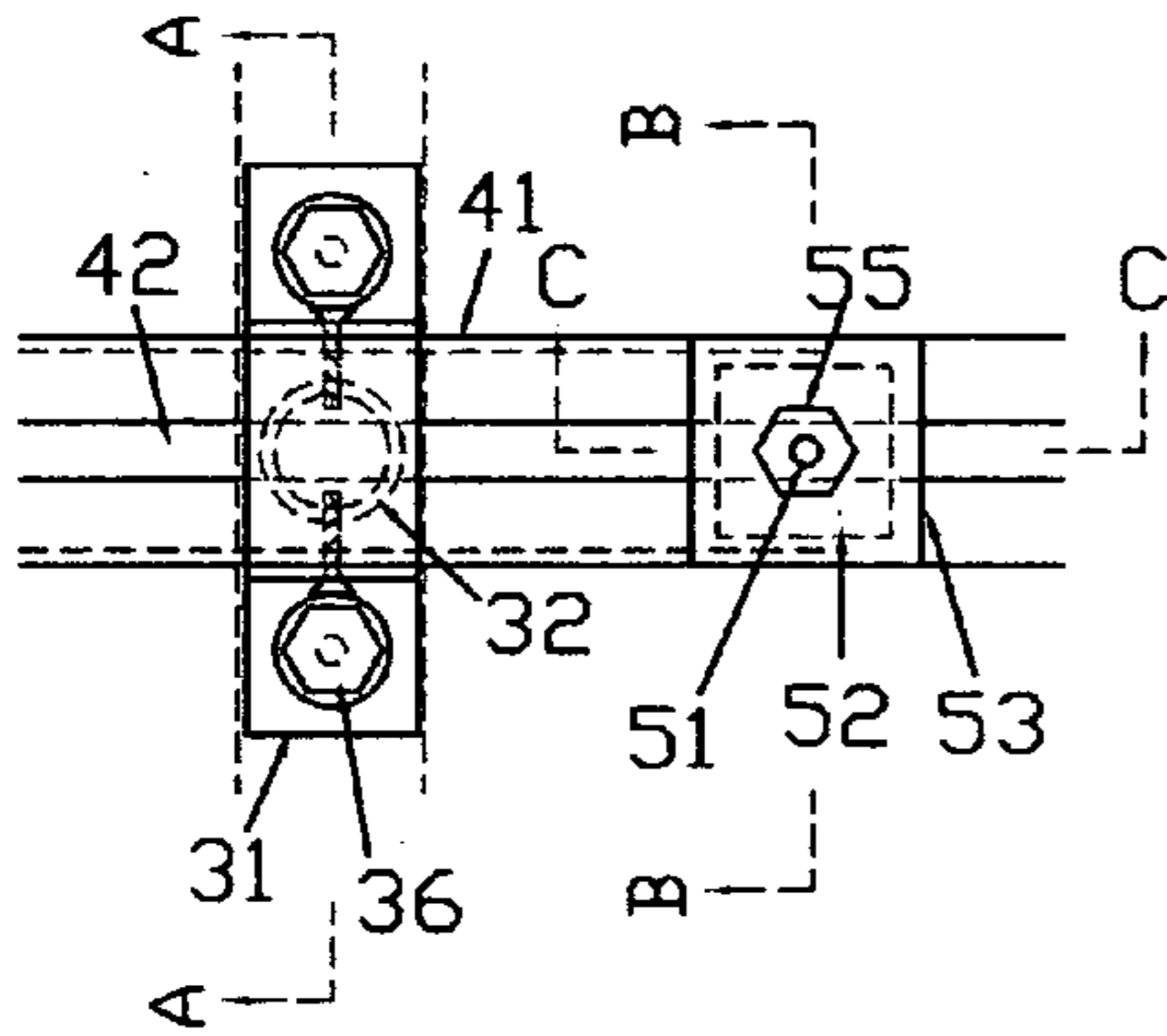


FIG 2, MOUNTING PLAN

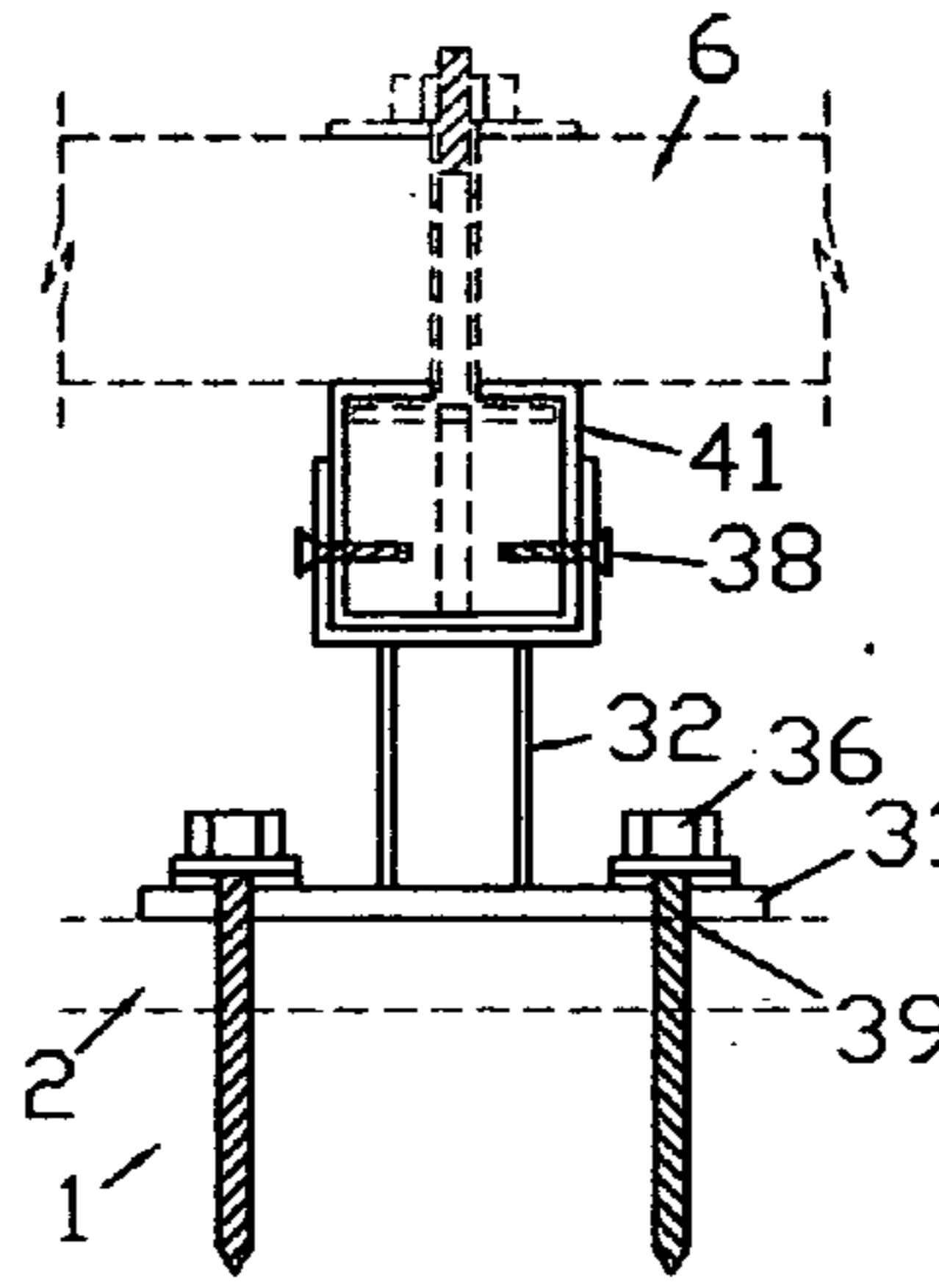


FIG 3A, SECTION A-A

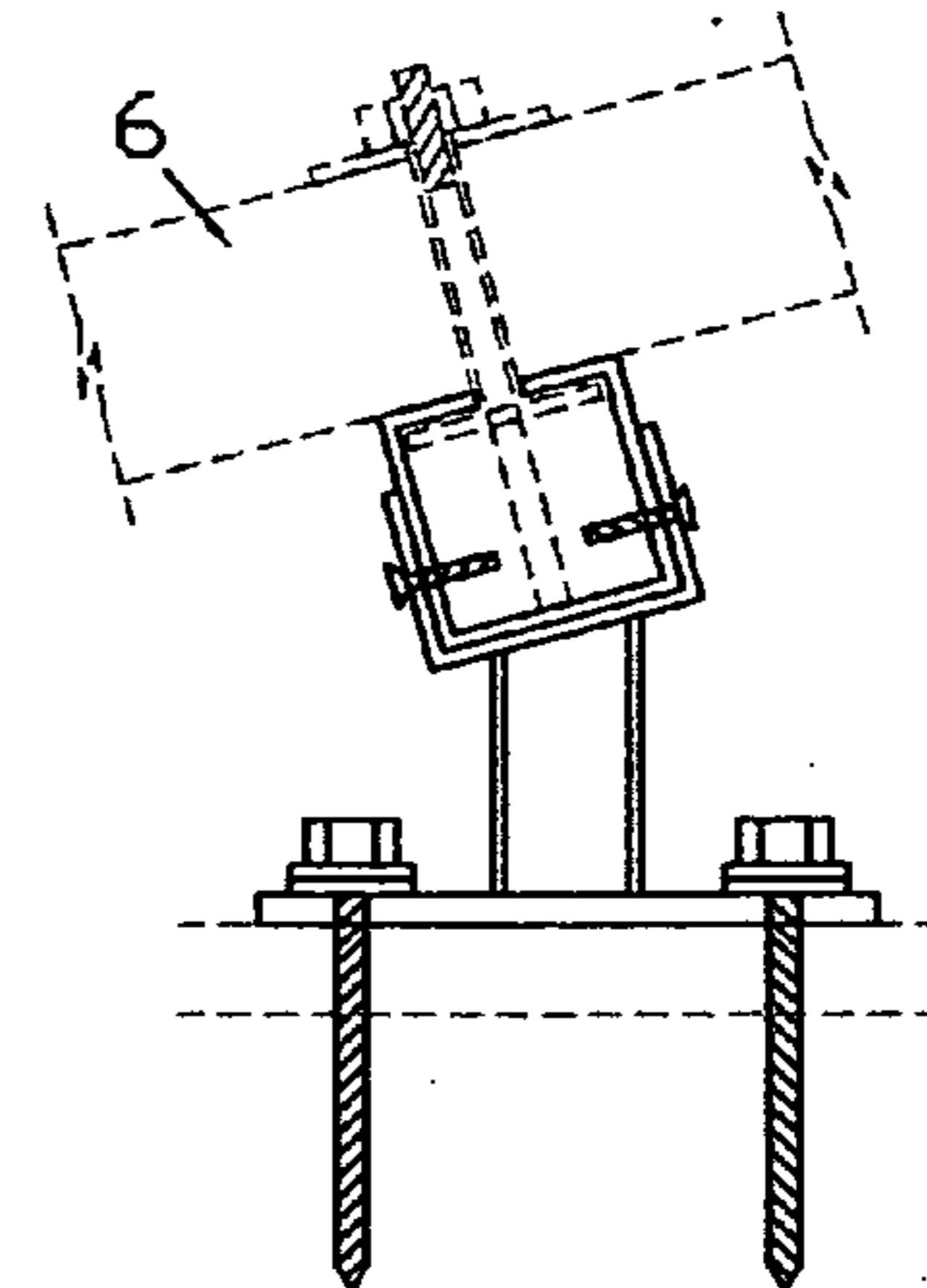


