Oct. 12, 1971 E. J. POYSER ET AL 3,611,666

SHEET METAL BOX BEAM

Original Filed July 2, 1968

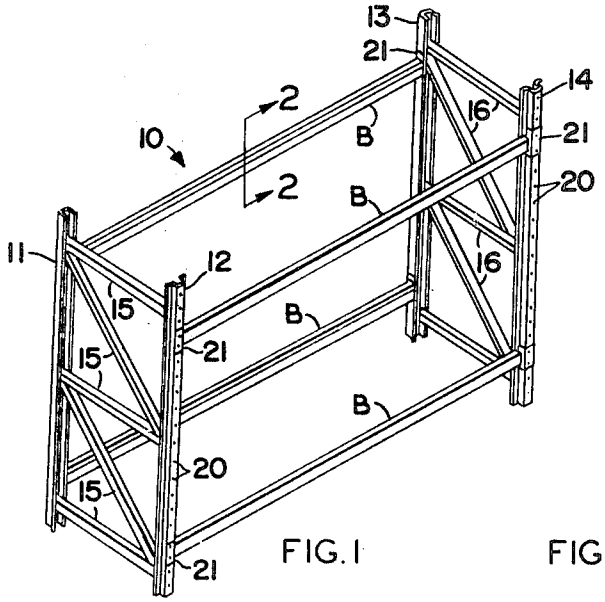

FIG. 1

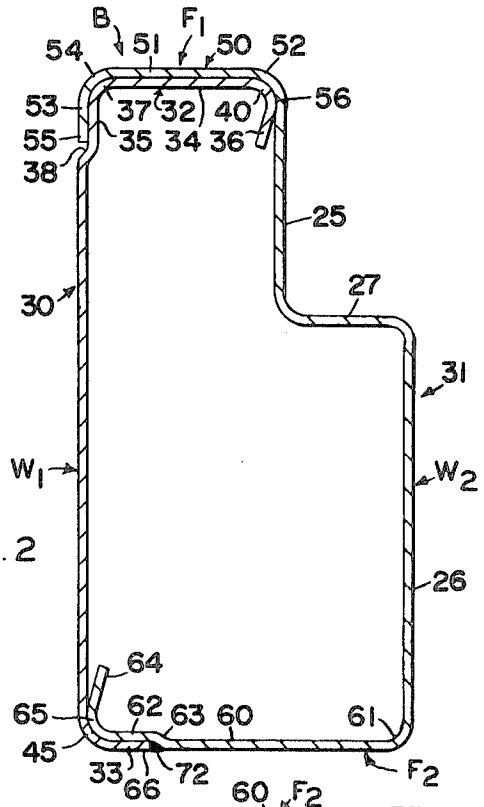

FIG. 2

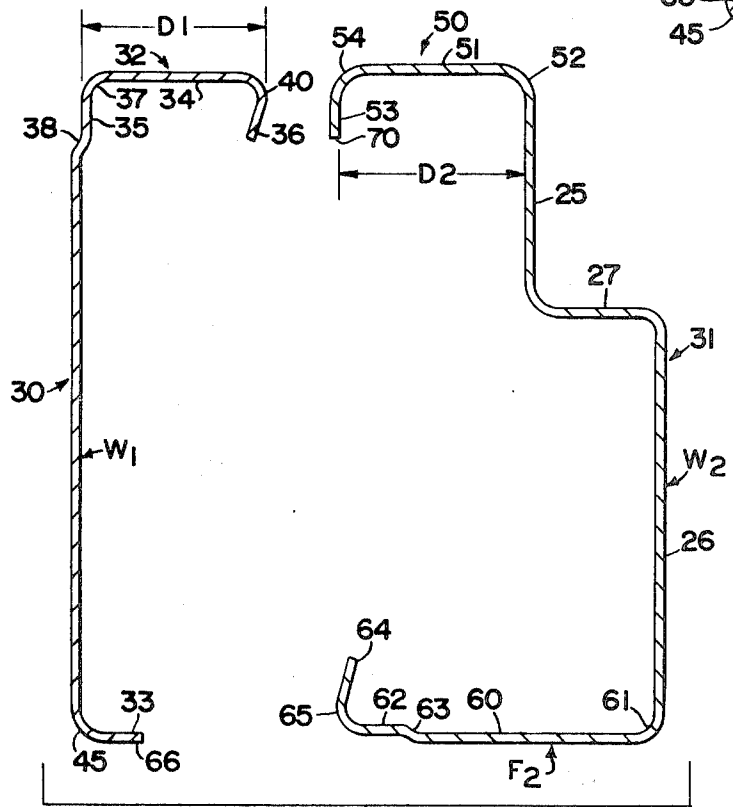

FIG. 3

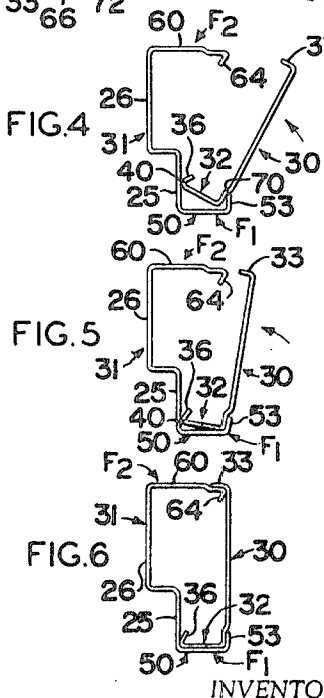

FIG. 4

FIG. 5

FIG. 6

INVENTORS
EDWARD J. POYSER
CALVIN R. CLAUER
BY
Watts, Hoffmann, Fisher & Heinke
ATTORNEYS.

United States Patent Office 3,611,666
Patented Oct. 12, 1971

3,611,666
SHEET METAL BOX BEAM

Edward J. Poyser, Canton, and Calvin R. Clauer, Youngstown, Ohio, assignors to Republic Steel Corporation, Cleveland, Ohio

Continuation of application Ser. No. 742,046, July 2, 1968. This application Mar. 10, 1970, Ser. No. 17,044
Int. Cl. E04c 3/07
U.S. Cl. 52—731 17 Claims

ABSTRACT OF THE DISCLOSURE

A beam construction comprised of a pair of sheet metal components each having a load supporting flange. Flanges of the lipped channel components are nested together and mechanically interlocked so that portions of the beam assembly subjected to compressive stresses are reinforced, yet sectional thicknesses are minimized in other portions of the beam. The two members forming the beam mechanically interlock in a manner which permits simple assembly. Welding of the components is not necessary to develop the strength of the beam.

CROSS-REFERENCED APPLICATIONS

This is a continuation of U.S. patent application Ser. No. 742,046, filed July 2, 1968, entitled, Beam Construction and Method of Assembling, now abandoned.

BACKGROUND OF THE INVENTION

(1) Field of the invention

The present invention relates to beam constructions and more particularly relates to sheet metal beam constructions usable in connection with pallet racks or the like.

The use of cold formed sheet metal beams in installations such as the longitudinal load supporting beams in pallet racks is desirable for a number of reasons. While it is desirable to use cold formed beams in this application, prior beams have had shortcomings. Typically the beams used horizontally have been constructed of two simple channel components welded together, particularly along the compression flanges, in order to develop the strength of the beam.

Producing such beams by methods other than cold forming e.g. by extrusion, can provide different sectional thicknesses in various portions of a beam, but the metal in such beams does not possess the strength per unit weight of cold formed sheet metal. Furthermore fabrication of these beams may be relatively costly in that special extrusion dies are required for each beam size.

In pallet rack applications, heavy horizontal beam weights reduce the load supporting capability of the rack since (1) there is a limit to the load supporting capabilities of the vertical posts in a rack upright, and (2) heavy beams increase the floor loading caused by pallet racks themselves. Thus the loads which can be safely supported on the racks in a given building without exceeding maximum permissible floor loadings, is reduced.

