United States Patent [19]

Brown et al.

[11] **3,717,964**

[45] **Feb. 27, 1973**

[54] MODULE FRAMES

[75] Inventors: **Victor E. Brown; Raul L. Mora,** both of Fort Lauderdale; **Evans T. Morton,** Pompano Beach, all of Fla.

[73] Assignee: **Behring Corporation,** Ft. Lauderdale, Fla.

[22] Filed: **July 9, 1970**

[21] Appl. No.: **53,502**

[52] **U.S. Cl.** **52/79,** 52/664, 52/690, 52/236

[51] **Int. Cl.** **E04b 1/34**

[58] **Field of Search**.....52/715, 664, 666, 690, 696, 52/650, 663, 633, 236; 182/228; 287/189.36 B; 29/513, 469, 155, 429; 219/107

[56] **References Cited**

UNITED STATES PATENTS

1,133,138	3/1915	Henderson	52/241
1,993,792	3/1935	Manske	52/241
2,581,750	1/1952	Bursik	52/656
3,204,382	9/1965	McGurn	52/241
3,229,431	1/1966	Paul	52/236
3,442,056	5/1969	Van Der Lely	52/236
736,495	4/1903	Cloud	182/228
1,592,109	7/1926	Jacobs	182/228
2,083,055	6/1937	Coddington	52/715
2,098,752	11/1937	Miller	287/189.36 B
2,200,159	5/1940	Davis	52/690
2,412,618	12/1946	Kantz	52/664
2,966,708	1/1961	Freeman	52/696

FOREIGN PATENTS OR APPLICATIONS

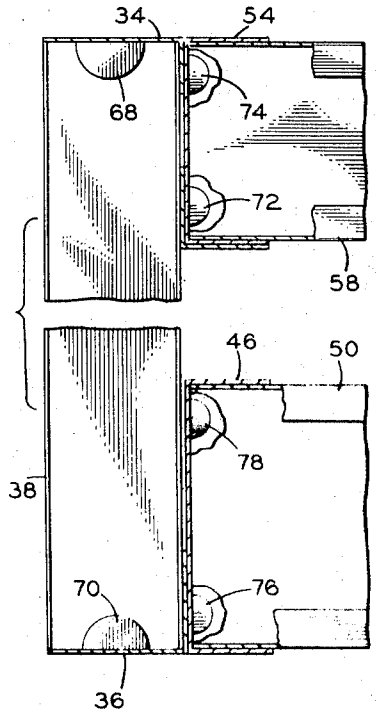
966,578	8/1957	Germany	52/656
694,018	6/1930	France	182/228
1,011,917	4/1965	Great Britain	52/79

Primary Examiner—John E. Murtagh
Assistant Examiner—Henry E. Raduazo
Attorney—Settle and Oltman

[57] **ABSTRACT**

The method of making frames and frame units for modules of modular buildings includes steps of punching perimeter beams to form stops on the beams where cross-beams are to be located, and assembling the cross-beams with a pair of the perimeter beams by butting the ends of the cross-beams against corresponding stops to position the cross-beams without using jigs or fixtures to establish their positions. Retainers may be formed in the perimeter beams next to the stops to temporarily retain the cross-beams in place until they are welded to the perimter beams. In some frame units, the perimeter beams and cross-beams are metal channels, and the beams are assembled flange-to-flange and web-to-web. One weld is made to connect each abutting pair of flanges next to the webs, and another weld is made at a point separated farther from the webs so that the webs reinforce each other and the flanges reinforce each other. Cross-beams may also be welded to the stops on the perimeter beams. The invention includes the frame units, part of the strength and load handling capabilities of which are derived from particular arrangements of stops and welds.