FIG 3B, SECTION A-A

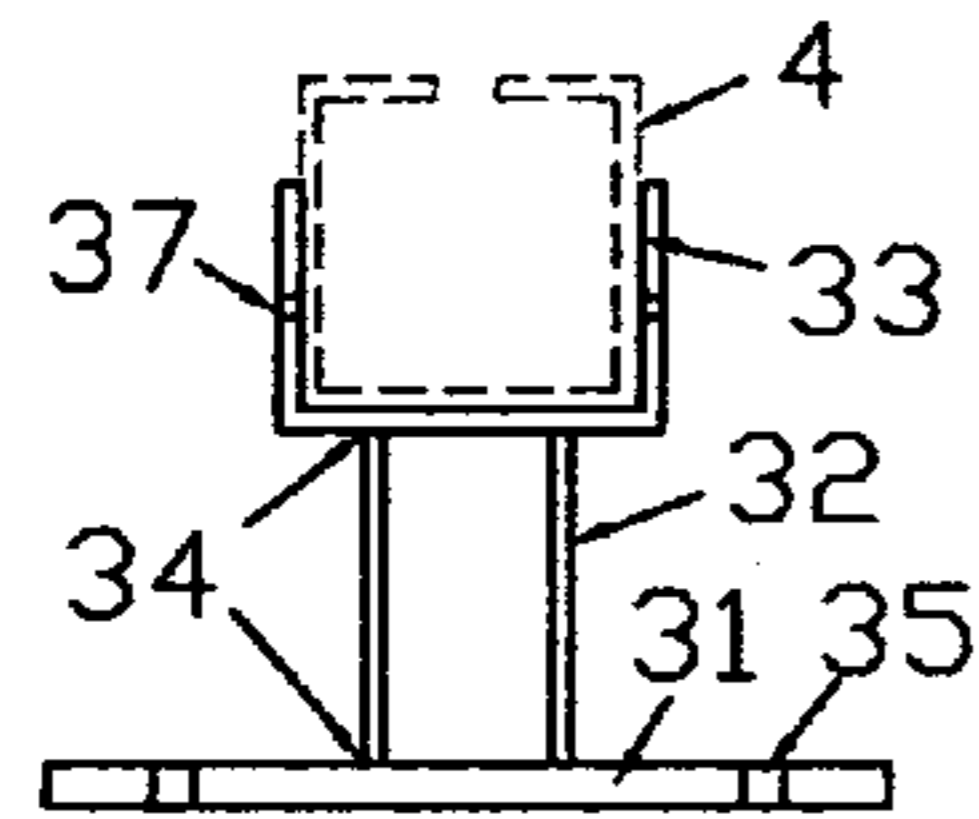


FIG 4, SUPPORT
SECTION B-B

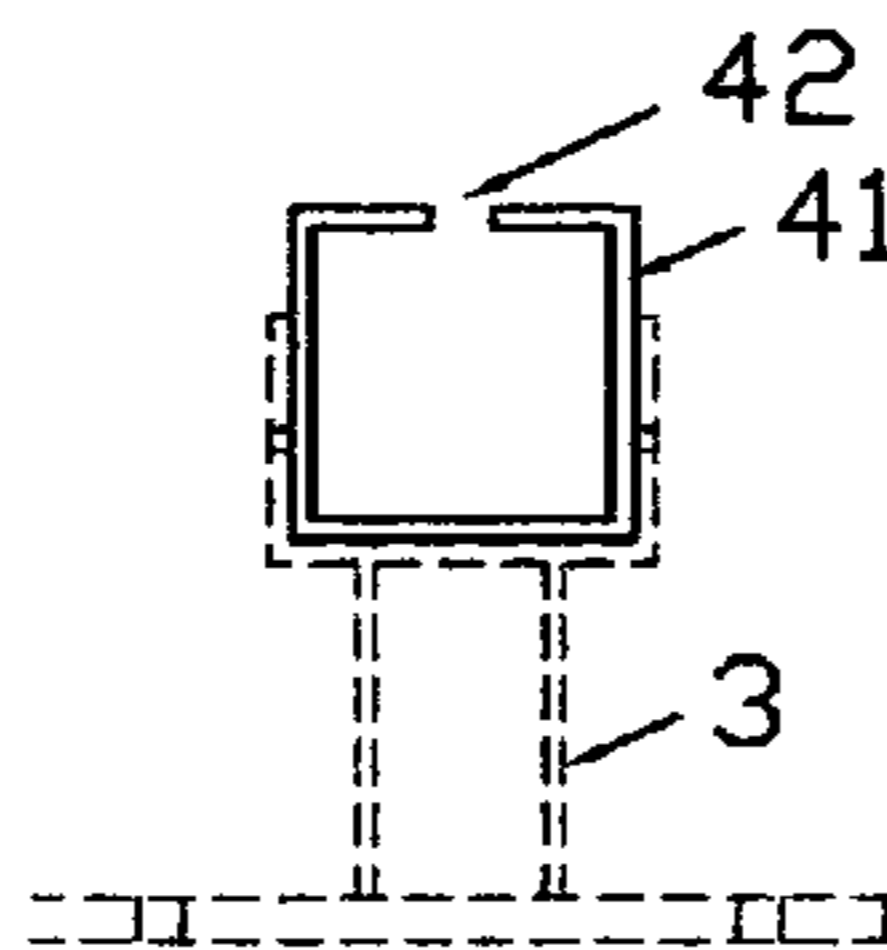