In pallet racks it is common to provide a dunnage supporting ledge intermediate the top and bottom flanges so that a supported pallet or other load is located in a horizontal plane by the portion of the beam above the ledge. The result is the upper flange is of reduced area and therefore of reduced strength in that portion of the beam which experiences maximum compressive loadings. Thus the problems of proper material distribution in a beam is amplified by a particular beam configuration such as the described ledge.

(2) The prior art

The prior art has attempted to solve the aforementioned problems by producing tubular beams constructed of more

than one sheet metal member. Such a beam construction is disclosed in the patent to Mosinski, U.S. Pat. No. 3,127,995, issued Apr. 7, 1964. This patent discloses a two-piece tubular pallet rack beam in which a pair of sheet metal members are assembled to provide double thickness upper and lower flanges. The beam members are welded together along the flanges to produce a unitary beam construction.

The beam disclosed in the Mosinski patent is relatively strong because of the fact that the upper flange of the beam is composed of the double thickness of sheet steel. The vertically extending sides of the beam are comprised of only a single thickness of material. The lower flange of this beam is formed of a double thickness of the material resulting in excessive weight and strength in that portion of the beam. Moreover, the extra thickness in the lower flange results in excessive cost.

The prior art has also attempted to increase the strength of multi-part tubular beam constructions by providing stiffening bends and lips. Stiffening lips increase the strength of beams having relatively small sectional thicknesses. In many instances stiffening bends and lips have necessitated assembling the beam members by telescoping one beam member within the other and then attaching the members together. Such assembly methods are inefficient.

In some proposals assembled beams were subjected to cold forming operations to insure maintaining the beam members firmly attached to each other. In other proposals the assembled beam members were welded at a number of locations or continuously along load supporting flanges after assembly. In still another proposal beam members were individually cold worked and then simultaneously cold worked into an assembled beam. This method required complex and expensive production equipment and in certain instances produced beams having weights which were excessive in relation to their load carrying capacity.

As noted previously these prior art beams have not been satisfactory from a load-weight aspect, and the production costs involved in their construction has been undesirably high due to inconveniences in assembling them and the sometimes extensive manufacturing operations involved.

Furthermore, some prior art proposals have provided composite beams in which the neutral axes of the components of the beams were spaced vertically from each other. These constructions have resulted in inefficient twisting because the beam components tended to be stressed unevenly under load.

SUMMARY OF THE INVENTION

The present invention provides an improved beam construction of the tubular or "box" type having a relatively heavy, concentration of metal in the compression flanges and relatively light concentration of metal in the tension portion of the beam. Thus, a beam having maximum strength for a given beam weight is provided.

A beam assembly constructed in accordance with the invention includes stiffening bends and lips. These bends and lips are so arranged that the compression flanges are fully effective and efficient assembly of the beam parts is facilitated. Moreover the bends and lips tend to maintain the beam assembled and provide a relatively regular unbroken exterior appearance.

Flanges of the beam members are nested together to form the load supporting flange construction and cooperate to provide a mechanical interlock between the member flanges such that only tack welds along the tension flanges rather than structural welds are used to maintain the members in an assembled condition. Further, because of the stiffened lips on the compression flanges, these flanges need not be welded together.

A beam constructed in accordance with the invention is quickly and easily assembled by placing a flange of one

member within a flange of the other beam member and rotating the beam members together. The member flanges are securely locked together and nested by rotating the members together. The assembly is constructed such that the two members will stay together without locking. To assure against non-uniform appearance, and against partial separation of the members due to bowing, they are tack welded along the tension or lower flange.

Where a beam constructed in accordance with the present invention is used in a pallet rack, clips are welded to ends of the beams. These clips are sufficient to maintain the beam in assembled form without the provision of tack welding.