5 Claims, 18 Drawing Figures



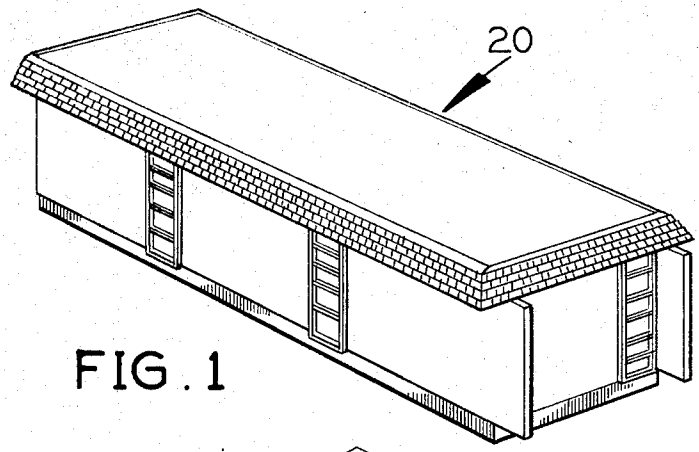


FIG. 1

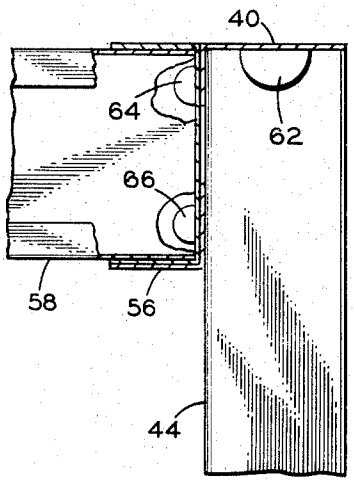


FIG. 3

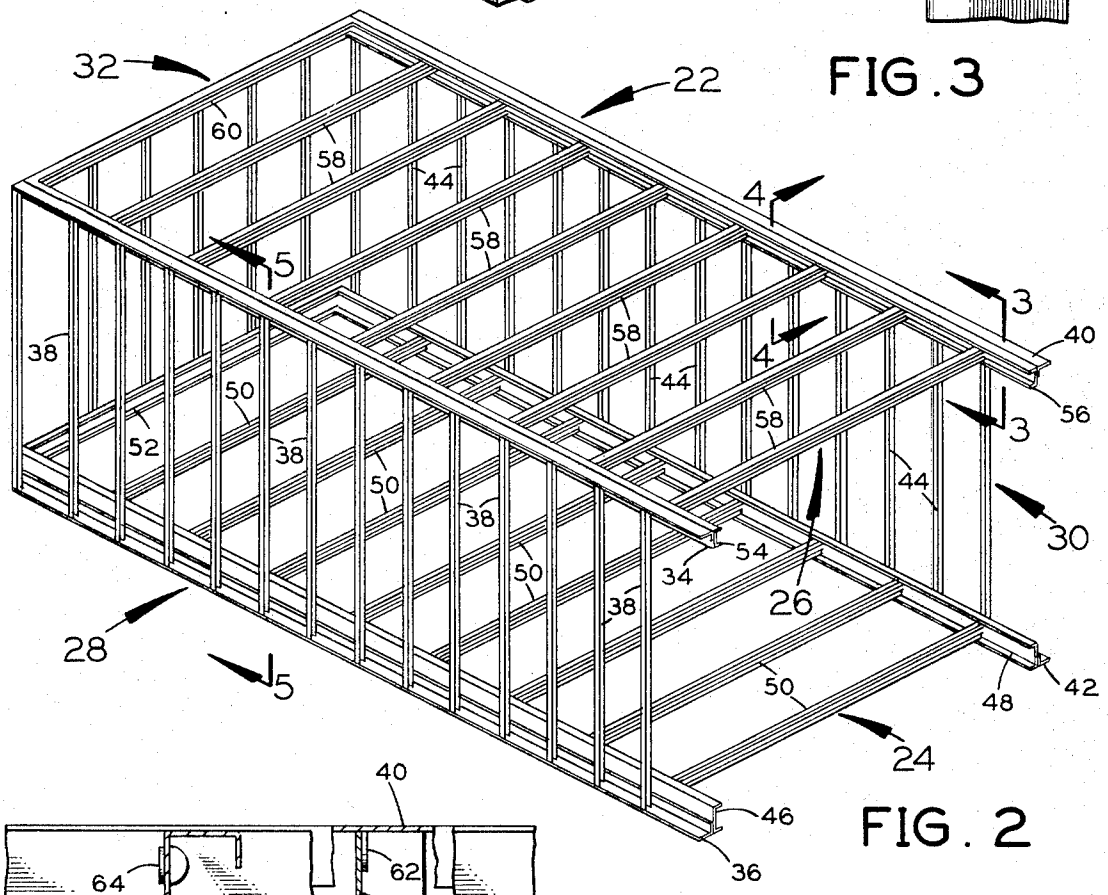


FIG. 2

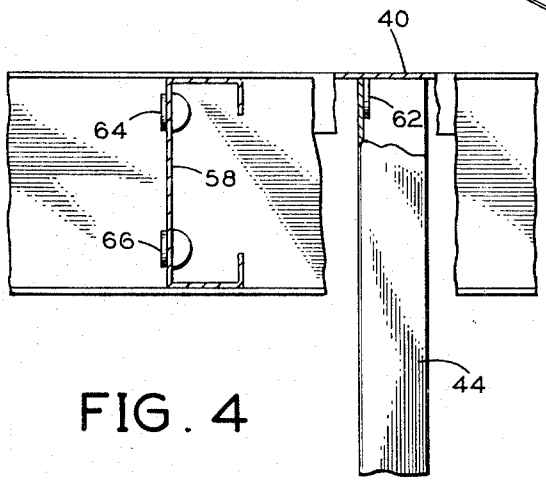


FIG. 4

INVENTORS
VICTOR E. BROWN
RAUL L. MORA
EVANS T. MORTON
BY SETTLE & OLTMAN
ATTORNEYS

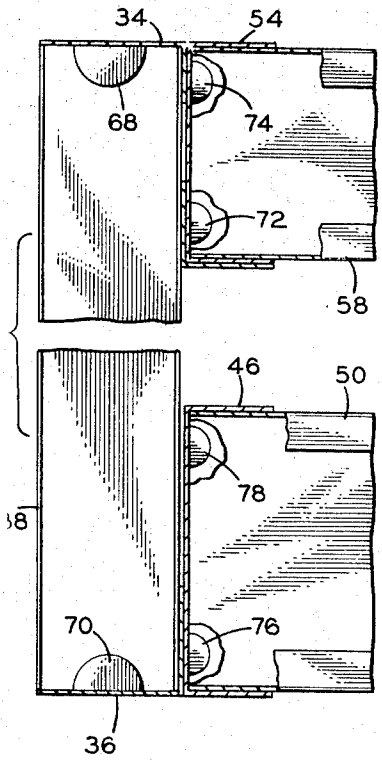


