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(54) **A method of roll-forming a pallet rack upright**

Rollformverfahren zur Herstellung einer Senkrechtstützstruktur eines Palettengestell

Procédé de formation à rouleaux d'une structure de support vertical d'un rayonnage à palettes

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Description

[0001] The invention deals with a way of roll forming, from a flat blank of preselected width and in a single roll forming machine, pallet rack uprights of omega type, suitable for different loading situations.

Background of the invention

[0002] Pallet rack uprights of so-called omega type are known, e.g., from WO89/05595. Loading situations for different pallet racks vary greatly and they often come in a number of standard designs. For each standard upright there is a roll forming set of rolls and the sets between the manufacture of different pallet rack uprights are changed. Optimising a pallet rack upright for a specific application is costly, since a new roll forming set of rollers has to be made.

Purpose of the invention and brief description thereof

[0003] One purpose of the invention is to enable roll forming of pallet rack uprights which is adapted to different load situations without having to change the roll sets. This is achieved by combining the following steps:

- roll forming of a centre groove consisting of two S-bends that are the same for different uprights, but with preselected distance from the middle of the blank to afford the desired width of the centre groove,
- roll forming of two S-bends which are the same for different uprights but with preselected distance from the middle of the blank, and
- roll forming of two corners between the S-bends and at preselected distance from the bends of the centre groove. FR 2237762 A shows a roll forming machine for forming pellet uprights with S-bends and corners with laterally fixed rollers.

[0004] By standardisation of S-bends in this way, one can roll form pallet rack uprights of this kind with desired strength properties for different loading situations by sideways shifting of the various sections for roll forming of the bends in a roll forming machine. In some cases one also needs to adjust the height of the last section's roll pair. A machine with movable sections of roll pairs is known from US 7,107,807 B2, but a machine for roll forming of pallet rack uprights with constant cross section along the length can be greatly simplified as compared to the more universally applicable machine shown in the patent.

[0005] When making uprights with different dimensions in this way, one also uses the same principle in a different roll forming machine to make square tubes with dimensions adapted to the particular upright and uses these tubes as diagonal struts between the front and rear uprights in a pallet rack. By easily and quickly adapting the dimensions of both uprights and struts, one can save on weight and costs as compared to making a plurality of standard uprights.

The invention is defined by the claims.

Short description of the drawings.

[0006]

Figure 1 shows a perspective view of a pallet rack upright made according to the invention, with struts that are also fastened to a rear upright.

Figure 2 is a cross section of the pallet rack upright of Fig. 1.

Figure 3 shows a first roll forming step to make the upright of Figures 1 and 2.

Figures 4-6 show subsequent manufacturing steps.

Description of the sample embodiment shown

[0007] The pallet rack upright 10 shown in **Fig. 2** is shown symmetrical, but can also be asymmetrical in certain cases, and it consists of a central flange 11 with a centre groove 12 and two webs 13,14. The centre groove consists of two S-bends 15,16 and an intervening straight part 17. Each web has an indentation 18 consisting of an S-bend 19, a straight section 20 and an outward pointing flange 21. Between the centre flange 11 and webs 13,14 are corners 22,23, shown as being right-angled. The straight section 20 of the two indentations 18 has a series of holes 25 as shown by Fig. 1. Only one of the indentations 18 of the webs is described, since the upright is symmetrical.

[0008] The roll forming of the pallet rack upright 10 shown will be described with reference to Figures 3-6.

[0009] **Figure 3** shows the blank 30, being a flat blank of sheet steel, preferably high-strength steel with a yield limit over 400 MPa. In a first roll forming section, the two S-bends 15,16 are formed on either side of the middle of the blank. The rolls 31, 32 of the last pair for the S-bend 16 are shown in Fig. 3. Advisedly, this forming section has four roll pairs on each side for consecutively bending these S-bends from the flat blank. Both sides of the roll forming section are laterally adjustable, for example, in the way shown by US 7,107,807 B2, so that one can predetermine the width of the centre groove 12 by preselecting the distance of the roll pair and thus the S-bends from the middle of the blank. All roll pairs on each side of the section are mounted on a common support so that all roll pairs are shifted together. The roll pairs produce the same S-bends regardless of the width setting. The roll pairs are adjustable only to accommodate the thickness of the blank, which can vary in a range, e.g., between 1 mm and 4 mm. This adjustment is done by changing the distance between the axles of the rolls in a pair.

