United States Patent [19]

Brown et al.

[11] **3,720,995**

[45] **March 20, 1973**

[54] **MODULE FRAMES AND METHOD OF MAKING SAME**

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

[22] Filed: **Aug. 26, 1971**

[21] Appl. No.: **175,282**

Related U.S. Application Data

[62] Division of Ser. No. 53,502, July 9, 1970.

[52] **U.S. Cl.** .....**29/482,** 29/469, 29/155, 287/189.36 B

[51] **Int. Cl.** **B23k 1/20**

[58] **Field of Search** 52/735.79; 29/155, 469, 475, 29/428, 482

[56] **References Cited**

UNITED STATES PATENTS

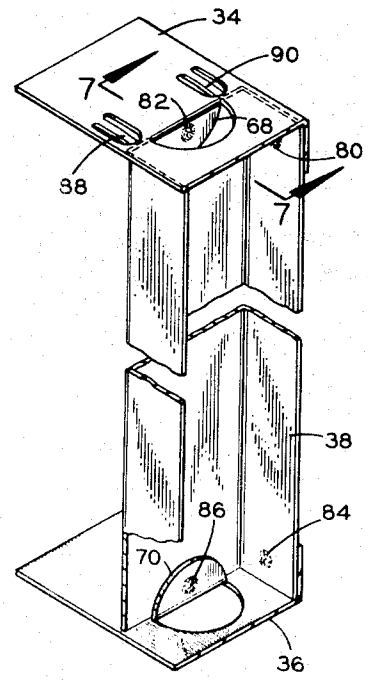
2,275,109	3/1942	McGee	52/735
3,604,176	9/1971	Campbell	52/735

Primary Examiner—Milton S. Mehr
Attorney—Settle and Ottman

[57] **ABSTRACT**

The method of making frames and frame units for modules of modular building 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 perimeter beams. In some frame units, the perimeters 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.