FIG 5, RAIL
SECTION B-B

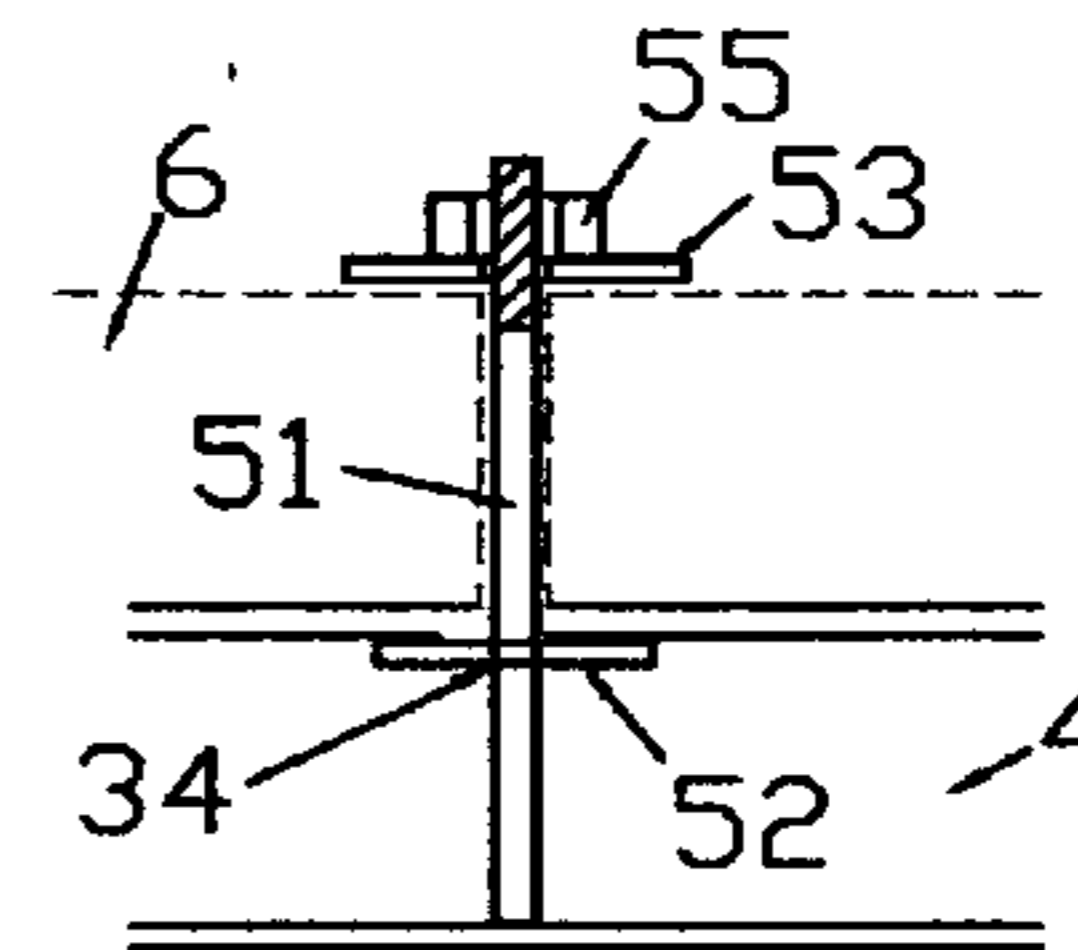


FIG 6A, SECTION C-C
FOR INTERIOR SOLAR PANELS

- 31: BASE PLATE
- 32: CIRCULAR TUBE
- 33: RAIL HOLDER
- 34: WELD CONNECTION
- 35: PRE-DRILLED HOLE FOR SCREW 36 WITH GASKET
- 37: PRE-DRILLED HOLE FOR SELF-DRILL SCREW 38
- 39: LIQUID WASHER

