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[54] **MOBILE HOME UNDERFRAME**

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[52] **U.S. Cl.** ..... **280/106 T**, 214/1 H, 280/30

[51] **Int. Cl.** **B60p 3/00**

[58] **Field of Search** ..... 214/1 H, 515, 152; 280/106 T, 34 A, 30, 80 B; 296/23 R; 52/143

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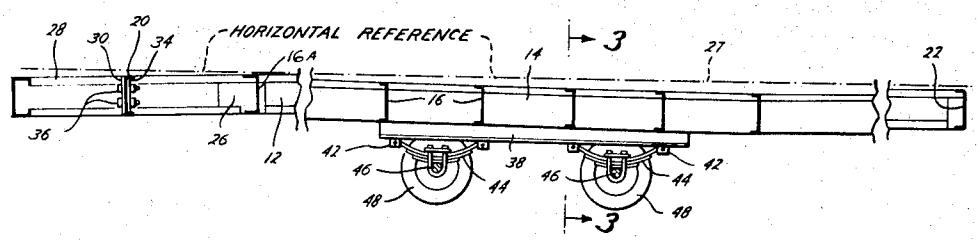
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Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Frank E. Werner
Attorney—Ned L. Conley et al.

[57] **ABSTRACT**

An underframe structure, system and method for use with mobile homes and other transportable buildings including a pair of longitudinal beams made of C-sections, an interlocking C-section used at the area of greatest bending moment, a reinforcing hat-section member rigidly affixed to each beam but removable therefrom to increase stiffness in the area of greatest bending moment, a wheel support structure depending from the hat-section member, and a removable hitch on the underframe which can be attached to the wheel support structure and hat-section members to move them independently of the underframe. The disclosure also includes a method of assembly of such an underframe structure, using a minimum of simple jigs. There is also disclosed a method for moving a mobile building from a first location to another location wherein a wheel support structure which includes elongate stiffening members is mounted beneath the building in such a way as to improve the stiffness of the building underframe during transporting, a removable hitch member is attached to the frame of the building, the building is moved to the other location, and the support structure and hitch are then removed from the mobile building and attached to each other for transportation independently of the building, while the building is lowered to a suitable foundation.