FIG. 5

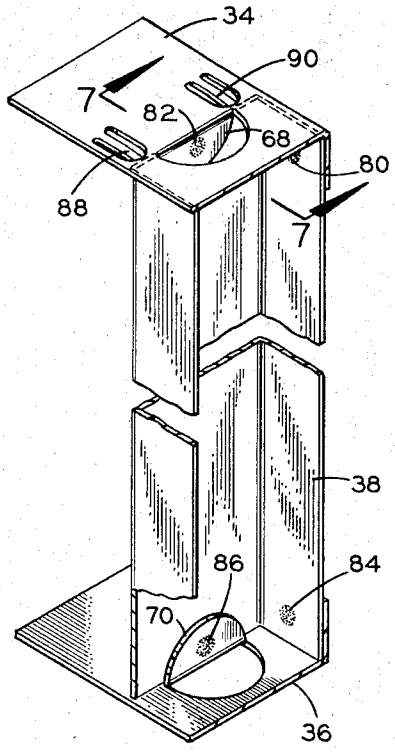


FIG. 6

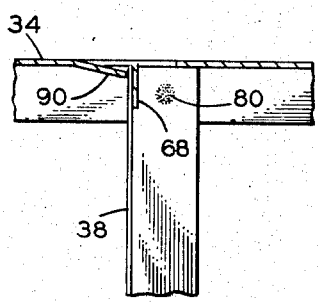


FIG. 7

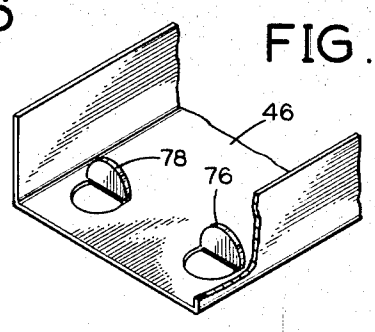


FIG. 8

FIG. 9

INVENTORS
VICTOR E. BROWN
RAUL L. MORA
EVANS T. MORTON
BY SETTLE & OLTMAN
ATTORNEYS

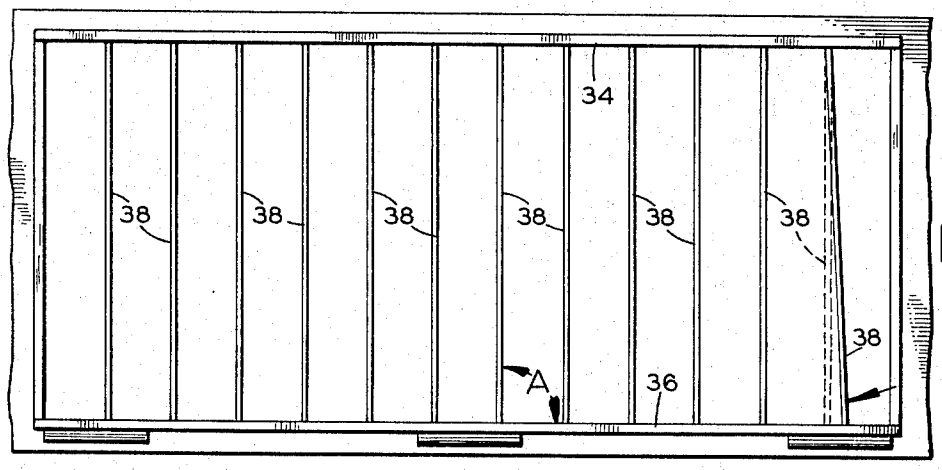


FIG. 10

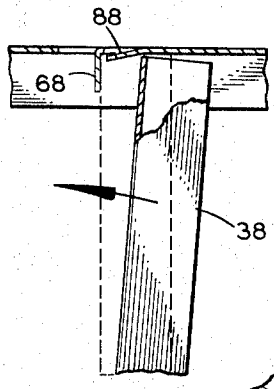