- 41: RECTANGULAR TUBE
- 42: SLOT FOR 51
- 51: THREADED ROD
- 52: SQUARE HOLDING PLATE
- 53: INTERIOR PANEL CLIP
- 54: EXTERIOR PANEL CLIP
- 55: SCREW NUT

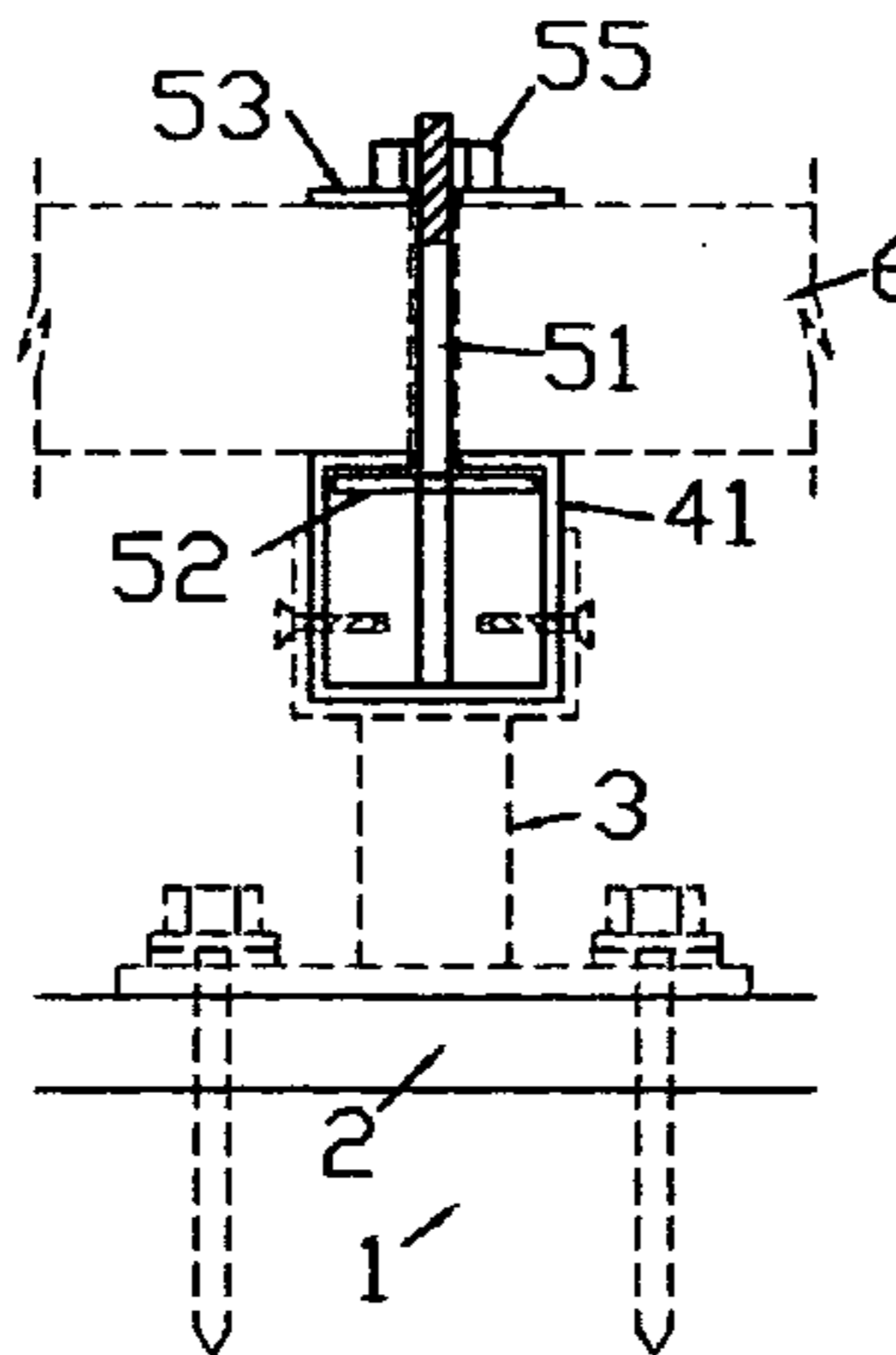


FIG 7, SECTION B-B

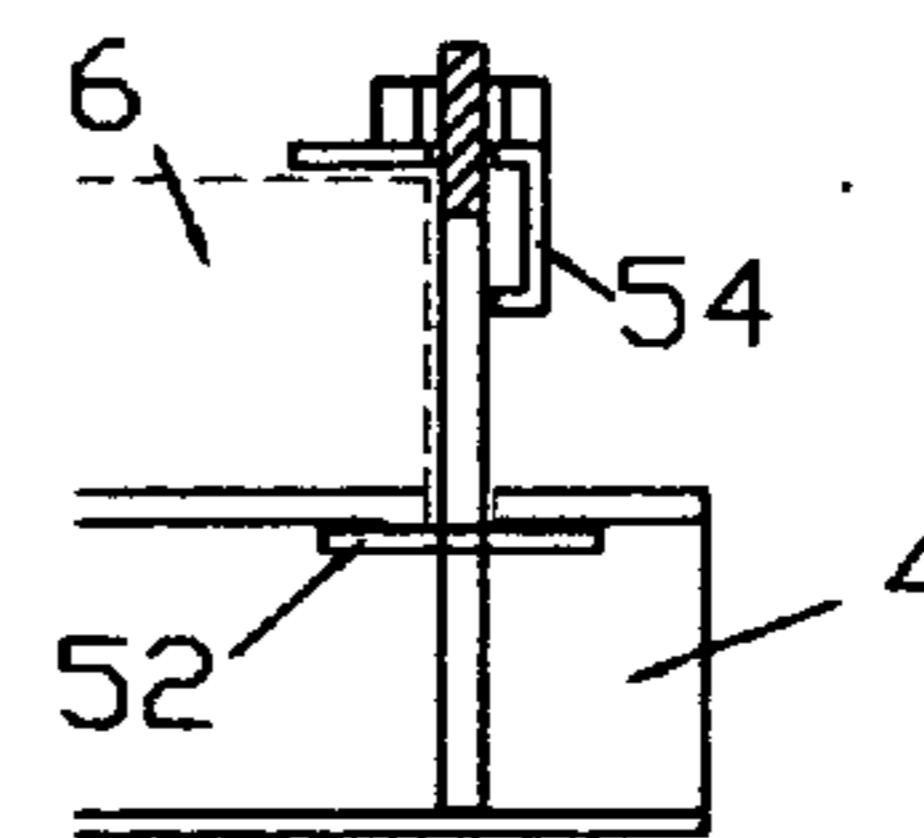


FIG 6B, SECTION C-C
FOR END SOLAR PANELS

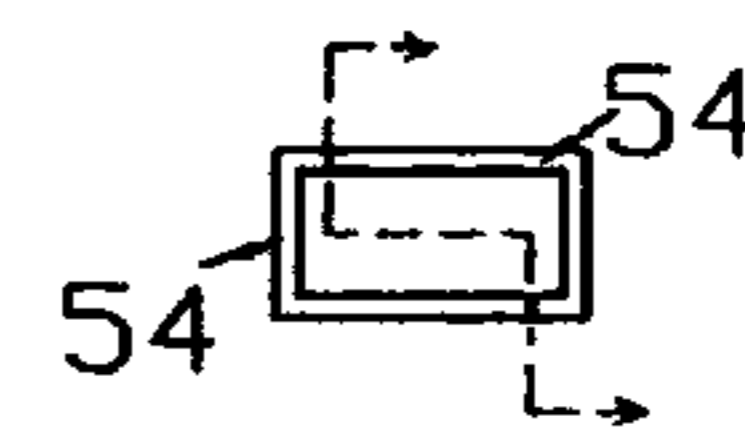


FIG 6C, CUT

SOLAR PANEL MOUNTING SYSTEM AND INSTALLATION

BACKGROUND OF THE INVENTION

[0001] This invention relates to a mounting system with low cost and easy installation of solar panels on the roof of a building.

DESCRIPTION OF THE RELEVANT ART

[0002] A great effort has been taking place in research and development of solar energy systems to generate electricity at a higher efficiency and a lower cost in recent years. The progress has been impressive. There are varieties of mounting systems in the market today. Most of them are made of special fabricated or extruded metals which are relatively expensive and time consuming to install. They resulted in a high percentage of the entire system costs. Technical labor to install the system on the roof under hot sun is difficult to find and expensive. This invention is to utilize the existing metal structural members in construction industry to reduce the material cost and to simplify the installation to save labor cost.

SUMMARY OF THE INVENTION

[0003] A general object of this invention is to utilize the existing metal structural components with simple supporting and clamping devices to save the cost of materials. Another object of this invention is to simplify the installation of the system to save the labor costs. According to the present invention a supporting device is prefabricated with pre-drilled screw holes on the base plate for screws with waterproof gasket to fasten the support to the roof rafter. Liquid washer is used at the screw locations to further insure the water-proofing. A circular metal tube as support is weld connected to a base plate at the middle at the bottom, also weld connected to a rail holder with pre-drilled holes on the top. The rail is screw connected to the rail holder through the pre-drilled holes on the rail holder. A threaded rod placed inside the rail extended from the bottom of the rail to above the solar panels is weld attached with a square holding plate right below the top side of rail and another square plate as clip above the solar panels to clamp down the solar panels by a nut on the top. The solar panels are thus well connected to the roof structures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The accompanying drawings, which are incorporated in and constitute a part of the specifications, illustrate preferred embodiments of the invention, and together with the description serve to explain the principles of the invention.