7 Claims, 9 Drawing Figures



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SHEET 1 OF 3

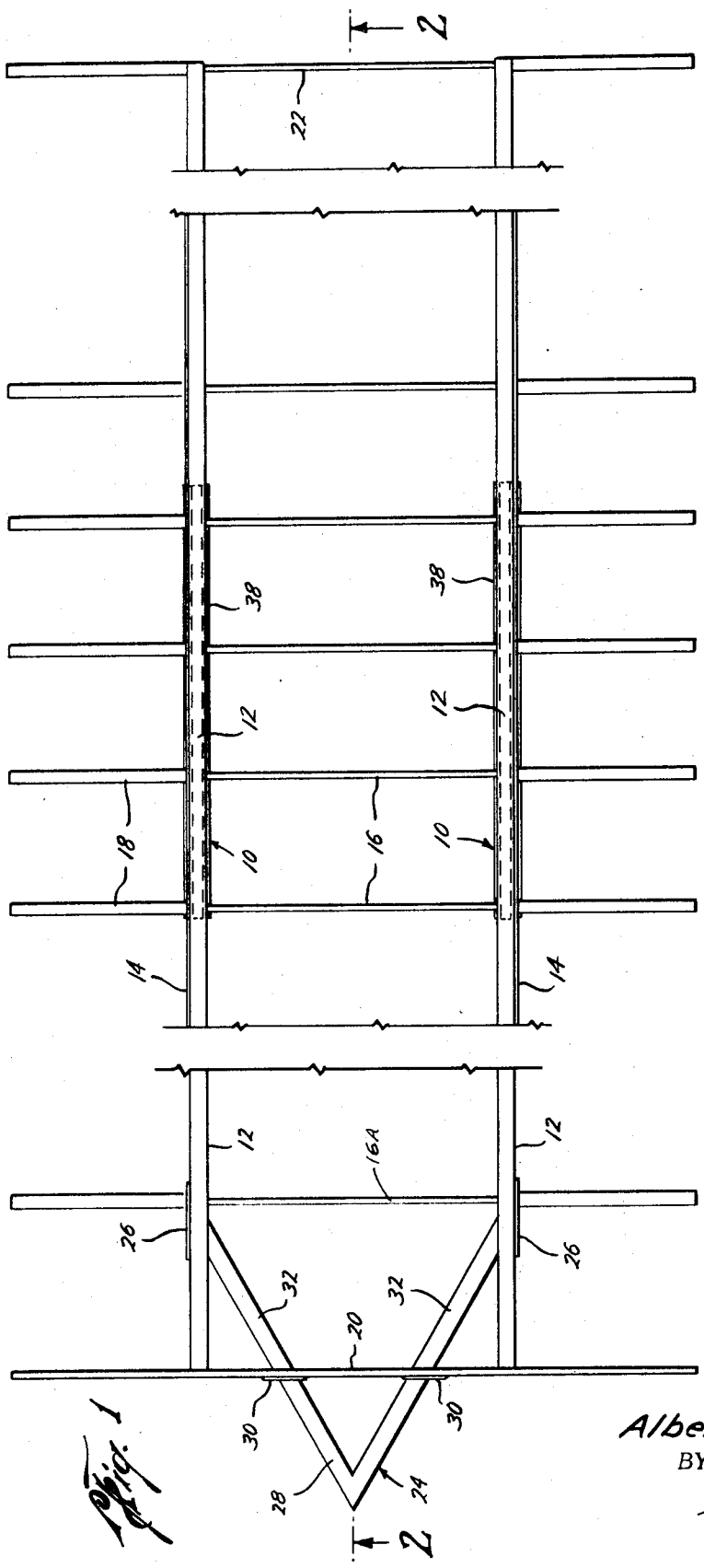


Fig. 1