FIG. 11

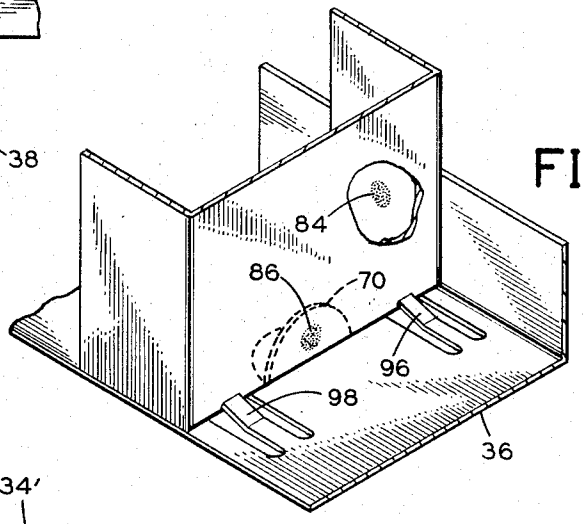


FIG. 12

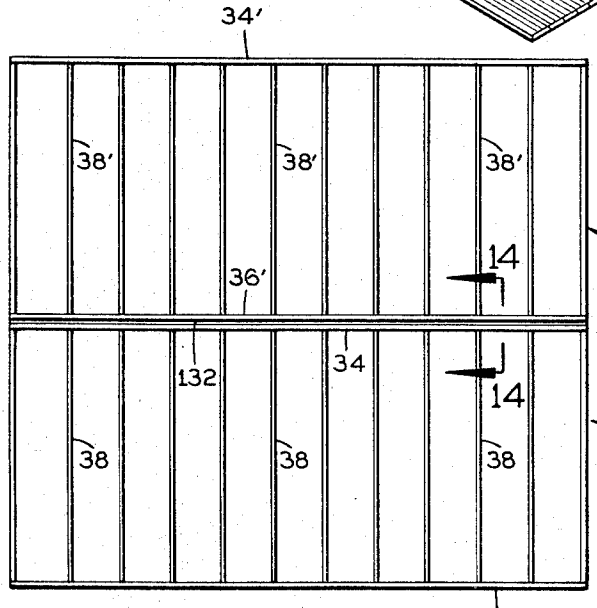


FIG. 13

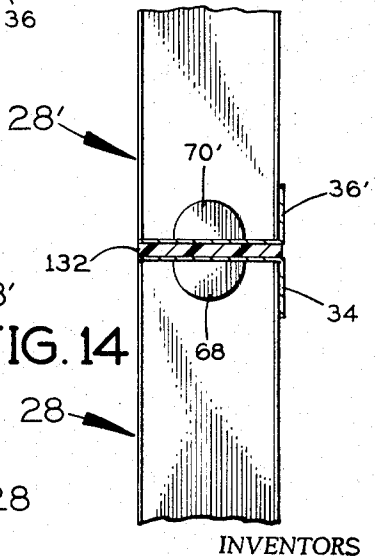


FIG. 14

INVENTORS
VICTOR E. BROWN
RAUL L. MORA
EVANS T. MORTON
BY SETTLE & OLTMAN
ATTORNEYS

FIG. 15

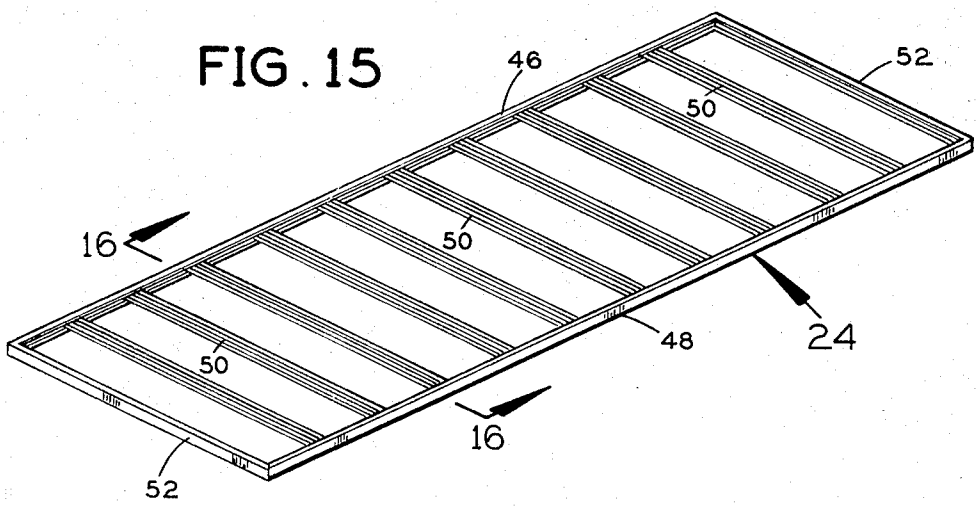
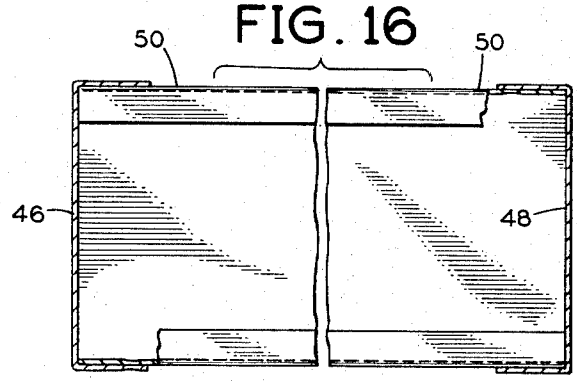