10 Claims, 18 Drawing Figures



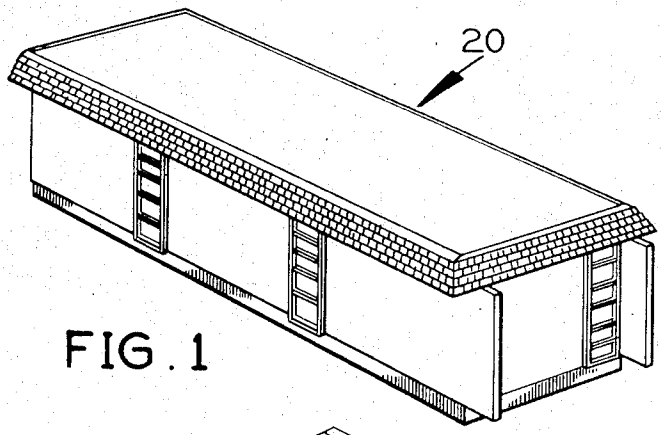


FIG. 1

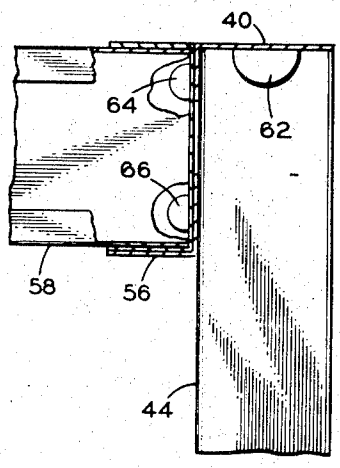


FIG. 3

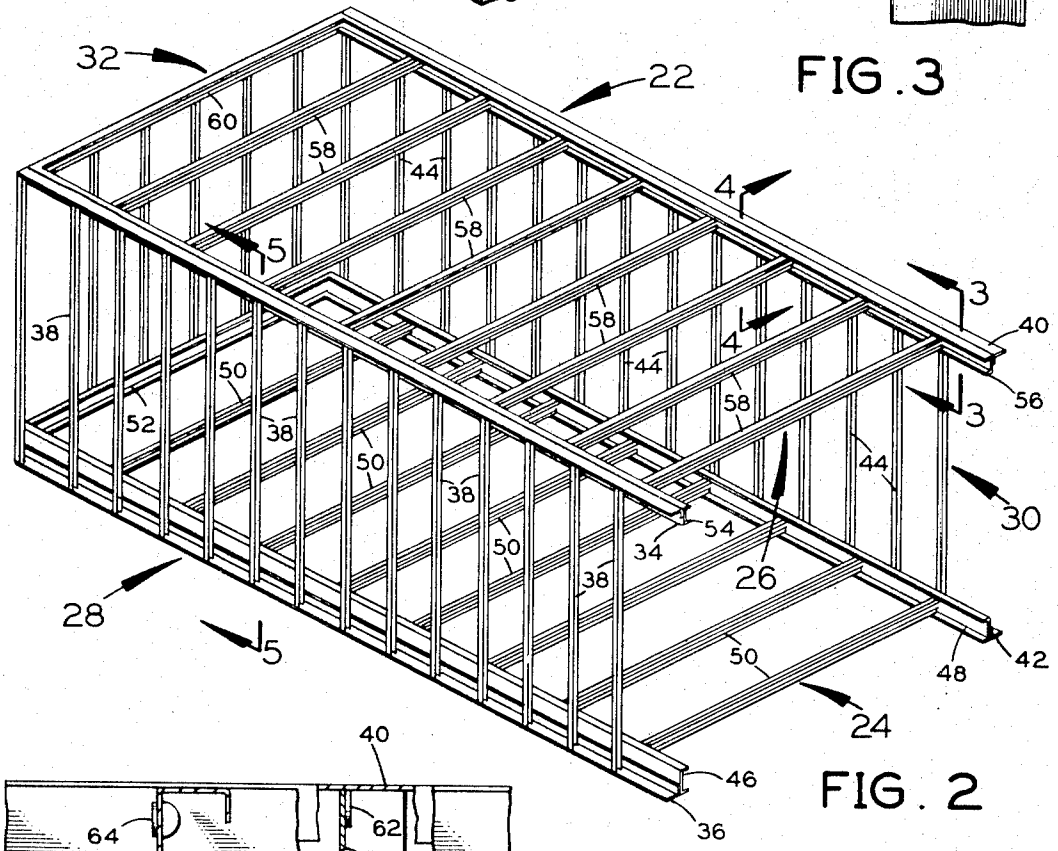


FIG. 2

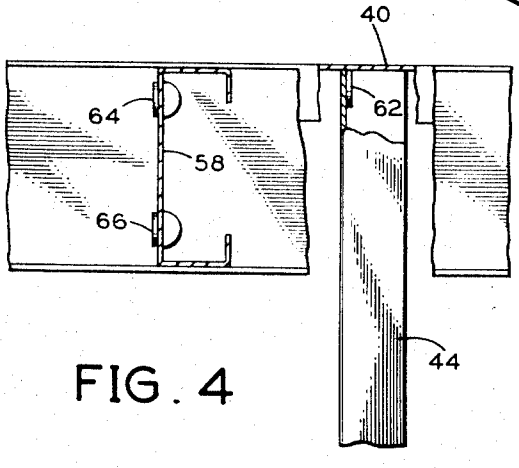


FIG. 4

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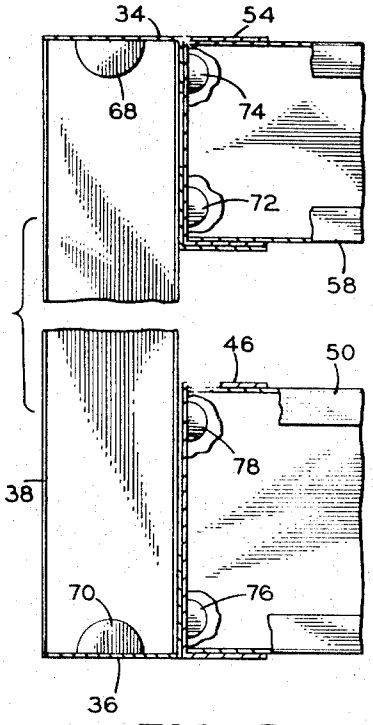