[0005] FIG. 1 shows a partial plan of the solar panel system and mounting locations.

[0006] FIG. 2 is an enlarged plan of the mounting system.

[0007] FIG. 3 is a cross-section A-A of the mounting system, showing how the support is tied to the roof rafter.

[0008] FIG. 4 illustrates the support with the structural components welded together and the locations of pre-drilled screw holes.

[0009] FIG. 5 shows the rail with a pre-cut slot on the top of a rectangular tube.

[0010] FIG. 6 shows the threaded rod weld connected by a square holding plate at the height right underneath the top side of the rail and another square plate above the solar panels as a clip to clamp down the solar panels by a nut.

[0011] FIG. 6C illustrates the way to cut a rectangular tube to two identical end panel clips.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Reference is now made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals indicate like elements throughout the several views.

[0013] With the rapid increase in the use of solar panels on the roof of buildings to generate electricity in recent years, various mounting systems have been created to install the solar panels. The cost of materials is relatively expensive because they are made of specially fabricated or extruded metals. This invention creates new simplified method by the utilization or modification of the existing structural members widely used in today's construction industry. The installation of the system is also simplified to save the labor costs. The support as illustrated in FIG. 4 is made in the factory by weld connecting a circular tube 32 to a base plate 31 at the bottom and weld connecting a u-shaped rail holder 33 on the top. The base plate 31 can be cut from a regular aluminum sheet to a size of 1/4 inch thick by 1 1/2 inches width by 6 inches long for example. Two pre-drilled holes 35 located as shown on FIG. 4 are provided for screws 36 with water-proof gasket to fasten support 3 to the roof rafter 1. In addition to the gaskets on the screws, liquid washer 39 as shown on FIG. 3A is placed at the screw 36 locations before drilling screw 36 to the rafter 1 to double ensure the waterproofing. Only one row of screw holes 35 is provided herein because most rafter widths are around two inches or less which normally are not wide enough to accommodate more than one row of screws 36. The number of screws 36 is determined by the loads, spacing of support 3 and the size of screw 36. One row of two screws for four feet spacing of support 3 for example is sufficient for general applications. More than two screws in one row with a longer and thicker base plate 31 may be used if needed. Rafter 1 could be flat or sloped and its material could be wood, steel or concrete. A regular stainless steel lag screw for wood, self-drilling stainless steel screw for steel and stainless steel concrete screw for concrete are examples to fasten support 3 to roof rafter 1.

[0014] The circular tube 32 can be cut from a regular metal pipe, such as an 1 inch diameter by 1/8 inch wall thickness aluminum pipe for example. Its height depends on the needs for roof drain and ventilation underneath the solar panels 6. Normally 2 inches to 6 inches is sufficient for applications. The top of the circular tube 32 can be cut flat as shown on FIG. 3A or tilted as shown on FIG. 3B according to the need of solar panels to be tilted toward the sun. The rail holder 33 can be cut from a regular rectangular metal tube with its width fit to hold rail 4. It can be cut in half to two identical pieces from a 2 1/4 inch by 3 inch by 1/8 inch wall thickness of a regular aluminum rectangular tube at 1 1/2 inches leg height to fit a 2 inch by 2 inch square tube rail 4 for example. Pre-drilled holes 37 on both legs of the rail holder 33 are provided in factory to accommodate screw 38 for fastening support 3 to rail 4. The use of self-drilling screw 38 at job site allows an even height of rail 4 on an inevitable small unevenness of the roof surface supported by plurality of identical supports 3 for the entire solar panel system. Screw 38 and its attaching structural members 33 and 41 should have enough strengths to carry downward and upward loads from the solar panels. Screw 38

should not be too long to interfere with the free passage of the threaded rod **51**. A 1/4 inch diameter by 3/4 inch long stainless steel self-drilling screw **38** for example can be used for a 2 inches by 2 inches rail **4**.

[0015] Rail **4** as shown on FIG. **5** is the main structural member made from a rectangular tube cut a slot **42** on the top to allow the plurality of threaded rods **51** to slide to proper locations from the ends of rail **4** for fastening the plurality of solar panels **6** to rail **4**. Its size is determined by the downward and upward loads from the plurality of solar panels **6** and spacing of the plurality of supports **3**. A 2 inches by 2 inches by 1/8 inch wall thickness aluminum square tube with 4 feet spacing of supports **3** for example is sufficient for normal applications. The 4 feet spacing of supports **3** can fit to most of the rafter spacing of 12 inch, 16 inches or 24 inches.