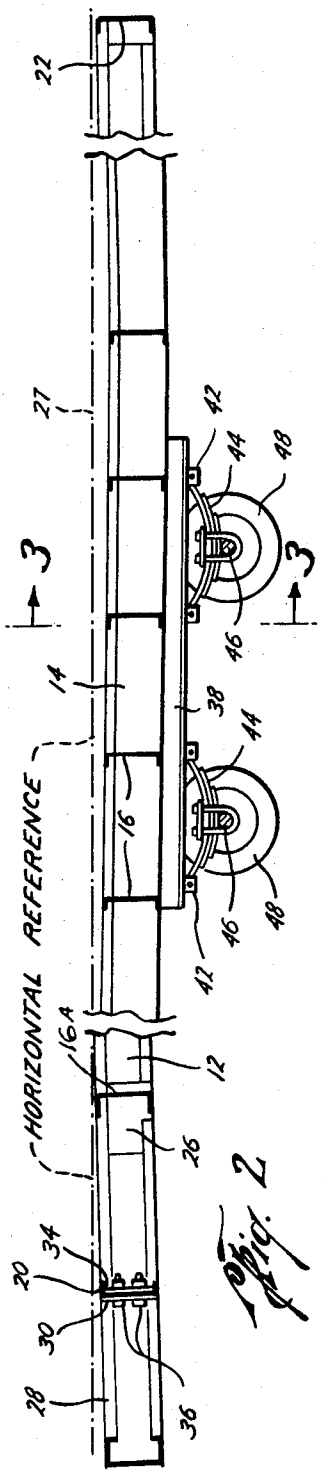


Fig. 2

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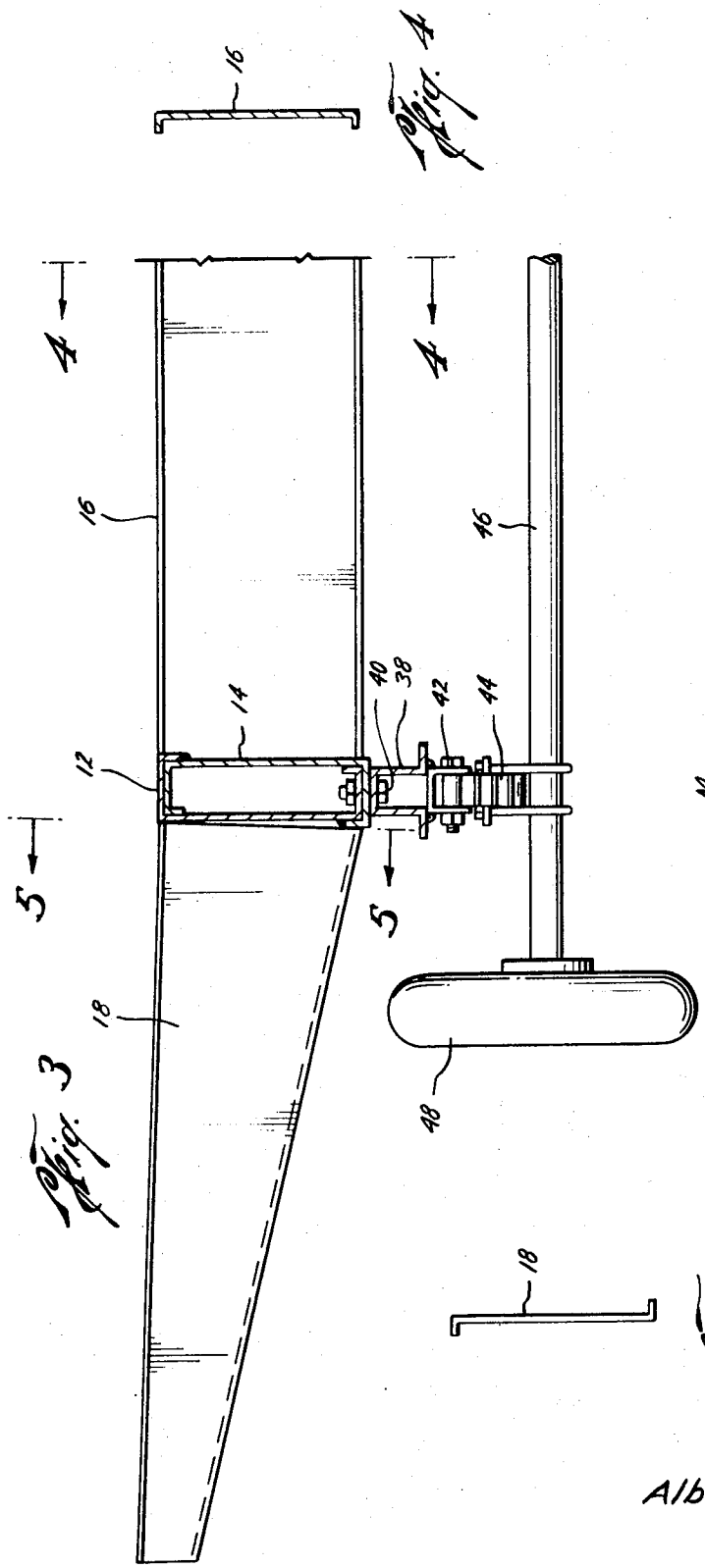


