Nov. 7, 1967 K. McCONNELL 3,351,212

PALLET RACK CONSTRUCTION

Filed Jan. 7, 1966 2 Sheets-Sheet 1

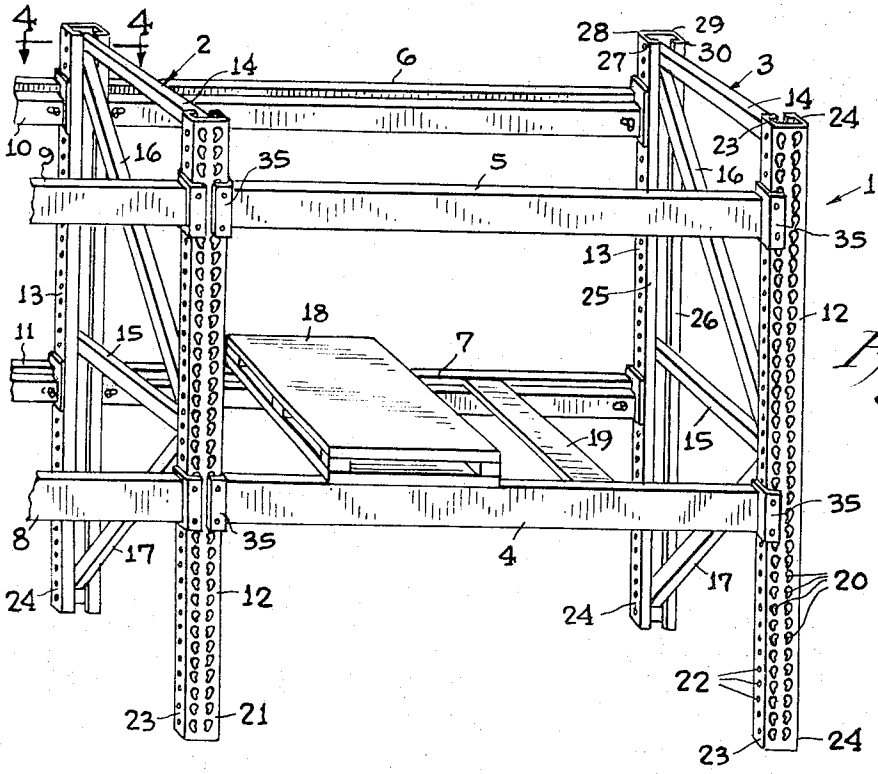


Fig. 1

Fig. 2

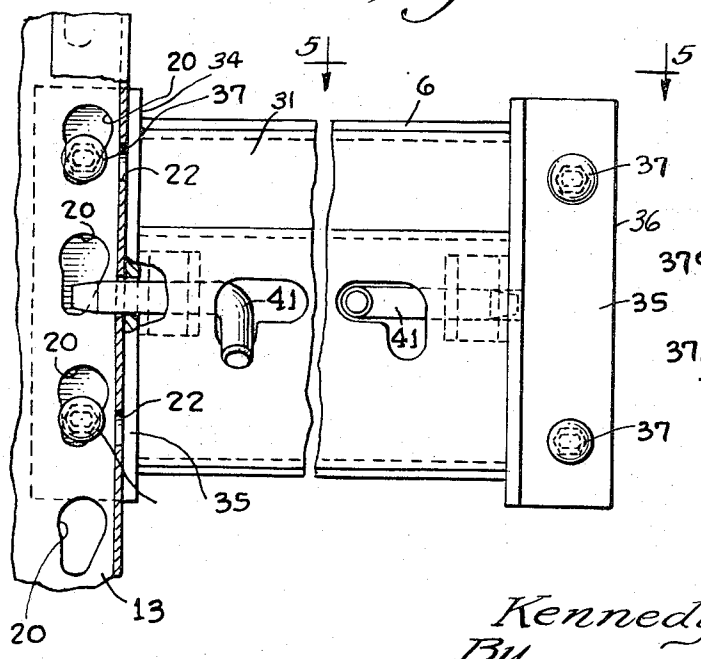
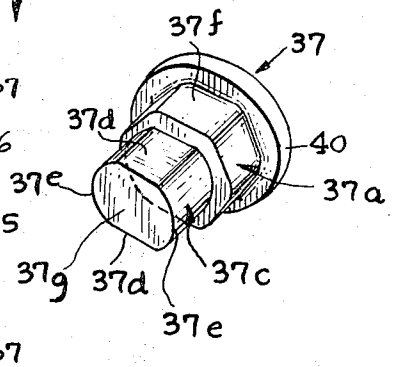