[0016] Threaded rod **51** as shown on FIG. **7** extends from the upper surface of the bottom side of rail **4** to above the solar panels **6** with sufficient length for nut **55** to fasten solar panels **6** to rail **4**. A partially threaded rod **51** sits on the upper surface of the bottom side of rail **4** so that screw rod **51** can stay at a proper height for fastening. A square holding plate **52** with its size fits to the distance between the interior faces of the side walls of rail **4** is weld attached to threaded rod **51**. Its rectangular shape prevents the threaded rod **51** from spinning when tightening nut **55** from the top. It also holds the solar panels **6** and rail **4** by clip **53** or **54**. A square clip plate **53** is used for a strong resistant to a high uplift wind load. It is placed on the top of solar panels **6** to fasten plurality of interior solar panels **6** to rail **4** as shown on FIG. **6A**. A clip **54** with the shape as shown on FIG. **6B** is used for fastening end solar panels. Exterior clip **54** can be cut in two identical pieces as shown on FIG. **6C**. A 1 inch by 2 inches by 1/8 inch wall thickness aluminum rectangular tube can be cut to two identical exterior panel clips **54** at 2 inches long for example. A 1/4 inch diameter stainless steel rod **51** and a stainless steel nut **55** with 1/8 inch thick aluminum holding plate **52** and interior panel clip **53** for example can be used for general applications. This invention allows the space between the solar panels at screwed rod diameter of 1/4 inch as shown by the above example instead of 1 inch by using the mounting system as shown in U.S. Pat. No. 7,600,349, "Low Profile Mounting system" issued to John E. Liebendorfer on Oct. 13, 2009 for example. This less in space not only save the whole area covered by the system, it also create a better structural connection for the clip to tie down the solar panels.

[0017] The present invention includes a method of installing the mounting system. The plurality of shop prefabricated supports **4** are screw connected to the plurality of roof rafters **1**. The plurality of supports **3** are placed at staggered locations for each row of solar panels **6** as shown on FIG. **1** so that loads from the solar panels **6** can be properly distributed to all rafters **1** underneath all solar panels **6**. Rail **4** is placed on the plurality of support holders **3** before drilling screws **36** to the plurality of rafters **1** to ensure a proper alignment of supports **3**. Liquid washer **39** is placed in pre-drilled holes **35** prior to support **3** is fastened to rafter **1** by screw **36**. After examining the evenness of rail **4**, rail holder **31** is fastened to rail **4** by screw **38** through the pred-drilled hole **37** at the job site. Factory prefabricated plurality of threaded rods **51** welded to a square holding plate **52** are slid to the proper locations from

the ends of rails **4**. The plurality of solar panels **6** are properly placed and fastened to rails **4** by nuts **55** with clips **53** underneath as shown on FIG. **6A** for interior solar panels or FIG. **6B** for end solar panels.

[0018] It will be apparent to those skilled in the art that various modifications can be made to the mounting system of the instant invention without departing from the scope of spirit of the invention, and it is intended that the present invention covers modifications and variations of the mounting system provided they come within the scope of the appended claims and their equivalents.

1. A mounting system comprising:

- a plurality of supports fastening to the plurality of roof rafters;
- a plurality of rails fasten to the plurality of supports to support solar panels;
- a plurality of clamp threaded rods inserted inside the rail tube and fasten the plurality of solar panels with clips.

2. The mounting system as set forth in claim **1**, with a support consists a circular tube weld connected to a base plate at the bottom and a rail holder on the top with pre-drilled screw holes at the base plate for screw connecting to the roof rafters, also pre-drilled screw holes at the rail holder for screw connecting to the rail. All of the materials are cut from existing metal structural members in the market.

3. The mounting system as set forth in claim **1**, with the supporting circular tube can be cut sloped to have the solar panels tilt toward the sun.

4. The mounting system as set forth in claim **1**, with a rail cut a slot on the top for supporting solar panels and the slot to guide plurality of clamps to proper locations to clamp the solar panels to the rail, the metal rail is available in the market as standard metal structural members.

5. The mounting system as set forth in claim **1**, with a clamp consists of a threaded rod, a square holding plate weld connected to the threaded rod and clip on the top of the solar panels to tie down the solar panels. All of the materials are available in the market as metal structural members

6. The mounting system as set forth in claim **1**, with the threaded rod sitting on the upper face of the lower side of rail to have the clamp system stay at a proper height for fastening.

7. The mounting system as set forth in claim **1**, with a square holding plate welded to the threaded rod at the lower face of the top side of rail to prevent from spinning when tightening the nut above the solar panels.

8. The mounting system as set forth in claim **1**, with a square holding plate welded to the threaded rod at the lower face of the top side of rail to hold the solar panels by clips above.

9. The mounting system as set forth in claim **1**, with the clip for the end panel is cut from a rectangular metal tube in two identical pieces.

10. A method for installing the mounting system, comprising the steps of

- fastening a plurality of supports to the roof rafters;
- fastening a plurality of rails to the plurality of supports;
- connecting the solar panels to the rails with a plurality of clamps.

11. The method of installing a mounting system, as set forth in claim **6**, uses gasket screws with further water-proofing by placing liquid washer at the screw locations to fasten the supports to the roof rafters..

12. The method of installing mounting system, as set forth in claim **6**, places rail on supports prior to fasten the supports to roof rafters to ensure a proper alignment of the supports.

13. The method of installing mounting system, as set forth in claim **6**, places supports at staggered locations for each row of solar panel to ensure a proper load distribution to the rafters.

14. The method of installing a mounting system, as set forth in claim **6**, screw connected to the rail at job site to ensure the evenness of the rail on an inevitable small unevenness of the roof surface.

15. The method of installing a mounting system, as set forth in claim **6**, provides the space between solar panels at a distance of threaded rod diameter.

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