Fig. 3

Fig. 4

Fig. 5

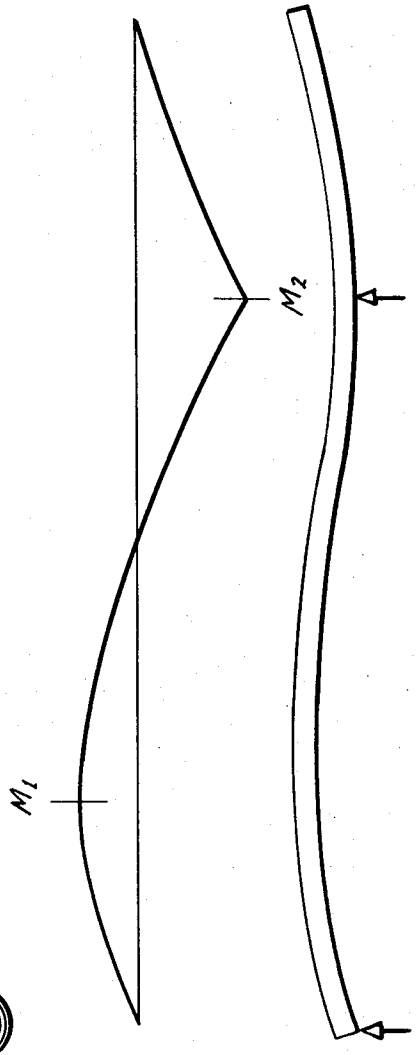


Fig. 6

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Fig. 7

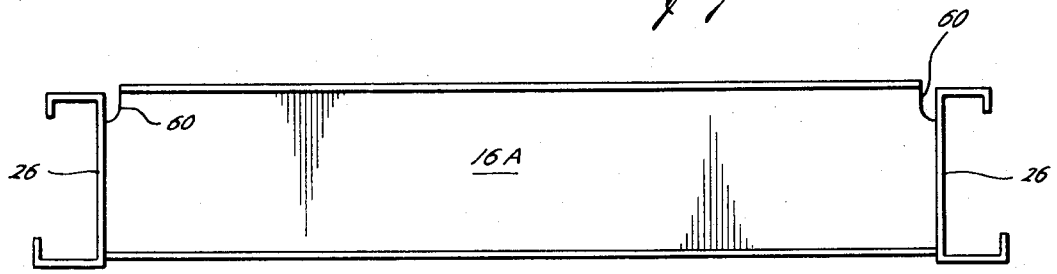


Fig. 8

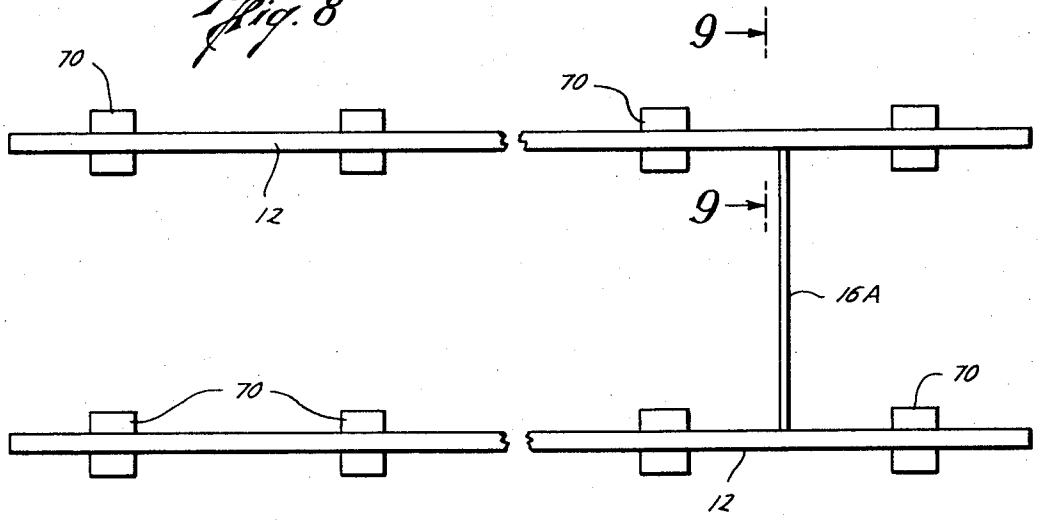
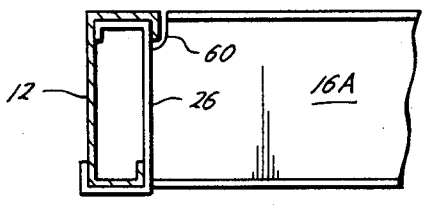


Fig. 9



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MOBILE HOME UNDERFRAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to underframe systems for portable buildings and to methods for moving portable buildings from one location to another.