[0010] **Figure 4** shows the next step in the roll forming. In this section of the roll forming machine, the two S-

bends 19 are formed and the last roll pair 35,36 in this section for forming of the left S-bend is shown in the figure. By parallel sideways shifting of both roll pair supports of the roll forming section, one preselects the position of the S-bends so that they are placed at the desired distance from the middle of the blank. Each support advisedly has six roll pairs.

[0011] **Figure 5** shows the next step, the forming of the corners (bends) 22,23, which are advisedly right-angled. The two supports of this section are also sideways movable so that the position of the corners can be preselected. For example, this section can have 8 roll pairs. The forming of the corners 22,23 is more critical than the forming of the S-bends 15,16 and 19 and in this case the rolls 37,38 are pointed directly toward the corner, i.e., the axles I and II of the roll pair make a 45 degree angle with the central flange 11 and web 13 or as close to 45 degrees as the geometry allows. Precisely 45 degrees means the adjustment for different thicknesses of blank is precise for both the central flange 11 and the web 13. Figure 4 also shows the rolls directed toward the corners. Figure 2 shows a roll pair which is not slanted, but the forming of the central groove is not critical.

[0012] When the roll pair is slanted, one has corresponding roll pairs on one side mounted after those on the other side, i.e., the roll pairs zig zag in each roll forming section of the machine so that the roll forming occurs alternately at the right and left side.

[0013] Sometimes no further roll forming is done, and the upright as it appears in Fig. 5 is the end product.

[0014] Most often side flanges 21 are desired. These are then formed in a final forming step, shown in **Fig. 6.** The two supports in this forming section can have six roll pairs and the figure shows the last pair 39,40. Besides being movable sideways, the roll pair 39,40 can also move vertically.

[0015] As the side flanges 21 are always short, one can roll form them in an intermediate step between the step of Fig. 3 and that shown in Fig. 4. The length of the side flanges must then be limited, or else they will hinder the roll forming in the step of Fig. 5. In this case, no roll pair needs to be vertically movable.

[0016] **Figure 1** shows a junction in a pallet rack with uprights made according to the invention. A front upright 10 of the kind shown in Fig. 2 has two struts 40, 41 braced between the surfaces 25 in Fig. 2 with a bolt 42 through the hole 20 and corresponding holes in the ends of the strut. The strut is in the form of a square tube and one of them is slanted upward/backward and the other is slanted downward/backward, and their other ends are secured in the same fashion in a rear upright. The central flange 11 of the upright is turned forward and has two rows of holes 43,44 in which a beam for support of the pallets can be secured between this upright and the upright(s) alongside it.

[0017] The two square tubes will be adapted to the distance between the two surfaces 25 of the upright on the web and the tube is made in an adjustable roll forming machine in order to fit this distance. One thus makes uprights with optimised dimensions and tailor-made square tubes as struts for the uprights for a single job order. The square tubes will withstand strong compression and the screws 42 can be tightened firmly, thereby obtaining larger stiffness than that of known pallet racks.

Claims

1. Method of roll forming, from flat blanks of preselected width and in a single roll forming machine, pallet rack uprights of omega type of different strength suitable for different loading situations, **characterised by** the combination of the following consecutive steps:

   - forming of a centre groove (12) consisting of two S-bends (15, 16), which are the same for uprights of different strength after preselecting the set distance from the S-bends to the middle of the blank to afford the desired width of the centre groove,
   - roll forming of two S-bends (19), which are the same for uprights of different strength, after preselecting the set distance from these S-bends to the middle of the blank, and
   - roll forming of a corner (22, 23) between the two S-bends on each side of the middle to bend upwards webs (13, 14) of the upright after preselecting the set distance from the corners to the S-bends of the centre groove.

2. Method according to claim 1, **characterised by** a further step of roll forming of an outwardly directed flange (21) at preselected distance from the edge of the blank.

3. Method according to claim 2, **characterised in that** said further step is a final step.

4. Method according to any one of the preceding claims, **characterised in that** the roll forming of the two corners (22,23) is done with slanting roll pairs (37;38).

5. Method according to claim 4, **characterised in that** one adjusts the distance between the axles (I, II) of the slanting pair of rolls to the thickness of the blank.

6. Method according to any one of the preceding claims, **characterised in that** one carries out the forming of the respective bends and corners alternately on the right and left side of the blank.