FIG. 16



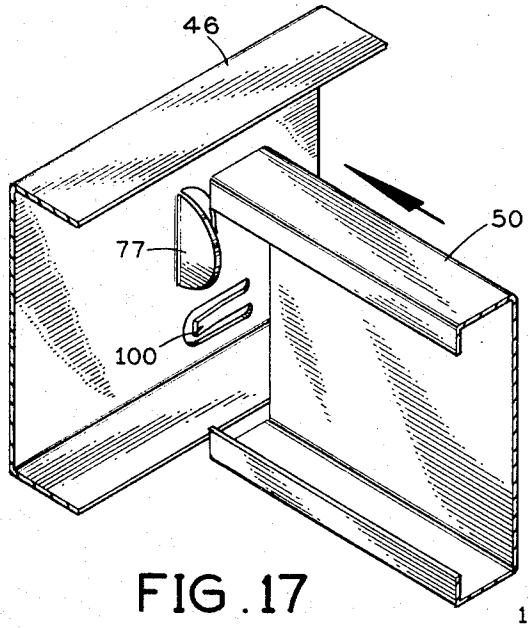


FIG. 17

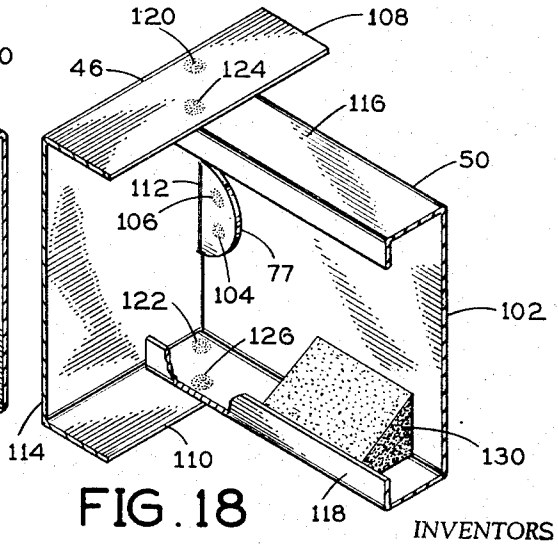


FIG. 18

INVENTORS
VICTOR E. BROWN
RAUL L. MORA
EVANS T. MORTON
BY SETTLE & OLTMAN
ATTORNEYS

MODULE FRAMES

BACKGROUND OF THE INVENTION

One particular type of modular building has modules which include metal frames made with beams and various other parts for doors, windows, wiring, plumbing, etc. Preferably, frame units for walls, floors and ceilings are constructed separately, and are then assembled in an assembly line and secured together to form a module. The positioning and retention of beams in constructing such frame units can result in large dimensional variations from unit to unit unless jigs and fixtures are used to accurately locate the beams. However, a manufacturer of modular homes ordinarily wishes to supply several different models of a given type of home, and due to design variations from one home model to another, different jigs and fixtures would be required for each model. This complicates production as well as requiring substantial investment in jigs and fixtures.

SUMMARY OF THE INVENTION

The present invention provides a method of making frames for modules wherein positioning of certain beams is accomplished in a self-jigging manner. Stops are provided on perimeter beams where cross-beams are to be located. This may be done by sequential punching in a programmed punch press to allow easy variation in the location of stops from one beam to another. Cross-beams are placed between two perimeter beams against corresponding stops. In some beams, retainers cooperate with the stops to temporarily hold the cross-beams. Then the cross-beams are welded to the perimeter beams to form frame units. Ultimately these frame units are assembled to form complete frames for modules and are welded together.

The frame units and frames are part of the invention and derive part of their effectiveness from particular arrangements of stops and welds. Cross-beams may be welded to the stops on the perimeter beams, and this helps to unitize the frame units so that when loads are applied they are well distributed. Perimeter beams and cross-beams in floor and ceiling units are channels which are welded together flange-to-flange and web-to-web so that the webs reinforce each other and the flanges reinforce each other. This helps to prevent web crippling even when relatively thin gauge materials are used.

Accordingly, it is an object of the invention to provide a method of making module frames which method is at least partly self-jigging.

Another object of the invention is to facilitate variation in beam locations from one module frame to another.

A further object of the invention is to construct a frame unit for a module so that it will distribute loads effectively.

Another object of the invention is to strengthen frames for modules by particular arrangements of welds.

Other objects of this invention will appear from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a module for a modular home;

FIG. 2 is a perspective view of a frame for the module of FIG. 1, the frame not being completed with door openings, window openings and the like;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2 and looking in the direction of the arrows;

FIG. 4 is a sectional view taken along line 4—4 of FIG. 2 and looking in the direction of the arrows;

FIG. 5 is a sectional view taken along line 5—5 of FIG. 2 and looking in the direction of the arrows;

FIG. 6 is a fragmentary perspective view of one cross-beam member extending between two perimeter beams in a wall frame unit included in the frame of FIG. 2;

FIG. 7 is a fragmentary sectional view taken along line 7—7 of FIG. 6;

FIG. 8 is a fragmentary perspective view of a portion of a perimeter beam for a floor frame unit or a ceiling frame unit;

FIG. 9 is a schematic view of a punch press useful in performing a punching operation in carrying out the method of the invention;

FIG. 10 illustrates a step of assembling cross-beams between two perimeter beams and placing the cross-beams against stops on the perimeter beams;

FIG. 11 further illustrates the placing of the cross-beams against stops on the perimeter beams;

FIG. 12 is a fragmentary perspective view illustrating the step of welding the cross-beams to the perimeter beams;

FIG. 13 is an elevational view of two wall frame units stacked vertically as may be done in constructing multistory buildings;

FIG. 14 is a sectional view taken along line 14—14 of FIG. 13;

FIG. 15 is a perspective view of a floor frame unit or ceiling frame unit as the case may be;

FIG. 16 is a sectional view taken along line 16—16 of FIG. 15;

FIG. 17 is a fragmentary perspective view of a portion of the floor frame unit before assembly thereof showing in particular the assembling of a cross-beam with a perimeter beam; and

FIG. 18 is a fragmentary perspective view illustrating the step of welding the cross-beam and the perimeter beam together as well as showing the final arrangement of stops and welds.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

As Shown on the Drawings:

Referring first to FIGS. 1 through 8, a modular building such as a home, apartment or other building, may consist of two or more modules which are constructed in a factory, transported to the building site, assembled together, and secured to each other and to a founda-

tion. A module **20** is shown in FIG. **1** to illustrate a typical module for one type of home, but it is to be understood that the invention is not limited in application to this particular module.