2. Description of the Prior Art

Portable buildings, such as mobile homes, are designed to be towed from one location to another and positioned more or less permanently at the second location. In most cases they are not thereafter moved to another location. It has been the practice to provide such portable buildings with an underframe made of steel beams which has a hitch at one end for connection to the towing vehicle and one or more pairs of wheels beneath the frame at a distance from the hitch of about two-thirds of the length of the building. The wheels are thus positioned so that they bear a major portion of the load and only a minor portion is carried on the towing vehicle. Such an arrangement is described, for example, in U.S. Pat. No. 3,276,790 to McKaig.

In order to reduce the cost of such structures it has been proposed to make the wheels and hitch removable so that once the portable building has been transported to the destination these elements can be removed, and the hitch used to tow the wheel structure back to the factory or dealer. Designs for this purpose are shown, for example, in U. S. Pat. No. 3,254,914 to Steck and U.S. Pat. No. 3,505,767 to Fyle, Jr.

A major problem in the transporting of mobile homes and other portable buildings in this manner has been that the underframes are not stiff enough to prevent distortion under the load of the structure of the building and furniture or equipment within the building. Thus it has been found, in one study, that the underframe is responsible for only about 15 per cent of the total stiffness (ratio of applied load to deflection) of a mobile home on the longitudinal direction. The remainder of the stiffness is provided by the side walls and the exterior covering on the walls. See the reports of Batelle Memorial Institute entitled "Design Improvements in Mobile Homes With New Applications of Steel" rendered to United States Steel Corporation on Mar. 17, 1967 and Jan. 31, 1968. These reports point out that because of the high proportion of the load carried by the wall structure the walls are subject to bending and buckling during transportation of the mobile home.

In many designs the poor connection between the frame and the side walls prevents depending on the side walls for supporting any of the floor load between the wheels and the hitch. In such installations the frame has to be designed to carry up to 75 percent of the total load (everything except the walls and the roof), during transportation of the home, to prevent tearing the frame and floor structure loose from the walls.

It has heretofore been proposed to add reinforcing structure to a frame member in areas of high load to decrease deflection of the frame member in such areas and thereby provide greater stiffness of the member. However, such additions of reinforcing means have been considered objectionable in the case of mobile homes and other portable buildings because of the increased weight and cost of an element which is required only during the relatively short period of transporting the building from one location to another.

SUMMARY OF THE INVENTION

The present invention provides an underframe and support structure for portable buildings and the like wherein the area most subject to deflection during transporting of the building is substantially strengthened for transporting, but wherein the strengthening structure is removed at the destination and can be reused in the transporting of additional structures. In one embodiment of the invention the underframe structure is substantially strengthened at areas of maximum stress by elements which are not removable.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a foreshortened plan view of an underframe according to one embodiment of this invention;

FIG. 2 is a longitudinal sectional view of the embodiment of FIG. 1, taken at line 2—2 of FIG. 1;

FIG. 3 is a transverse half-sectional view of the embodiment of FIG. 1 taken at line 3—3 of FIG. 2;

FIG. 4 is a sectional view of one element of the embodiment shown in FIG. 1, taken at line 4—4 of FIG. 3;

FIG. 5 is a sectional view of one element of the embodiment shown in FIG. 1, taken at line 5—5 of FIG. 3;

FIG. 6 is a generalized moment diagram showing the bending moments longitudinally of an underframe of the embodiment shown in FIG. 1;

FIG. 7 is an elevational view of a subassembly of the embodiment shown in FIG. 1;

FIG. 8 is a plan view of the embodiment of FIG. 1, shown in an intermediate stage of construction; and

FIG. 9 is a sectional view taken at line 9—9 of FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The underframe shown in the drawing generally comprises a pair of parallel spaced apart longitudinally extending beams 10, each of which, in the embodiment shown, is made up of a main beam 12 and reinforcing beam 14 which is substantially shorter than the beam 12 and extends along an intermediate portion thereof, preferably being tackwelded to it so that the two beams function as a unit. Connecting cross beams 16 extend between the two main beams and outriggers 18 extend laterally outwardly from each main beam generally aligned with the cross beams 16. Cross beams 16 and outriggers 18 are preferably welded to the main beams. A front end beam 20 closes the front end of the underframe and a rear end beam 22 closes the rear end of the frame. A hitch assembly 24 is provided at the front end of the underframe for connection to a towing vehicle.