Fig. 3



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Nov. 7, 1967 K. McCONNELL 3,351,212

PALLET RACK CONSTRUCTION

Filed Jan. 7, 1966 2 Sheets-Sheet 2

Fig. 4.

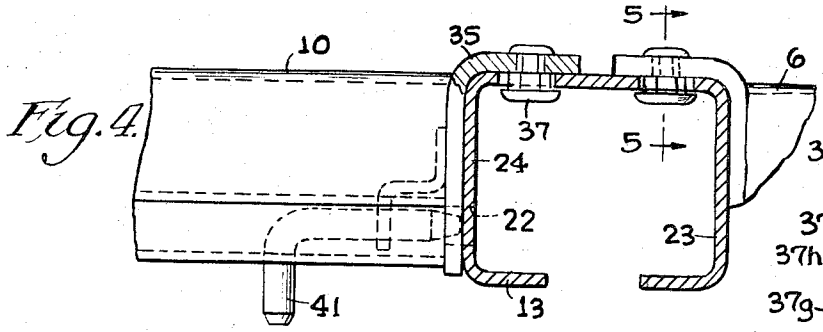


Fig. 5

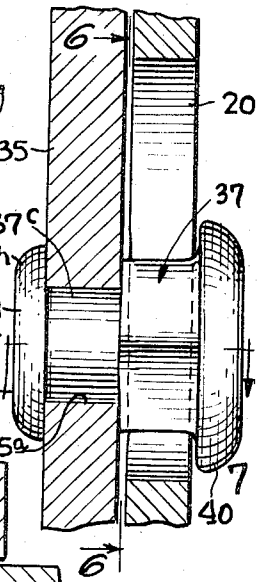


Fig. 7.