A basic frame structure **22** for a module such as the module **20** is shown in FIG. **2**. It is to be understood that this frame structure illustrates the invention, but it is incomplete in that doors, windows, interior walls, and many other accessory structures have been omitted. The frame **22** includes a floor frame unit **24** and a roof frame unit **26**. There are three wall frame units **28**, **30** and **32**.

The wall frame unit **28** consists basically of two perimeter beams **34** and **36** which are each in the form of an angle beam, and a plurality of cross-beams **38** extending parallel to each other between the perimeter beams **34**, **36**. The cross-beams **38**, known as studs, are preferably in the form of channel beams, as may be seen more clearly for example in FIG. **6**.

On the other side of the frame **22**, the wall frame unit **30** consists of two perimeter beams **40** and **42**, each in the form of an angle beam, and a plurality of cross-beams **44** extending parallel to each other between the perimeter beams **40**, **42**. The cross-beams **44**, known as studs, are channels identical to the channels **38**. The other wall **32** likewise has two perimeter beams and cross-beams and is of the same construction as walls **28** and **30**. The fourth wall has been omitted from FIG. **2** but is the same.

The floor frame unit **24** includes two perimeter beams **46** and **48**, which are in the form of channels, and cross-beams or joists **50** which are also in the form of channels. The cross-beams **50** extend parallel to each other between the perimeter beams **46** and **48**. There may also be perimeter beams at the ends of the floor frame unit **24** such as the perimeter beam **52**.

The roof or ceiling frame unit **26** is substantially identical to the floor frame unit **24** and includes perimeter beams **54** and **56** in the form of channels, and cross-beams or joists **58** also in the form of channels. There may be perimeter beams at the ends of the frame unit **26** such as the perimeter beam **60**.

All of the beams described and illustrated in connection with FIG. **2** are made of metal, preferably high strength steel. It may be noted that the floor frame unit **24** and the roof or ceiling frame unit **26** are recessed within the wall frame units **28**, **30** and **32**. The perimeter beams **34** and **36** together with the studs **38** are welded to the perimeter beams **54** and **46**. Similarly, the perimeter beams **40** and **42** together with the studs **44** are welded to the perimeter beams **56** and **48**. By having the floor frame unit **24** and the roof frame unit **26** welded to the inside faces of the wall frame units **28**, **30** and **32**, additional rigidity and strength is obtained in the final structure because there is less hinging action at the welded joints. This feature of the frame construction is described and claimed in a co-pending application Ser. No. 38,100 filed on May 18, 1970 by John M. Evans and Evans T. Morton and assigned to the present assignee.

In accordance with one aspect of the present invention, the perimeter beams of the various frame units are provided with stops which may be in the form of tabs, and the cross-beams which extend between the perimeter beams butt against these stops. Referring first to FIG. **3**, it may be seen that the cross-beam **44** of the wall frame unit **32** butts against a stop or tab **62** formed in the perimeter beam **40**. The lower end of cross-beam **44** likewise butts against an identical stop formed in the lower perimeter beam **42**. In the roof frame **26**, the end of a cross-beam **58** shown in FIG. **3** butts against two stops or tabs **64** and **66** formed in the perimeter beam **56**. The same elements are shown in FIG. **4** from a different angle.

FIG. **5** is a sectional view taken through the other wall frame unit **28**, and shows a cross-beam **38** having its upper end butting against a stop or tab **68** formed in the perimeter beam **34** and having its lower end butting against a stop or tab **70** formed in the perimeter beam **36**. FIG. **5** also shows the left ends of two cross-beams **50** and **58**. It may be seen that the end of cross-beam **58** butts against two stops or tabs **72** and **74** formed in the perimeter beam **54** of the roof frame unit. Similarly, the end of cross-beam **50** butts against two stops or tabs **76** and **78** formed in the perimeter beam **46** of the floor frame unit.

FIG. **6** illustrates how the cross-beams or studs of the wall frame units **28**, **30** and **32** may be welded to the perimeter beams. In FIG. **6**, the perimeter beams **34** and **36** are shown together with a cross-beam **38**. It may be seen that there is a spot weld **80** between a flange of stud **38** and the inside flange of perimeter beam **34**. There is another weld **82** connecting the web of stud **38** to the stop or tab **68**. Likewise, at the lower end of stud **38** a weld **84** connects the inside flange of stud **38** to the inside flange of perimeter beam **36**, and another spot weld **86** connects the web of stud **38** to the stop or tab **70**. It is not essential to provide two welds at each end of the studs **38**. For example, the welds **80** and **84** could be used alone or the welds **82** and **86** could be used alone.