Since the interlocking constructions involve the use of stiffening bends and lips on the compression flanges, the load carrying capacity of the beam is increased. Even though the nested flanges of the beam member are locked together, localized overstressing of the material of the nested flanges is avoided because the interlocking structure does not restrain slight movements of one flange relative to the other under load.

The lower flange of the beam construction is defined substantially entirely by one of the beam members and is therefore of minimum section thickness and weight. The location at which the beam members are welded together is preferably in the vicinity of the bottom flange at a location where a lip on one member overlies the bottom flange of the other member.

The assembly of the beam is quickly and easily effected with minimum production costs. As noted, the exterior of the beam is regular and "clean" in appearance. That is, the exterior surface extends substantially unbroken about the beam and the beam is devoid of projections, ridges ect.

A principal object of the present invention is the provision of a new and improved beam of the character referred to having a relatively large load supporting strength and light weight and which is simply and economically constructed.

Other objects and advantages of the present invention will become apparent from a consideration of the following detailed description made with reference to the accompanying drawings which form a part of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a pallet rack employing beams constructed in accordance with the invention;

FIG. 2 is a sectional view as seen from the plane indicated by 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view of components of the beam of FIG. 2 prior to assembly; and

FIGS. 4, 5 and 6 are cross-sectional views of the beam components at different conditions during assembly.

DESCRIPTION OF A PREFERRED EMBODIMENT

A pallet rack **10** is illustrated in FIG. 1. The pallet rack **10** includes vertical supports **11–14**. The verticals **11**, **12** are spaced rigidly apart by laterals **15** and the verticals **13**, **14** are spaced apart by laterals **16**. Load supporting beams B extend between the verticals **11**, **13**, and **12**, **14**, respectively. The beams B are disposed in pairs at vertically spaced locations on the supports with each pair of the beams B having load engaging surfaces lying in a common horizontal plane for the reception of pallets (not shown).

The verticals **11–14** are defined by channel-like sheet metal members. The laterals **15**, **16** are received between the flanges. The closed side, or web, of each vertical has a plurality of openings **20** at vertically spaced locations. The openings **20** provide supporting surfaces which are engaged by clips **21** attached to ends of the beams B. The clips **21** preferably include fingers which extend into the openings **20** so that the beams B are removably secured to the verticals. This construction permits the elevation of each pair of the beams B to be adjusted. The construction of the verticals **11–14**, laterals **15**, **16** and the clips **21** is a conventional welded assembly and may be the same as that disclosed in the noted patent to Mosinski.

The beam construction B is illustrated in cross-section in FIG. 2. The beam B is a generally tubular member having a top flange construction **F1**, a bottom flange construction **F2**, and webs or side walls **W1**, **W2**. In the illustrated embodiment the web **W1** lies in a generally vertically extending plane while the web **W2** includes laterally spaced wall portions **25**, **26** defining a horizontal shoulder or ledge **27** between them. A pallet or dunnage can be supported on the shoulders **27** of a pair of the beams B, or upon the top flange construction **F1**. In some instances the shoulder **27** may be omitted so that the beam B defines a substantially rectangular tube.

The beam B is a two part assembly including the beam members **30**, **31** (see FIG. 3). The beam member **30** includes the web **W1**, a top flange **32** at the vertically upper side of the web **W1**, and a web stiffening lip **33** disposed along the vertically lower side of the web **W1**. The top flange **32** includes a horizontally extending flange part **34** and generally vertically extending flange stiffening lip **36**. A web portion **35** extends along the side of the flange part **34** opposite the stiffening lip **36** functioning as another stiffening lip to strengthen the flange part **34**. The web portion **35** is offset from the vertical plane of the web **W1** by an offset **38**. The flange stiffening lip **36** is disposed at a relatively large acute angle with respect to the plane of the flange portion **34** and connected to it by a bend **40**.

The web lip **33** at the vertically lower side of the web **W1** is bent out of the plane of the web **W1** along a bend **45** and extends horizontally a relatively short distance along the lower flange construction **F2**.