Patentansprüche

1. Verfahren zum Rollformen, aus flachen Rohlingen

ausgewählter Breite und in einer einzelnen Rollformmaschine, von Palettengestell-Senkrechtstützstrukturen des Omegatyps unterschiedlicher Festigkeit, die für unterschiedliche Beanspruchungssituationen geeignet sind, **gekennzeichnet durch** die Kombination der nachfolgend aufgeführten aufeinanderfolgenden Schritte:

- Formen einer Mittelnut (12), die aus zwei S-Kurven (15, 16) besteht, die für Senkrechtstützstrukturen unterschiedlicher Stärke gleich sind, nach der Vorauswahl des Einstellabstands von den S-Kurven zur Mitte des Rohlings, um die gewünschte Breite der Mittelnut bereitzustellen,
- Rollformen von zwei S-Kurven (19), die für Senkrechtstützstrukturen unterschiedlicher Stärke gleich sind, nach der Vorauswahl des Einstellabstands von den S-Kurven zur Mitte des Rohlings, und
- Rollformen einer Ecke (22, 23) zwischen den beiden S-Kurven an jeder Seite der Mitte, um Stege (13, 14) der Senkrechtstützstruktur nach oben zu biegen, nach der Vorauswahl des Einstellabstands von den Ecken zu den S-Kurven der Mittelnut.

2. Verfahren nach Anspruch 1, **gekennzeichnet durch** einen weiteren Schritt des Rollformens eines nach außen gerichteten Flansches (21) bei einem vorausgewählten Abstand von der Kante des Rohlings.

3. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** der weitere Schritt ein Endschritt ist.

4. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Rollformen der zwei Ecken (22, 23) mit schrägen Rollenpaaren (37; 38) erfolgt.

5. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, dass** man den Abstand zwischen den Achsen (I, II) des schrägen Rollenpaares zur Dicke des Rohlings anpasst.

6. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** man das Formen der jeweiligen Kurven und Ecken abwechselnd an der rechten und linken Seite des Rohlings ausführt.

Revendications

1. Procédé de formation à rouleaux, à partir d'ébauches plates de largeur présélectionnée et dans une unique machine de formation à rouleaux, de structures de 5support vertical d'un rayonnage à palettes de type oméga de résistances différentes appropriées à différentes situations de charge, **caractérisé par** la combinaison des étapes consécutives suivantes :

- former une rainure centrale (12) consistant en deux courbes en S (15, 16), qui sont les mêmes pour des structures de support vertical de résistances différentes 10après avoir présélectionné la distance de réglage des courbes en S au milieu de l'ébauche pour procurer la largeur désirée de la rainure centrale,
- former par rouleaux deux courbes en S (19) qui sont les mêmes pour des structures de support vertical de résistances différentes, après avoir présélectionné la distance de réglage de ces courbures en S au milieu de l'ébauche, et
- former par rouleaux un coin (22, 23) entre les deux courbes en S de chaque côté du milieu pour plier vers le haut des cloisons (13, 14) de la structure de support vertical après avoir présélectionné la distance de réglage des coins aux courbes en S de la rainure centrale.

2. Procédé selon la revendication 1, **caractérisé par** une étape supplémentaire consistant à former par rouleaux une bride dirigée vers l'extérieur (21) à distance présélectionnée depuis le bord de l'ébauche.

3. Procédé selon la revendication 2, **caractérisé en ce que** ladite étape 25supplémentaire est une étape finale.

4. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la formation par rouleaux des deux coins (22, 23) est faite avec des paires de rouleaux inclinées (37 ; 38). 30

5. Procédé selon la revendication 4, **caractérisé en ce que** l'on ajuste la distance entre les axes (I, II) de la paire inclinée de rouleaux à l'épaisseur de l'ébauche.

6. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'on exécute la formation des courbes et coins respectifs alternativement du côté droit et du côté gauche de l'ébauche.