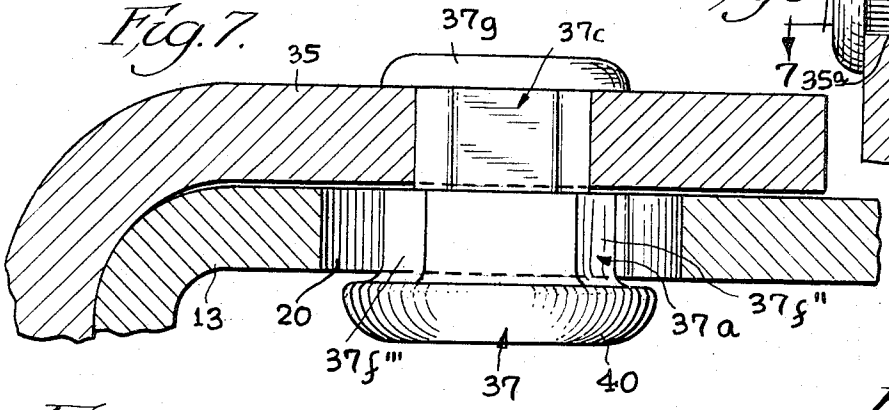
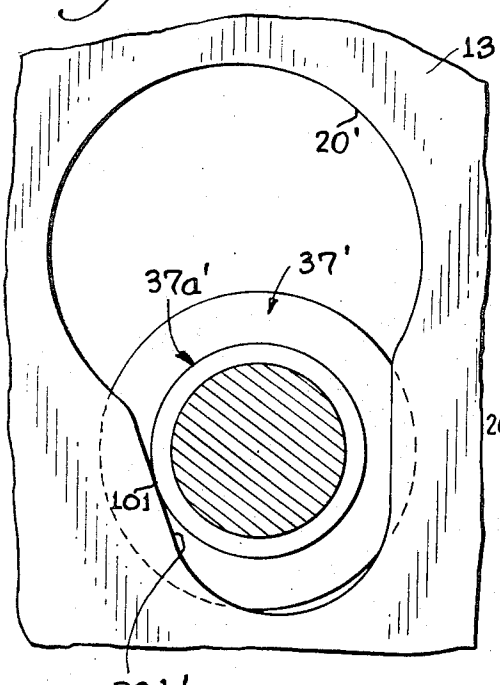
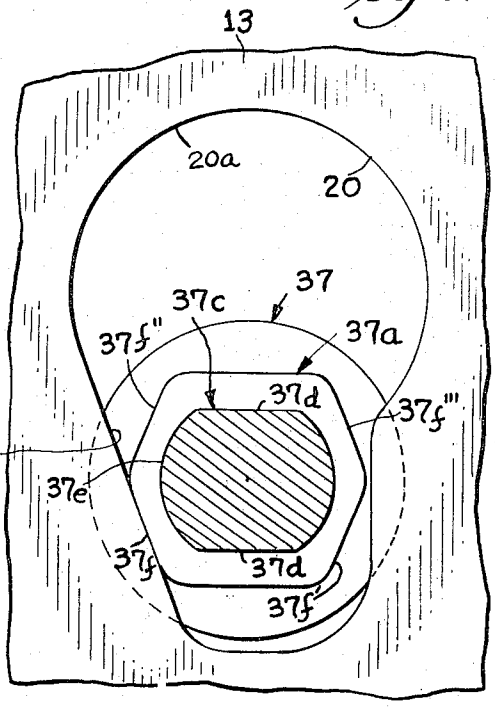


Fig. 8.



PRIOR ART

Fig. 6.



United States Patent Office 3,351,212 Patented Nov. 7, 1967

3,351,212

PALLET RACK CONSTRUCTION

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Filed Jan. 7, 1966, Ser. No. 519,278
3 Claims. (Cl. 211—177)

ABSTRACT OF THE DISCLOSURE

A pallet rack type support structure having beams and uprights connected together by means of flanged lugs engaging keyhole openings. The lugs have a plurality of peripheral flat surfaces extending at different angles to provide for flat contact between the lugs and the sides of the keyhole openings in different oriented positions of the lugs.

This invention relates to the art of pallet racks of a type embodying vertical upright members detachably secured to horizontal load supporting members and particularly applies to an improved connector between the vertical and horizontal members.

In United States Patent 3,070,237, issued Dec. 25, 1962, is shown a typical pallet rack structure of a type in which the features of this invention can be particularly embodied. In that type of pallet rack, the vertical upright members are provided with sloped keyhole slots into which studs or lugs are connected for the purpose of providing connections between the vertical and horizontal members. The studs or lugs are of circular cross-section in the regions of their contact with the keyhole slots and this substantially provides line contact between the studs or lugs and the portions of the keyhole slots they engage. This line contact provides heavy stress concentration when the pallet rack is under load and, in time, the region of contact becomes indented and this decreases the rigidity of the connections.

It is the principal object of this invention to provide improved connections between the vertical and horizontal members by means of an improved design for the studs or lugs used in the connections.

In order to achieve this object, it is another object of this invention to provide an improved lug or stud which has at least one flat surface on it used to engage a portion of a keyhole in an upright in order to provide a large area of bearing contact.

It is still another object of the invention to provide such a lug or stud which is reversible when assembled to its horizontal member so that proper orientation of any flat surfaces on it is automatic.

It is another object of the invention to provide such a stud or lug which is readily adapted to right or left hand orientation because it is provided with a plurality of flat bearing surfaces, any one of which can be the particular bearing surface for a horizontal member, depending upon how the lug or stud happens to be assembled to the horizontal member.