The beam member **31** includes the majority of the bottom flange **F2**, the web **W2** and a top flange **50**. The top flange **50** has a horizontally disposed flange portion **51** which is disposed at right angles to the web portion **25** and connected to it by a longitudinally extending bend **52**. The opposite lateral side of the flange **51** defines a flange stiffening lip **53** which is bent at right angles to the top flange portion **51** and connected to it by a bend **54**.

The portion of the lower flange **F2** defined by the beam member **31**, includes a generally horizontally extending flange portion **60** connected to the wall portion **26** by a bend **61**. The flange portion **60** includes an offset part **62** which extends horziontally parallel to the flange portion **60** and is spaced from the flange portion **60** by an offset **63**. A longitudinally extending flange stiffening lip **64** is connected to the offset portion **62** by a longitudinally extending bend **65**.

Referring again to FIG. 2 the flanges **50**, **32** of the beam members **31**, **30** respectively, are nested together so that when the beam B is assembled these flanges are tightly interlocked and from the beam flange **F1**. The interlocking relationship between the flanges is due to the fact that the external dimension **D1** across the flange **32** from the flange lip **35** to the bend **40** is the same or slightly larger than the internal dimension **D2** from the flange lip **53** to the wall **25**. Thus the bends **40**, **52** of the beam members **31**, **30** are tightly engaged at one side of the flange construction **F1** and the flange lips **35**, **53** which are engaged at the opposite side. The interlocking cooperation between the flanges additionally causes slight compression of the flange portion **34** assuring tight engagement with the portion **51**.

ASSEMBLY OF THE BEAM

FIGS. 4–6 illustrate assembly of the beam B. The beam member **31** is oriented with the flange **50** disposed along the lower side of the member **31**. The beam member **30** is cocked relative to the beam member **31** so that the planes of the webs **W1**, **W2** define an acute angle. The flange **32** of the beam member **30** is then inserted into the

flange **50** of the member **31** along the entire length of the beam members.

When the members **30**, **31** are initially engaged, as illustrated in FIG. 4, edge **70** of the flange lip **53** engages the offset **38** and the bend **40** engages the wall **25**. The beam member **30** is then rotated about the edge **70** toward the member **31**. As the member **30** is rotated it is fulcrumed about the engagement between the edge **70** and offset **38**. The bend **40** provides a bearing surface which moves along the wall **25**.

As the beam member **30** continues to be rotated and urged toward the flange **50** the pressure engagement between the bend **40** and wall **25** increases. This causes resilient deflection of the flange lip **53** and of the flange portion **34** as illustrated in FIG. 5. As the planes of the webs W1, W2 approach a parallel relationship the flange lip **53** resiliently returns toward its relaxed positions. It should be noted that because of the dimensions D1, D2 the flange lip **53** cannot completely relax when assembly of the beam B is complete. When the beam members are in their FIG. 6 position the flange lips **35**, **53** and the bends **40**, **52** are resiliently engaged tending to compress the flange portion **34** and to expand the flange portion **51**. As a result the flange **32** is firmly locked in a nested position within the flange **50**.

In effect, the flanges of the members "snap over center" during assembly because the compression of the flange **32** and tension in the flange **50** are greater when the beam members **30**, **31** are in their FIG. 5 condition than when these members are in their FIG. 6 condition. Thus the nested flanges tend to resiliently maintain the beam members assembled as illustrated in FIG. 6 without any additional structure for completing the assembly.

In the assembled beam the edge **70** of the flange lip **53** is disposed closely adjacent the offset **38** on the member **30** with the flange lip **53** disposed in the plane of the web W1. The web lip **33**, overlaps the offset portion **62** and the bend **65** bears against the bend **45**. The web lip **33** lies in the plane of and forms a part of the flange F2. Thus, the assembled beam construction presents a smooth overall exterior surface.

In the preferred embodiment the web lip **33** and the offset **63** are secured together by a weld either in the form of tack welds or a fillet weld **72**. The formation of the weld **72** constitutes the final step in the assembly of the beam B. Where the beam is to be used in a pallet rack, the weld **72** can be omitted. The clips **21** are welded to the ends of the beam in the usual fashion and these welds along with the mechanical interlock of the upper flanges of the beam members maintain the beam in its assembled form.