FIG. 5

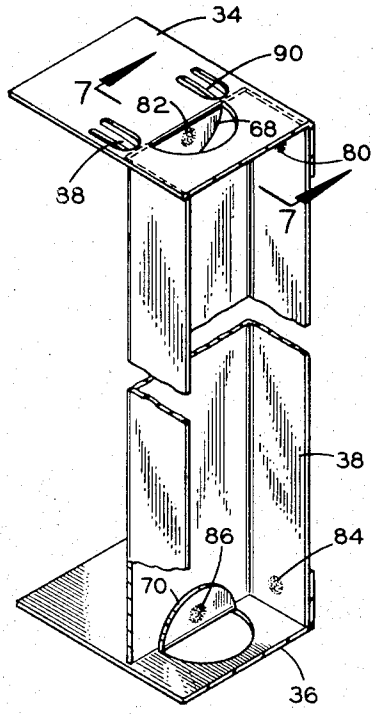


FIG. 6

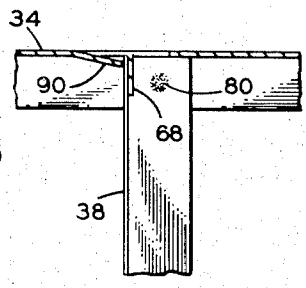


FIG. 7

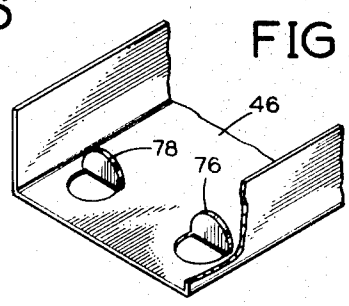


FIG. 8

FIG. 9

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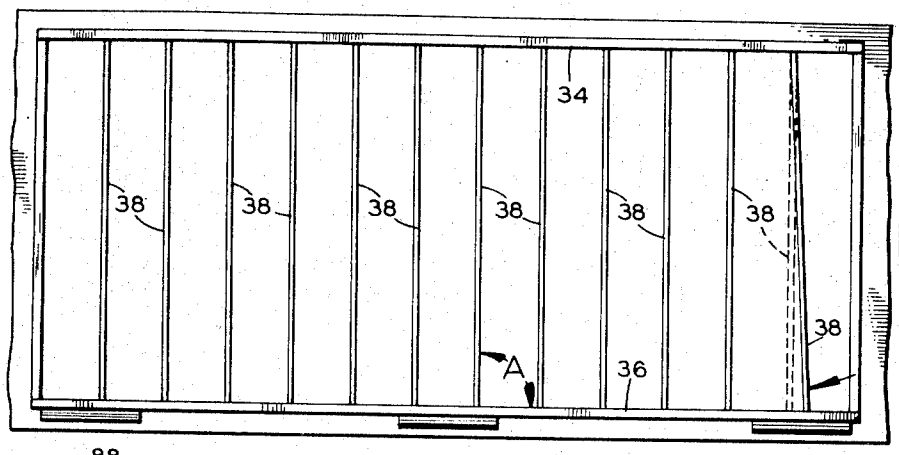