Other objects and advantages of the invention should become apparent upon reference to the accompanying drawings in which:

FIG. 1 shows a perspective view of a partially cut-away pallet rack embodying the features of this invention;

FIG. 2 shows a partially cut-away and sectional elevation view of a horizontal beam connected to a vertical upright;

FIG. 3 shows a perspective view of a stud or lug embodying the features of the invention;

FIG. 4 shows a horizontal sectional view of a vertical member connected to a horizontal member as viewed approximately along the lines 4—4 of FIG. 1;

FIG. 5 is enlarged sectional view along the line 5—5 of FIG. 4 to particularly show one of the connector lugs in position;

FIG. 6 is an enlarged sectional view along the line 6—6 of FIG. 5;

FIG. 7 is an enlarged sectional view along the line 7—7 of FIG. 5; and

FIG. 8 shows an enlarged sectional view similar to FIG. 6, except that it shows the prior art connection.

As viewed in FIG. 1, a typical support structure or pallet rack 1 consists of a pair of ladder-shaped upright frames 2 and 3 spaced apart from each other and joined together by means of horizontal beams 4, 5, 6 and 7. These beams are joined at their ends to the upright frames 2 and 3 in a manner hereinafter described. The upright frame 2 is also joined to the ends of other horizontal beams 8, 9, 10 and 11 which, although not shown, extend to an additional spaced upright frame similar to frames 2 and 3. In this manner the entire pallet rack 1 can be made any length required. Just as the beams 8, 9, 10 and 11 extend from the frame 2, other beams can extend in the opposite direction from the frame 3 so that the pallet rack can be extended in length in either direction.

Each of the upright frames 2 and 3 consists of a front upright 12 and a rear upright 13 joined together by horizontal front to back members 14 and 15 and diagonal braces 16 and 17. Naturally the lengths of the members 14, 15, 16 and 17 can be appropriately cut to space the uprights 12 and 13 as far apart as necessary to provide the proper span between the front beams 4 and 5 and the rear beams 6 and 7. Also, the uprights 12 and 13 can be made as tall as necessary in order to accommodate the required vertical spacing of the horizontal beams, as well as to permit positioning of as many vertically spaced beams as desired. Also, additional members similar to 14, 15, 16 and 17 can be added to provide sufficient rigidity and strength.

With the structure as shown in FIG. 1, the beams 5 and 6 provide a span across which pallets or other articles can span so that the beams act as their support at an upper level. Similarly the beams 4 and 7 provide a spanned support for pallets or other objects at a lower level. A pallet 18 is shown supported by the beams 4 and 7 and also a board 19. If continuous shelving is required so that objects will not fall through the spanned opening between the beams, a plurality of boards 19 can be positioned side by side along the beams to provide a continuous uninterrupted support for various shapes and sizes of objects.

The front to back members 14 and 15 and diagonal braces 16 and 17 are preferably welded at their ends to the uprights 12 and 13 in order to provide the completed ladder-shaped upright frames 2 and 3. This enables the frames 2 and 3 to be shipped as integral units, thus saving erection time and also insuring a rigid structure which might not be obtained if nuts and bolts or other fastening means are used to secure these members together.

Each of the uprights 12 and 13 is provided with two rows of first openings 20 extending along the entire length of the front walls 21 of the uprights. The openings 20 are equally spaced from each other by a fixed increment. Each of the uprights 12 and 13 is also provided with a row of equally spaced openings 22 along opposite side walls 23 and 24 of the uprights. These side walls 23 and 24 are positioned parallel to each other and are connected therebetween by the front wall 21 which forms the upright into a channel shape. The side walls 23 and 24 are provided with flanges 25 and 26 which extend toward each other in a plane parallel to the front wall 21 of the upright. The flanges 25 and 26, the side walls 23 and 24 and the front wall 21 together provide a flanged channel-shaped upright with four corners 27, 28, 29 and 30 which impart column strength and rigidity to the uprights.