FIGS. **6** and **7** illustrate retainer prongs **88** and **90** formed in the perimeter beam **34** directly adjacent the tab **68**. It will be understood that there are identical prongs formed in the perimeter beam **36** directly adjacent and on opposite sides of the tab **70**. As may be seen in FIG. **7**, the web of the stud **38** fits between the prongs **88** and **90** and the tab **68**. The studs can be forced over the prongs such as **88** and **90** when the studs are being placed against the stops such as stops **68**. The prongs will yield to allow the end of the stud to pass and then spring back to retain the stud against the tab **68** until the stud is welded in place. This considerably simplifies the positioning of the studs, and saves a great deal of equipment which would otherwise be required for clamping and holding the studs in place.

FIG. **8** merely illustrates in greater perspective the configuration of the tabs **76** and **78** in the perimeter beam **50**.

FIGS. **9** through **12** illustrate basic steps in the method of the invention. The invention includes a step of providing perimeter beams with stops located at predetermined positions spaced along the length thereof at which cross-beams are to be located. FIG. **9** illustrates how this may be accomplished. A perimeter beam **34** is shown passing through a punch press **91** which sequentially punches stops or tabs in the perimeter beam **34**. The press **91** has die sets **92** and **94** which are designed to form both the tabs **68** and the retainer prongs **88**,**90** in a single punching step. The specific

position of a given tab **68** and retainer **88,90** on the perimeter beam **34** can be controlled very accurately. The press **91** may be of the numerically controlled type. Thus, the locations of all of the tabs **68** for a given beam can be programmed into the press, and specific locations can be selected by feeding input information into the press such as from punched cards. Then as the beam **34** passes through the press, tabs **68** and retainer prongs **88** are punched at precisely located position where cross-beams are to be placed in the ultimate frame unit. It is easy to vary the spacing from one tab to another within a given beam merely by proper selection of the input information for the punch press. It is also easy to change the location of tabs from one beam to another.

It may be seen that by forming the stops on the perimeter beams at preselected positions on the beams as by a punching operation, a considerable investment in jigs and fixtures is saved. If it were necessary to rely upon jigs and fixtures to position the cross-beams, different fixtures would have to be provided for different positions of beams. The setup time for a given frame unit would be considerably increased, and there would be considerably more labor involved also.

FIGS. **10** and **11** illustrate the step of assembling the cross-beams **38** with two perimeter beams **34** and **36** and placing the ends of the cross-beams **38** against the stops or tabs **68** and **70** to position the cross-beams without requiring jigs or fixtures to establish those positions. The beams **38** (and **44**) are assembled vertically. FIG. **11** in particular shows the upper end of a cross-beam **38** being forced over the prongs **88** into position against a tab **68**. FIG. **12** illustrates the lower end of the cross-beam **38** after it has been butted against the tab **70**, and after the retainer prongs have returned to hold the lower end of the stud **38** in place.

FIG. **12** also shows the welds **86** and **84** which may be used to weld the stud **38** to the perimeter beam **36**, and thus illustrates the step of welding the studs to the perimeter beams. All of the wall frame units are made by essentially the same sequence of steps.

The floor frame unit **24** and the roof frame unit **26** are made by the sequential steps illustrated in FIGS. **15** through **18**. A floor frame unit **24** is shown in FIG. **15** including the perimeter beams **46,48** and the cross-beams or joists **50**. FIG. **16** shows the manner in which the joists **50** fit inside the channel flanges of the perimeter beams **46** and **48**.

The first step is to punch the perimeter beams **46** and **48** to form the stops where cross-beams are to be located. Retainer prongs may be formed in the perimeter beams **46** and **48** if desired, but they are not necessary in all cases since the floor frame units are usually fabricated in a horizontal position. In FIG. **17**, a single stop or tab **77** replaces the two stops **76** and **78** shown for example in FIG. **8**. A retainer prong **100** is also shown. The stops **77** are punched at precise locations for cross-beams in exactly the same manner described in connection with FIG. **9**. Then a plurality of the cross-beams **50** are assembled with the perimeter beams extending parallel between the perimeter beams. The ends of the cross-beams are placed against the stops **77** to position the cross-beams without requiring jigs or fixtures for their positioning. Next, the cross-beams are welded to the perimeter beams.

A specific arrangement of welds which is unexpectedly strong is shown in FIG. **18**. It may be seen that the web **102** of beam **50** is welded to the tab **77** at **104** and **106**. The tab **77** is perpendicular to the flanges **108** and **110**, and the tab **77** thus provides a corner at **112** which stiffens the web **114** of beam **46**. By having the tab **77** welded to the web **102**, the two webs **114** and **102** reinforce each other.

Also, the flange **108** is welded to flange **116** and flange **110** is welded to flange **118** in a desirable manner. There are welds at **120** and **122** which are very close to the two webs **102** and **114**, these welds being very close to the corner formed by the two webs **102** and **114**. There are two other welds **124** and **126** separated farther from the webs **102** and **114** than the welds **120** and **122**, and these welds are spaced diagonally from welds **120** and **122**.