Fig 1

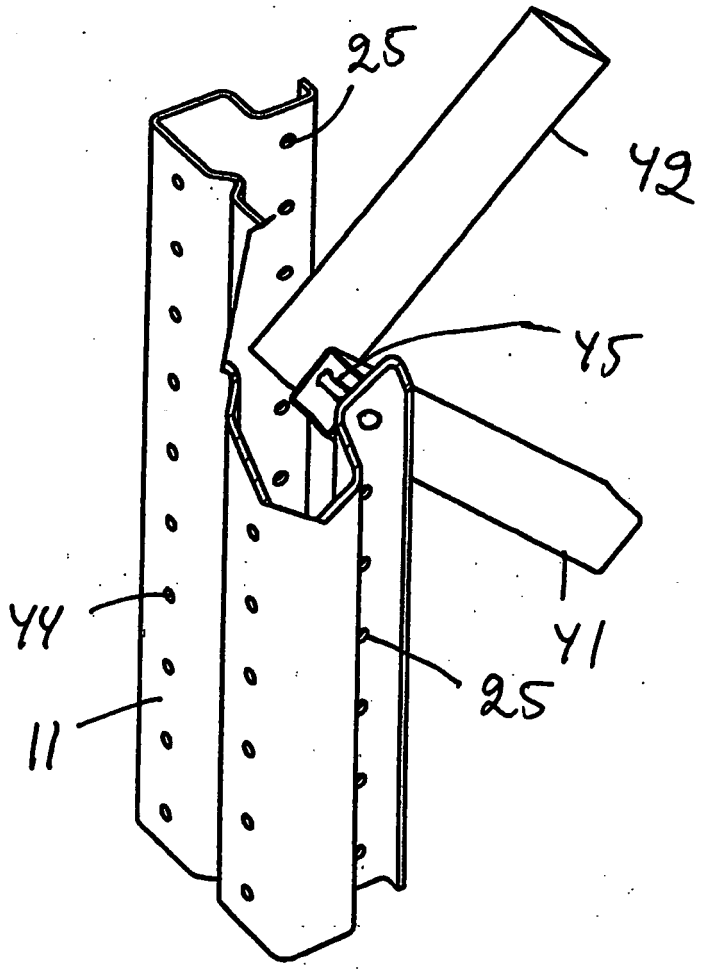


Fig 2

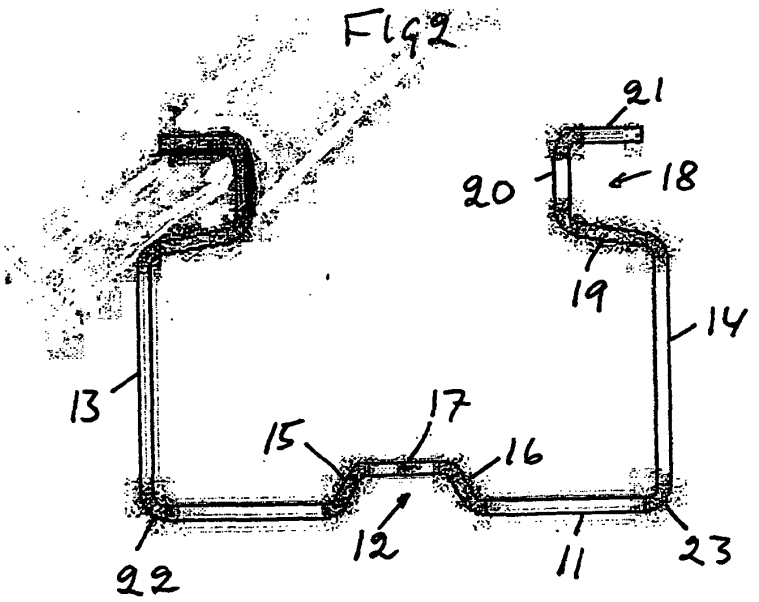


Fig 3

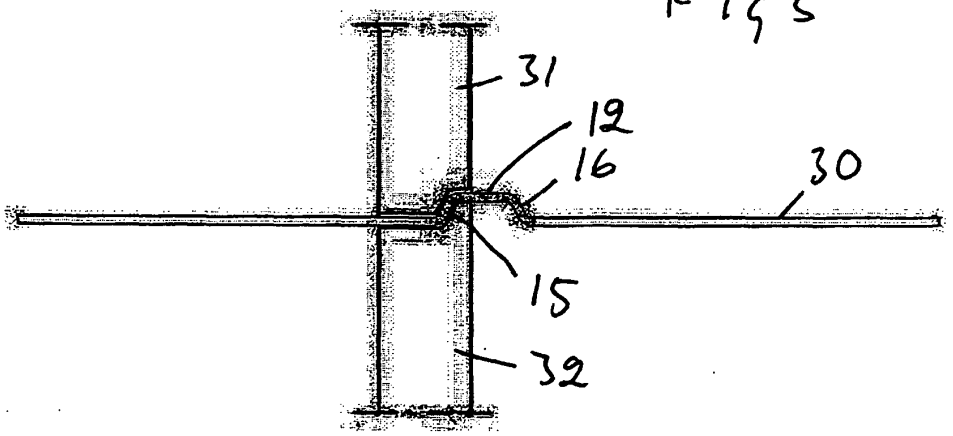


Fig 4

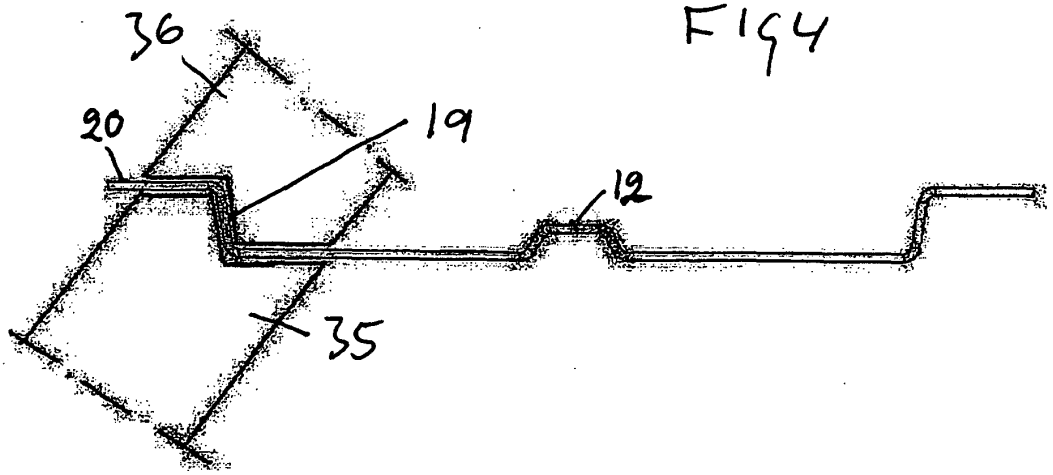


Fig 5