Even though different number designations have been given to the horizontal beams, they are all identical in structure and can be used interchangeably as front or back beams by merely rotating them 180° end to end in a horizontal plane.

As shown in FIGS. 1, 2 and 4 a horizontal beam **6** consists of an L-shaped tube **31**. This tube **31** is welded at each of its ends to one wall **34** of an L-shaped end flange **35**. The other wall **36** of the end flange **35** is provided with two inwardly extending flanged lugs **37** which are in fixed positions on the end flange **35**.

Each lug **37** is provided with the improved features of this invention. As shown in FIG. 3, the lug **37** has a hexagonal central portion **37***a* connected between an enlarged diameter flange or flanged portion **40** and small diameter portion **37***c* which is provided with two flats **37***d* and two radius portions **37***e*. The hexagonal portion **37***a* has six flat portions **37***f* which are substantially of the same size. As indicated especially in FIGS. 5 and 7, the lug or stud **37** is attached to an L-shaped end flange **35** by passing the portion **37***c* through an opening **35***a* in the flange **35** which opening is of the same size as the cross-sectional shape of the portion **37***c*. After it is inserted, the free end **37***g* is peened over and provided with a flange **37***h* which retains the stud **37** in the hole **35***a*. The shape of the hole **35***a* corresponding to the cross-section of the lug portion **37***c* keeps the lug from rotating and insures proper orientation of the lug when it is assembled to the flange **35**.

In order to assemble a horizontal beam to an upright **12** or **13**, the beam is extended horizontally and its L-shaped end flange **35** is brought to bear against the front wall **21** and a side wall **23** or **24** of an upright. In order to do this the lugs **37** on the flange are aligned to pass through the openings **20** in the upright. These openings **20** are key-shaped, having an enlarged circular portion **20***a* intersecting a narrow elongated portion **20***b* which is slightly canted toward the center of the upright. Having two rows of these holes **20**, the effect is that these elongated portions **20***b* are canted or sloped toward each other. Also, a hole **20** in one row is positioned immediately opposite a hole **20** in the adjacent row. Since there is equal spacing between all of the holes, each is positioned with another immediately adjacent to it laterally. The enlarged circular portion **20***a* is of a diameter larger than the diameter of the flanges **40** of the lug **37** so that the lug **37** can freely fit through it. The portion **37***a* of the lug is slightly smaller than the width of the elongated portion **20***b* so that the lug can be dropped down into the elongated portion **20***b* after it has been passed through the circular portion **20***a*. Because of the particular dimensions of the end flange **35** and the positions of the lugs **37** thereon, as the lugs of the flange slide down the incline of the elongated portions **20***b* of the holes **20**, the wall **34** of the end flange is brought to bear tightly against a side wall **23** or **24** of the upright **12** or **13**. These lugs **37**, therefore, provide bearing support for the horizontal beam **6** along the plane of the front wall **21** of the upright **13**.

By drawing the wall **34** of the end flange **35** snugly against the side wall **23**, this provides a fairly rigid connection between the horizontal beam **6** and the upright **13**.

In order to further enhance the rigidity of the structure, the horizontal beams **4**, **5**, **6** and **7** are all provided with sliding bolts **41**. The operation of these sliding bolts **41** is described with particularity in U.S. Patent 3,070,237 referred to above.

In prior construction, as shown in FIG. 8, a lug **37'** engages a keyhole opening **20'** similar in shape to the keyhole opening **20**. The lug **37'** is provided with a circular portion **37***a'* which corresponds to the hexagonal portion **37***a* of the lug **37**. It is quite apparent that this circular portion **37***a'* engages the wall of the elongated hole portion **20***b'* along line contact at region **101**. With this type of connection, as lug **37'** is urged downwardly with the result that the connection between flange **35** and upright **13** is tightened, the contact at portion **101** becomes deformed because of the heavy stress concentration. This has the effect of destroying the dimensional relationship creating the tightening action as the lug **37'** cams along the surface of the hole portion **20***b'* and, in time, looseness at the connections develops which diminishes joint rigidity.