In the preferred embodiment of the invention the main beam 12 and the reinforcing beam 14 are each C-section members having substantially indentical web and flange dimensions which are interlocked with each other as shown in FIG. 3, with the upper, narrower flange of beam 14 being contained within the upper flange of beam 12 while the lower flange of beam 12 rests within the lower wider flange of beam 14, and with the outside lip of each beam welded to the web of the other beam. The two beams may be of different wall thicknesses, but otherwise are preferably of substantially the same dimensions in cross section. Preferably they are cold rolled from sheet steel for ease in fab-

rication and to insure uniformity and strength Such structures are known in the prior art for use in construction. If desired, the two beams may be spot welded together to improve their ability to act as a unit. In some embodiments of the invention, however, it may be desirable to omit beam **14** altogether.

In the embodiment shown the cross beams **16** and **16A** and the end beams **20** and **22** are channel members which may also be cold rolled from sheet steel. In this embodiment the outriggers **18** are Z-shaped members. The cross beams and outriggers are attached to the longitudinal beams **10** as by welding, with a short piece of C-section member **26** interlocked with the main beam **12** at the point of attachment of each cross member **16A** which does not intersect the reinforcing beam **14.** As shown in FIGS. **3** and **4** the outriggers **18** are fastened with a slight upward camber, i.e. the outer end is higher than the end attached to the longitudinal beam. The purpose of this is to compensate for deflection which occurs as a result of the weight added when the wall structure is erected.

In addition the beams **10** may also be provided with initial camber, as shown with reference to the horizontal reference line **27** in FIG. **2.** Such camber can be provided in the rolling of the beams **12,** so that for example the rear end of beam **12** may be two to three inches higher than the portion of the beam directly over the wheels, and the portion of the beam between the wheels and the hitch carried curved upwardly and then downwardly, as shown for example in exaggerated form in FIG. **6** of the drawing. Thus, in this embodiment the main frame as rolled is in cross section in the form of an ogee. This curvature compensates for deflection which occurs due to the weight added when the floor and wall structure are built onto the underframe, so that when the mobile home structure is completed the underframe will be substantially straight.

Alternatively, the camber may be provided after the underframe is assembled on the wheels, by first lifting at the rear end (the right end as shown in the drawing) and heating the upper surface of the beams **10** until the weight of the wheels causes the beam to sag the desired amount, and then putting a support between the wheels and the front end, pressing down on the front end, and heating the bottom of the beam.

According to this invention the hitch **24** comprises a V-shaped member **28** having a flange **30** welded on each leg and a pair of diagnonal members **32** extending in alignment with the V-shaped member to intersect the parallel beam members **12.** The diagonal members **32** are welded to the short C-shaped sections **26** and to flanges **34** at their opposite ends, which are received within the end cross member **20.** The flanges **34** strengthen the cross member **20** at the point where the hitch is attached. Aligned bolt holes are provided through the corresponding flanges **30** and **34** and the web of the cross beam **20** for receiving bolts **36** by means of which the hitch element **28** is removably fastened to the underframe.

Removable support assembly is provided for use during construction and while transporting the underframe from one location to another, such support assembly comprising a pair of longitudinally extending channel shaped members **38** having their webs lying flat against and extending longitudinally of the lower flange of the longitudinal beams **10,** and being ridigly but removably fastened thereto by means of bolts **40.** The fastening is such that the channel shaped members **38** are held in tight engagement with the beams **10** so that each combined beam and channel member acts as a composite structural member, i.e. there is substantially no slippage between them, and structurally they act as a single unit. Because of this, the amount of stiffness added by the addition of mmbers **38** is two to three times as great as the stiffness of the members **38** alone. Preferably the channel shaped member has, as shown in the drawing, a hat shaped cross section, i.e., has a lip on each flange extending outwardly. Since the lower edge of this member is under compression the outwardly extending lip on each side increases the resistance to buckling of the member.