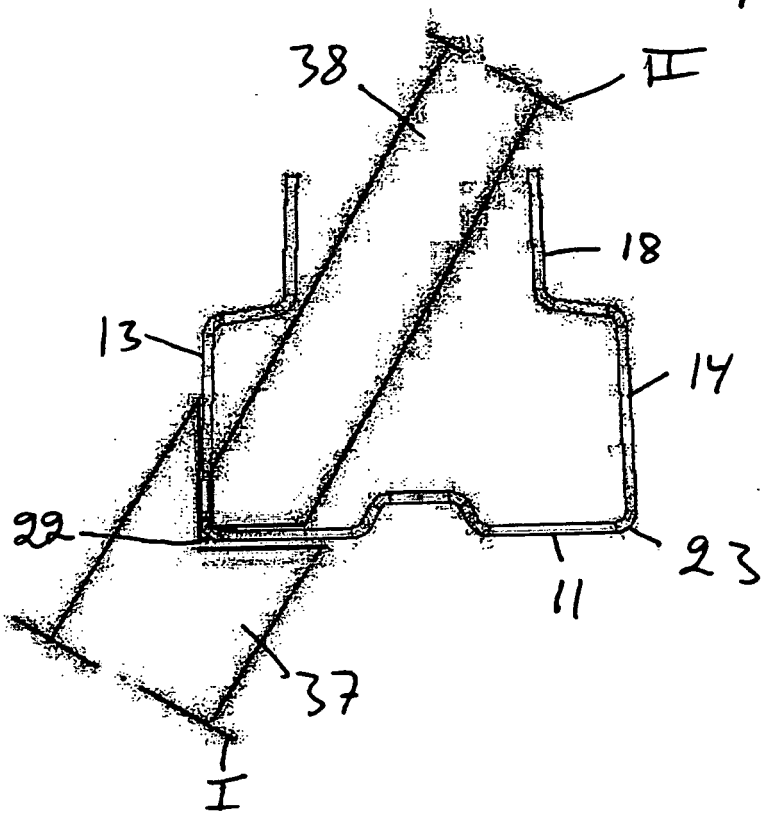
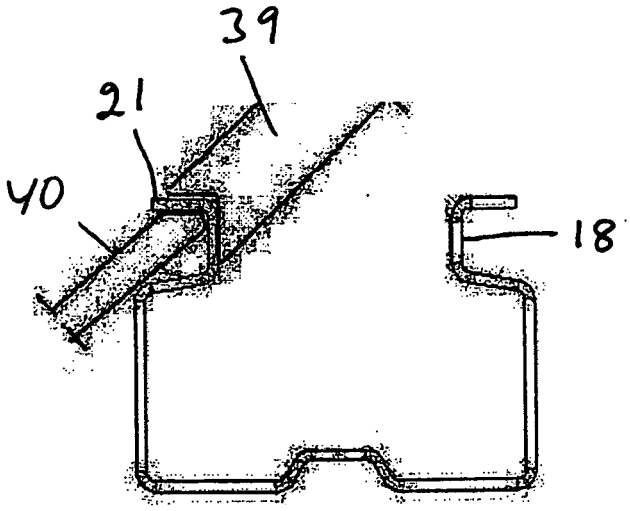


Fig 6



REFERENCES CITED IN THE DESCRIPTION

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- US 7107807 B2 **[0004] [0009]**