Thus, welds **120** and **122** effectively weld the two beams together web-to-web, and the two welds **124** and **126** effectively weld the two beams **50** and **46** together flange-to-flange. This means that the webs **102** and **114** reinforce each other and the flanges **116** and **118** respectively reinforce the flanges **108** and **110**.

After the frame units have all been assembled and welded, the various frame units **24**, **26**, **28**, **30** and **32** are assembled together into a generally cubicle shape and are welded together in accordance with the previous description. The frame units are ordinarily finished with surfacing material and other structure before they are welded together. In a commercial production facility, the frame units may be completed in subassembly bays, and then assembled together and welded on a final production line. FIG. **18** shows that the cross-beams **50** of the floor frame unit **24** may be filled or partially filled with sound deadening material such as sand cement **130** to help to deaden the sound of the cross-beams **50**. The cement **130** adds weight to the cross-beams and changes their natural frequency to a relatively low frequency which does not have unpleasant qualities.

As previously mentioned, the particular arrangement of welds shown in FIG. **18** gives unexpected strength to the floor and roof frame units **24** and **26**. The webs of the various beams reinforce each other and the flanges of these beams also reinforce each other. As a result, it is possible to use relatively thin gauge material for the beams and still achieve frame units of high compressive and tensile strength. Similarly, the welding of the cross-beams or studs **38** and **44** in the wall frame unit to the tabs or stops such as the tabs **68** and **86** shown in FIGS. **11** and **12** increases the strength and load distributing characteristics of the wall frame unit. This is illustrated particularly in FIGS. **13** and **14**. In FIG. **13**, two wall frame units **28** and **28'** are shown stacked one above the other as they would be arranged if two frames **22** were placed one above the other. This happens in construction of multi-story buildings. It may be seen that if some of the studs **38** and **38'** were shorter than others, there would be a possibility of the perimeter beams **34** and **36'** becoming distorted with a resultant uneven distribution of loads. However, by welding the studs **38** and **38'** to the tabs such as tabs **68** and **70**, the wall frames are unitized so that loads are distributed uniformly. This distribution of loads is facilitated by providing compressible material such as styrofoam at

132 between the perimeter beams 34 and 36' as shown in FIG. 14. The styrofoam will compress to conform to the beams 34 and 36' and thus take up any irregularities in these beams.

It is apparent that the invention provides module frames and a method of making module frames wherein certain positioning steps are self-jigging. This considerably speeds up production, reduces investment in jigs and fixtures, saves labor and conserves floor space in an assembly operation. Furthermore, the welding of the various beams to the stops which are used for self-jigging imparts strength to the structures and improves load distribution. A particular arrangement of welds is provided for the floor and roof frame units which imparts unexpectedly high strength to these structures. The floor frame unit can be sound deadened in an extremely simple manner.

Having thus described our invention, we claim:

1. A frame unit for a module of a modular building including in combination, a pair of metal perimeter beams in the form of channels which are parallel to each other and spaced apart by a cross-dimension of a frame unit, each of said perimeter beams having a plurality of tabs punched out from and integral with the channel web thereof and projecting between the channel flanges, said tabs being spaced all along the length of said perimeter beams and located at predetermined positions for cross-beams, a plurality of cross-beams in the form of channels spaced all along and extending between said perimeter beams parallel to each other and having ends butting against respective ones of said tabs to position the same, each of said cross-beams having the channel flanges thereof respectively abutting the channel flanges of said perimeter beams and the web thereof abutting the webs of said perimeter beams to form corners, and each abutting pair of flanges having a first spot weld joining the same at a corner next to the webs of said beams and a second spot weld joining the same at a point spaced diagonally along said pair of flanges from said corner so that the webs of said perimeter beams and said cross-beams reinforce each other and the flanges of said perimeter beams and said cross-beams reinforce each other.

2. The frame unit as claimed in claim 1 in which the webs of said cross-beams are spot welded to said tabs.

3. A frame unit for a module of a modular building including in combination, a pair of angled metal perimeter beams which are parallel to each other and spaced apart by a cross-dimension of a frame unit, said perimeter beams having a web and at least one flange, each of said perimeter beams having a plurality of tabs integral therewith and projecting along a flange thereof, said tabs being spaced at intervals all along the length of said perimeter beams to provide stops for positioning cross-beams, a plurality of angled metal cross-beams spaced all along and extending between said perimeter beams parallel to each other, said cross-beams having a web and at least one flange, each of said cross-beams having the web thereof abutting a pair of said tabs on said perimeter beams and forming a corner with the webs of the perimeter beams, each cross-beam also having at least one flange thereof respectively fitting inside and abutting the flanges of said perimeter beams, and each abutting pair of flanges having a first spot weld interconnecting the same at a corner next to the webs of said beams and a second spot weld spaced diagonally along said pair of flanges from said first spot weld and separated farther than said first weld from the webs of said beams so that the webs of said perimeter beams and said cross-beams reinforce each other and the flanges of said perimeter beams and said cross-beams reinforce each other.

4. The frame unit as claimed in claim 3 in which the ends of said cross-beams and said tabs have a spot weld connecting them together.

5. A box module for a modular building consisting of a plurality of frame units as claimed in claim 3 having the perimeter beams thereof welded together at corners to form the box module, the frame units including horizontal ceiling and floor frame units and a plurality of vertical side frame units.

* * * * *