FIG. 10

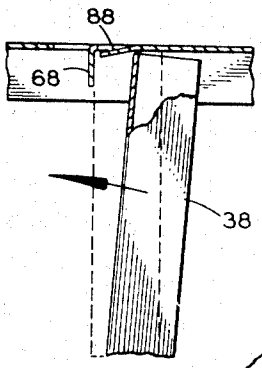


FIG. 11

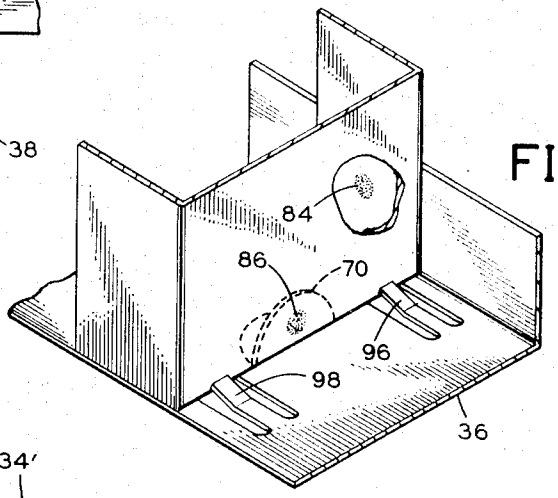


FIG. 12

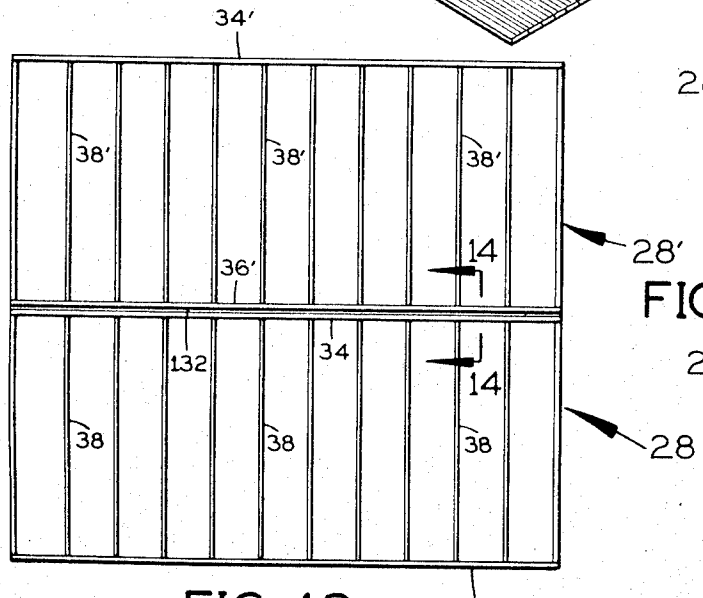


FIG. 13

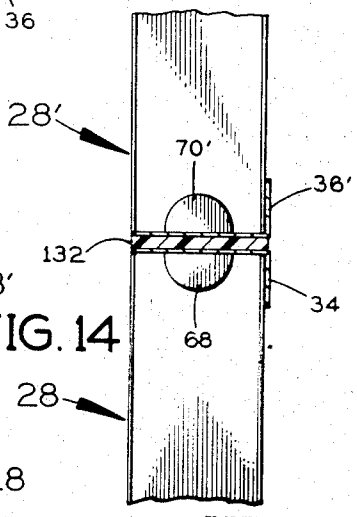


FIG. 14

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FIG. 15

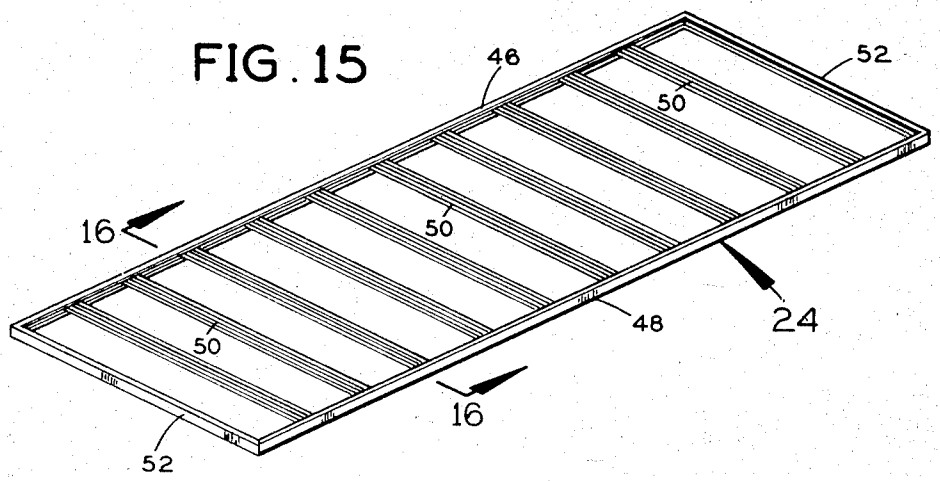
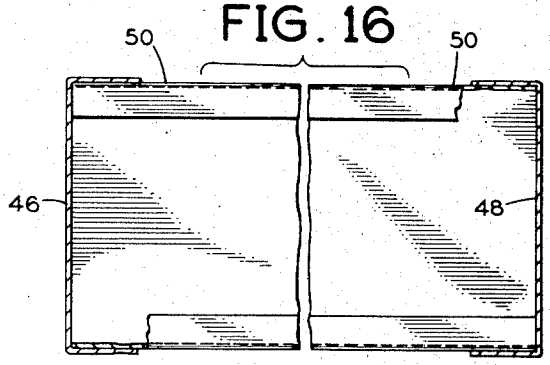