The members **38** are provided with a plurality of spring shackles **42** which may, for example, be welded thereto to receive the ends of springs **44** which are mounted in a conventional manner on axles **46,** which in turn support one or more pairs of wheels **48.** The usual pivoting links and the like may be used to allow functioning of the springs.

For ease in assembly, the nuts into which bolts **38** are received may be welded over bolt holes cut in the lower flange of beams **12** and **14,** and hat-section member **38** may have corresponding holes in its web.

Although two axles are shown in the drawing, one axle is sometimes used, and larger mobile homes may have three or more.

In the construction of an underframe according to the present invention the longitudinal beams, cross beams and outriggers are assembled in a jig, with welded connections being made therebetween as previously described herein. The hitch elements are also assembled onto the underframe. In those underframes which utilize the reinforcing beam **14** interlocked with the main beam **12,** the lower flange of beam **12** must have suitable holes punched and nuts welded on to receive the bolts **40** which are utilized to bolt on the channel member **38.**

The support assembly may be assembled separately from the underframe structure and the underframe structure then lifted onto the support assembly and connected as by means of the bolts **40.** The combined assembly may then be towed to the next stage of assembly, where the usual floor joists and flooring is attached. The weight of this material is enough to counteract the camber which was rolled into the beams **10** so that once the floor has been assembled onto the underframe the beams **10** are straight and level. Wall sections may then be mounted on the floor structure. As previously noted herein, the wall sections are stiff enough to support themselves and the roof so that the weight of these sections does not cause undesirable deflection of the underframe.

In a preferred embodiment of the invention, the cross beams **16A** are assembled on to the short segments of C-section material **26** as shown in FIG. **7,** the end of the cross beams being welded to the pieces of C-section. As shown in the drawing, the ends of the cross beams **16A** are notched at the top at **60** to provide clearance for the upper lips of the longitudinal beams **12.**

For assembly, the longitudinal beam members **12** are preferably supported at a good working height on supports **70,** which preferably are adjustable in height, as by means of scissor jacks or the like, so that the beams **12** may be levelled. When the beams **12** are laid in place the assemblies of cross beams **16A** and members

26 may be inserted by twisting slightly so that the upper flanges of the members **26** slip within the beams **12** and the welded assembly can then be lifted upwardly to interlock the C-sections, as shown in FIG. **9.** Clamps may be applied to hold these pieces in place. This provides rigid positioning of the two beams **12** with respect to each other and accurately locates them at the proper distance apart. When all of the cross beams of **16A** are assembled in this manner, they may be welded in place.

Other cross beams **16** may then be welded in place and the outriggers and the hitch structure attached as shown in the drawings. The wheel assembly may then be bolted in place, the adjustable supports lowered to lower the frame on to the wheel assembly, and the entire underframe assembly may be towed away. When the assembly of the structure has been completed it may be removed from the support structure for storage or for transportation by rail or other means, or it may be left on the wheel support structure and towed to the destination selected. Upon arrival at the destination the mobile home or other portable bulding may be jacked up, the bolts **40** removed, and the wheel support structure moved from beneath the mobile home. The bolts **36** may then be removed so that the hitch **24** can be taken off the front end. An adapter member (not shown) may then be bolted between the channel members **38** and the hitch member **24** bolted thereto for towing the wheel assembly back to the factory or dealer.

The mobile home may then be lowered to rest on a concrete slab or other suitable foundation. Preferably the beams **10** will rest flat on a flat slab, and brackets welded or bolted to the beams **10** (not shown herein) may be used to bolt the underframe to the concrete slab, thereby providing substantial resistance to overturning of the mobile home by high winds.

When the center of the wheel support structure is approximately two-thirds of the length of the mobile home from the hitch point, assuming a substantially uniform load throughout the length of the mobile home, the maximum bending moment on the underframe is at the center of the wheel support structure and is approximately twice the bending moment at the next highest point which is roughly one-fourth of the length of the underframe from the hitch connection. This is illustrated in FIG. **7** of the drawing where the highest bending moment is shown at M_2 and the next highest bending moment is shown at M_1.