With the improved stud or lug **37**, particularly indicated in FIG. 6, one of the flat surfaces **37***f* on the lug portion **37***a* provides wide bearing area of contact along the hole portion **20***b*. With this flat area of contact, there is little tendency to deform the contacting surfaces because the load stress is spread over the entire area of contact. The result is a minimum change in joint dimensions with a resultant continuance of joint rigidity.

This stud or lug **37** has the further advantage that it can be used for right hand or left hand connections. For example, it is apparent that the connection shown in FIG. 6 is one which is used for a connection of a flange **35** at the left end of a beam, as indicated in FIG. 4 where the keyhole has a cant or slope in one direction. The holes in the upright for connections to the right end of a beam are of the opposite slope and, when the right end of a beam is connected to the upright, the flat surface **37***f'* may be used to provide the bearing surface of contact. It should also be apparent that the stud or lug can be inverted in the opening **35***a* during its initial assembly to a flange **35** with the result that either of the other two flat surfaces **37***f''* and **37***f'''* can be used depending upon whether or not it is a left hand or right hand connection. Actually the upper and lower flat surfaces **37***f* are not used. They can remain flat or be curved, whichever is easier to manufacture. In any case, it should be apparent that the particular shape of the hole **35***a* allows the stud or lug **37** to be positioned in one position or in an inverted position and there will always be a flat surface **37***f* which will properly align with the inner wall of the hole portion **20***b* in order to provide a large bearing area for a rigid connection.

Although only a single embodiment of the invention has been shown and described, it should be evident that the invention can be made in many different ways without departing from the true scope of the invention as defined by the appended claims in which I claim:

1. A support structure comprising vertical uprights and horizontal beams, each of said beams being positioned between two of said vertical uprights spaced from each other by approximately the length of a beam, the two vertical uprights being provided with front walls facing in a direction away from the axis of the beam and side walls facing each other in a direction of the beam between the uprights, a flanged lug on the end of said beam, the uprights being provided with keyhole openings along said front walls for engaging the lug to provide support of the beam along said front walls, said lug having a first flat surface on its outer periphery and each of said openings being partially bounded by a second flat surface on its inner peripheral wall, said flat surfaces engaging each other when the lug is positioned through one of the openings, said first flat surface on the lug being one of a plurality of flat surfaces on the outer periphery of the lug extending at different angles, and said second flat surfaces extending at corresponding different angles on the inner peripheral wall of the keyhole openings to permit flat abutment of a first flat surface of the lug with a corresponding second flat surface of the opening when the lug engages the opening.

2. In a support structure of a type having vertical uprights and horizontal beams, the vertical uprights being provided with walls having keyhole openings therein, and the beams having flanged lugs thereon for engaging the keyhole openings to provide connections between the beams and the uprights comprising, each keyhole opening being partially bounded along its inner peripheral wall by a flat edge extending at an angle to its respective up-

right, and each flanged lug having a flat surface on its outer periphery extending at the same angle when a lug and keyhole opening are in connecting positions relative to each other, the flat surface of a lug flatly abutting the flat edge of a keyhole opening when the keyhole opening and the lug are engaged to form a connection between a beam and an upright, the flat surface on the outer periphery of the lug being one of a plurality of such flat surfaces on the outer periphery of the lug, each flat surface extending at a different angle so that the lug can be oriented to flatly abut different keyhole openings having inner peripheral flat edges extending at a corresponding different angle.

3. In a support structure as defined by claim 2 characterized by, said keyhole openings being arranged in two parallel vertical rows along each upright with the keyhole openings of one row canted at a first angle and the keyhole openings of the other row canted at a second angle so that the respective planes of contact between abutting

flat edges and flat surfaces of the keyhole openings and lugs along the one row of keyhole openings extend at the first angle and the planes of contact between abutting flat edges and flat surfaces of the keyhole openings of the other row extend at the second angle.

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