Although a preferred embodiment of the invention has been described with a certain degree of particularly, it is understood that the present disclosure of the preferred form has been made only by way of example, and that numerous changes in details of construction and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention.

What is claimed is:

1. A box beam construction comprising:

(a) a first beam member including a web and first and second spaced flange portions projecting from longitudinally extending edges of the web, said flange portions projecting in generally parallel relationship from the same face of the web;

(b) said first flange portion including a central part and a lip projecting from a longitudinal edge of the central part, the lip being spaced from the web and generally paralleling the web, said lip projecting from the first flange portion toward the second flange portion;

(c) a second beam member interlocked with the first beam member and including a flange portion nested within said first flange portion, said nested flange portion including a central part adjacent said first flange portion central part and first and second spaced lip parts respectively adjacent the lip of said first flange portion and the first member web;

(d) said second member including a web portion connected to said first lip part by an offset and extending generally parallel to and spaced from said first member web; and,

(e) said second member including a flange lip, said second member flange lip and said second flange portion of said first beam member being in overlying relationship with one another.

2. The beam of claim **1** wherein said first flange portion lip part and said second web are disposed substantially in a common plane.

3. The beam of claim **2** wherein said second flange portion includes an offset and an offset part and wherein said second member flange lip overlies said offset part with the second member flange lip and the majority of said second flange portion lying in a common plane.

4. The beam of claim **1** wherein said second flange portion includes an offset and an offset part and wherein said second member flange lip overlies said offset part with the second member flange lip and the majority of said second flange portion lying in a common plane.

5. The beam of claim **4** wherein said second member flange lip and said second flange portion offset are tack welded together.

6. A sheet metal beam assembly for horizontal orientation to support a load between its ends including first and second beam members connected together to form said assembly and comprising:

(a) a load supporting beam flange construction including a load supporting flange portion of one of said members and a load supporting flange portion defined by the other of said members;

(b) one of said flange portions resiliently gripping said other flange portion to lock said flange portions together in load supporting relationship and urging said beam members together remote from said flange construction;

(c) one of said beam members including a second flange portion extending parallel to said flange construction, said second flange portion of said one beam member connected to a portion of said other beam member by a weldment; and,

(d) said second flange portion of said one beam member including an offset portion, said offset portion including a surface portion engaged with a lip portion of said other beam member which overlies said surface portion.

7. A two part sheet metal beam having a top or load bearing flange, a bottom flange and spaced webs extending between said flanges:

(a) said top flange comprising:

(1) a flange on one beam part comprising a first flange part extending from the web of said one beam part in a plane substantially normal to the plane of said web and a first lip portion extending toward the bottom flange of said beam in a plane intersecting the plane of said first flange part at an included angle no greater than 90°;

(2) a flange on said other beam part comprising a second flange part extending from the web of said other beam part in a plane substantially normal to the plane of said web of the other beam part, a second lip portion extending from said second flange part in a plane intersecting the plane of said second flange part at an included angle of no more than 90°, and a radiused bearing surface portion connecting said second flange part and said second flange lip;

(3) said flange of said other beam part nested within said flange of said one beam part with said first and second flange parts closely adjacent each other;

(4) the maximum dimension between the outside surface of the web of said other beam part and said bearing surface being at least as great as the distance between the inside surface of the web of said one beam member and said first lip portion whereby said flange on said other beam part is compressed by said web and said first lip of said one beam part;

(5) at least the depending edge of said first lip portion of said one beam part engaging the web of said other beam part during insertion of said flange of said other beam part into said flange of said one beam part whereby the compressive force in said flange part of said other beam part is minimum when said flanges are nested; and,

(b) said lower beam flange comprising a lower flange part on one of said beam parts biased into engagement with said other beam part by the force of engagement between said flanges forming said top flange.