In order to insure adequate support between the wheel support structure and the hitch the beam **12** is designed with sufficient stiffness that, combined with the stiffness provided with the side wall, adequate resistance to deflection from the moment M_1 can be provided. It is apparent, however, that if the beam is designed so that it has only enough stiffness to resist M_1, it will deflect too much at the areas of greater bending moment. Such deflection is prevented in the preferred embodiment of this invention by including the reinforcing beam **14,** which extends over a distance encompassing all of the area of greater bending moment, and which provides a substantial degree of greater stiffness to this portion. The channel-shaped member **38,** which may have the same length or be shorter than reinforcing beam **14,** then provides additional strength in the area of highest bending moment.

In some installations, the increased resistance to bending in the area of highest bending moment may be provided by the hat-section members **38** alone, so that the reinforcing beams **14** are not required.

However, when the mobile home has been moved to its final resting place this stiffness to resist M_2 is not required, since when placed on a foundation the underframe will be supported at numerous points along its length, and preferably will be supported throughout its length, so that there will be no concentrated bending moment such as exists during transportation of the mobile home.

One of the principal advantages of the use of the interlocking C-sections is the fact that identical C-sections may be used for the main beams and the reinforcing beams. However, if additional strength is required, it is only necessary to roll one or the other of the beams from a thicker gauge material. Thus, additional strength can be added without adding to the bulk of the beams.

Another advantage of the interlocking C-sections is that they are readily interlocked with each other, since they are easily assembled together without sliding one down the length of the other. Such sections are also advantageous as compared to channels because the net depth (web width) required for a particular load is reduced by the amount of the return lip. In other words, for a corresponding channel to have the same strength it would have to be higher. Thus, the use of a C-section, as opposed to a channel, allows a reduction in the overall height of the underframe, thereby lowering the overall height of the mobile home. This, plus the removal of the wheel support structure and other frame members beneath the main beams **10,** allows the mobile home to be set lower to the ground, thereby in many cases eliminating the need for steps for entry into the mobile home, and facilitating enclosing the underframe for better insulation of the floor.

Thus, according to this invention there has been provided an underframe structure for a mobile home or other portable building which is adequate to provide full support for the building during transporting from one location to another, and which includes a reinforcing structure which is attached to the underframe in such a way as to form an integral part of the support structure during transporting, thereby providing the additional stiffness required to counteract the high bending moment present over the wheels, but which support structure is removable upon arriving at the destination, when such additional stiffness is no longer needed.

Although preferred embodiments of the invention have been shown and described herein, the invention is not limited to these embodiments but only to those which are within the scope of the accompanying claims.

I claim:

1. A support frame comprising

a pair of parallel spaced-apart beams,

a plurality of cross-members secured therebetween, and

a support structure connected to said beams to support said beams along at least one line traversing said beams intermediate their ends, whereby the bending moment on said beams at and adjacent said line is substantially greater than at other points along the length of the beams,

each of said beams comprising

a C-section with its web lying in the vertical plane, said C-section having upper and lower flanges of different widths,

a second C-section having substantially identical web width and flange widths interlocked with the first C-section with the narrower flange of each C-section nesting within the wider flange of the other C-section, said second C-section extending a length encompassing a substantial portion of the area of substantially greater bending moment but substantially less than the length of the first C-section.

2. A support frame as defined by claim 1 wherein the lip of the exteriorly disposed flange of each C-section is welded to the web of the other C-section.

3. A support frame as defined by claim 1 and including

a channel-shaped member affixed to the lowermost flange of each beam to depend therebelow and extending longitudinally of the beam for a length encompassing a substantial portion of the area of substantially greater bending moment.

4. A support frame as defined by claim 3 wherein said channel-shaped member is hat-shaped.

5. A support frame as defined by claim 3 wherein the support structure is connected to the channel-shaped members, whereby the support frame is supported through the channel-shaped members.

6. A support frame as defined by claim 5, wherein the support structure comprises a pair of wheels mounted on an axle, and

the axle is mounted on leaf springs, the ends of which are secured to the channel-shaped members.

7. A support frame as defined by claim 5 wherein the channel-shaped members are removably attached to the beams.

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