FIG. 16



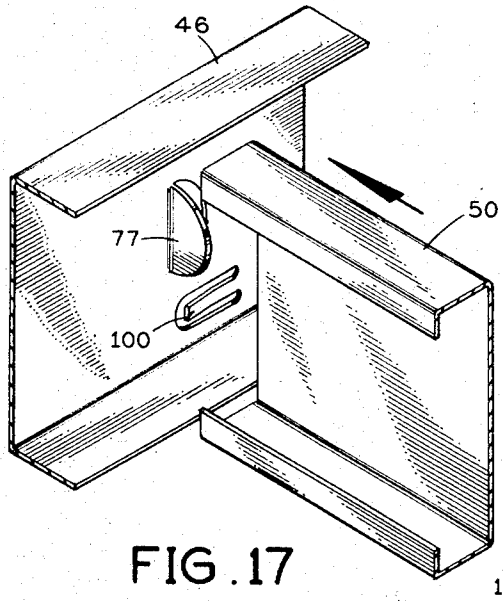


FIG. 17

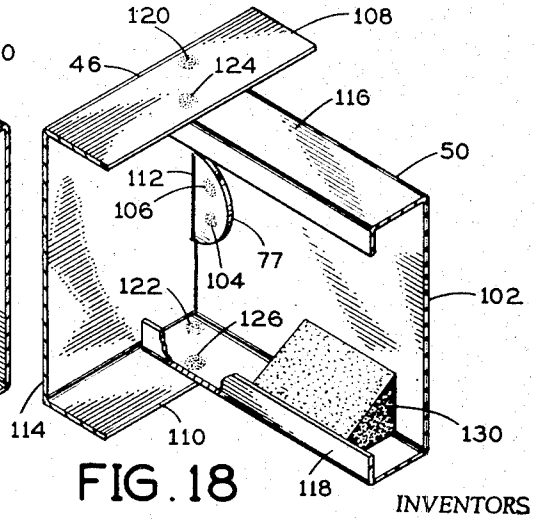


FIG. 18

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MODULE FRAMES AND METHOD OF MAKING SAME

This is a division of application Ser. No. 53,502 filed July 9, 1970.

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 multi-story 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 foundation. 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 forms 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 with 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 forced formed 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 perime-

ter 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 sub-assembly 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 34 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 method of constructing a frame unit for a module of a building comprising the steps of

a. providing perimeter beams with projecting stops spaced along the length of the beams at selected positions where cross-beams are to be located in a completed module frame,

b. retaining a pair of said perimeter beams parallel to each other and spaced apart by a dimension of a frame unit for a building module,

c. placing a plurality of cross-beams perpendicularly between said perimeter beams and parallel to each other and butting each cross-beam against a respective one of said stops at each end of the cross-beam to accurately position the cross-beam without jigs or fixtures to establish that position,

d. fixing the perimeter beams and the cross-beams to each other at the ends of said cross-beams to form frame units,

e. assembling a plurality of said frame units with each other to form a module frame for a building, and

f. securing the frame units together.

2. The method as claimed in claim **1** in which said beams are metal and step (d) is carried out by welding the ends of said cross-beams to said perimeter beams.

3. The method as claimed in claim **2** in which the ends of said cross-beams are welded to said respective stops.

4. The method as claimed in claim **2** in which said perimeter beams and said cross-beams are channels, and step (d) is carried out by welding the flanges of the cross-beam channels to the flanges of the perimeter beam channels with a weld next to the webs of the channels and another weld spaced outwardly from the webs so that the webs reinforce each other and the flanges reinforce each other.

5. The method as claimed in claim **4** in which the webs of said cross-beam channels are also welded to the stops on said perimeter beams which stops are located in the webs of said perimeter beam channels.

6. The method as claimed in claim **1** in which said beams are metal and step (a) is carried out by punching said perimeter beams to form said projecting stops.

7. The method as claimed in claim **4** in which said perimeter beams are passed through a punching device to sequentially form said projecting stops by successive punching.

8. A method of constructing a frame for a module of a building comprising the steps of

providing tabs on perimeter beams at selected points spaced along the length thereof at predetermined positions where cross-beams are to be located in a completed module frame,

assembling cross-beams with and between pairs of perimeter beams to form frame unit including placing each cross-beam of a frame unit against a tab of a perimeter beam at each end of the cross-beam to accurately position each cross-beam at the pre-selected location without jigs or fixtures for positioning of the cross-beams,

fixing the perimeter beams and the cross-beams of each frame unit to each other,

assembling a plurality of frame units to form a module frame, and

securing the frame units together.

9. A method of constructing a frame unit for a module of a building comprising

punching metal perimeter beams at selected points spaced along the length thereof to form tabs with retainers at predetermined positions where cross-beams are to be located in a completed module frame,

assembling metal cross-beams with and between pairs of perimeter beams to form frame units, each cross-beam of a frame unit being place between a tab and a retainer of a perimeter beam at each end of the cross-beam to accurately position the cross-beam at the selected position, and

welding the perimeter beams and the cross-beams of each frame unit to each other.

10. A method of constructing a frame for a module of a building comprising

punching metal perimeter beams at selected points spaced along the length thereof to form tabs at predetermined positions where cross-beams are to be located,

assembling metal cross-beams with and between pairs of perimeter beams to form frame units including placing each cross-beam of a frame unit against a tab of a perimeter beam at each end of the cross-beam to accurately position the cross-beam,

welding the perimeter beams and the cross-beams of each frame unit to each other,

assembling a plurality of frame units to form a module frame, and

welding the frame units together.

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