8. A beam as claimed in claim **7** wherein the neutral axes of said beam parts are disposed substantially the same distance from said top flange.

9. The beam as claimed in claim **7** wherein one of said beam parts includes a ledge portion defined in its web, said ledge portion adapted to engage a load.

10. A beam as claimed in claim **7** and further including means for connecting said lower flange part of said one beam part to said other beam part.

11. The beam as claimed in claim **10** wherein said beam includes clip members welded to ends of said beam.

12. A beam as claimed in claim **10** wherein said means includes a weldment between said lower flange part and said other beam part.

13. A sheet metal beam assembly for horizontal orientation to support a load including first and second beam members connected together to form said assembly and comprising:

(a) a load supporting beam flange construction defined by a flange portion of one beam member which coextends with and is adjacent a flange portion of said other beam member;

(b) one of said flange portions resiliently gripping said other flange portion to lock said flange portions together to define said flange construction and to urge said beam members together remote from said flange construction;

(c) one of said beam members defining a second flange portion extending substantially parallel to said flange construction and engaging part of said other beam member at said remote location; and,

(d) a weld joint between said second flange portion of said one beam member and said part of said other beam member.

14. A two part sheet metal beam having a top or load bearing flange, a bottom flange and spaced webs extending between said flanges:

(a) said top flange comprising:

(1) a flange on one beam part comprising a first flange part extending from the web of said one beam part in a plane substantially normal to the plane of said web and a first lip portion extending toward the bottom flange of said beam in a plane intersecting the plane of said first flange part at an included angle no greater than 90°;

(2) a flange on said other beam part comprising a second flange part extending from the web of said other beam part in a plane substantially normal to the plane of said web of the other beam part, a second lip portion extending from said second flange part in a plane intersecting the plane of said second flange part at an included angle of no more than 90°, and a radiused bearing surface portion connecting said second flange part and said second flange lip;

(3) said flange of said other beam part nested within said flange of said one beam part with said first and second flange parts closely adjacent each other;

(4) the maximum dimension between the outside surface of the web of said other beam part and said bearing surface being at least as great as the distance between the inside surface of the web of said one beam member and said first lip portion whereby said flange on said other beam part is compressed by said web and said first lip of said one beam part; and,

(b) said lower beam flange comprising a lower flange part on one of said beam parts biased toward engagement with said other beam part by the force of engagement between said flanges forming said top flange.

15. The beam claimed in claim **14** wherein said lower flange part is welded to said other beam part,

16. The beam claimed in claim **14** wherein said lower beam flange is defined by a single thickness of said sheet metal.

17. A box beam construction comprising:

(a) a first beam member including a web and first and second spaced flange portions projecting from longitudinally extending edges of the web, said flange portions projecting in substantially parallel relationship from the same face of the web;

(b) said first flange portion including a central part and a lip projecting from a longitudinal edge of the central part, the lip being spaced from the web and substantially paralleling the web, said lip projecting from the first flange portion toward the second flange portion;

(c) a second member interlocked with the first beam member and including a flange portion nested within said first flange portion, said nested flange portion including a central part adjacent said first flange portion central part and first and second spaced lip parts respectively engaging the lip of said first flange portion and the first member web;

(d) said second member including a web portion connected to said first lip part and extending substantially parallel to and spaced from said first member web; and,

(e) said second member including a flange lip, said second member flange lip and said second flange portion of said first beam member being in overlying relationship with one another, said nested flange portion of said second beam member and said first flange portion of said first beam member being engaged and tending to urge said flange lip of said second beam and said second flange portion of said first beam member toward the overlying relationship.

References Cited

UNITED STATES PATENTS

2,975,874	3/1961	Pagan	52—731 X
3,127,995	4/1964	Misinski	211—148
3,234,704	2/1966	Burgess et al.	52—731
3,332,197	7/1967	Hinkle	52—732 X

PRICE C. FAW, JR., Primary Examiner

U.S. Cl. X.R.

138—163