Feb. 19, 1963 E. C. FORSYTHE ETAL 3,077,642

SELF-SUPPORTING STRUCTURE

Filed July 22, 1957 3 Sheets-Sheet 1

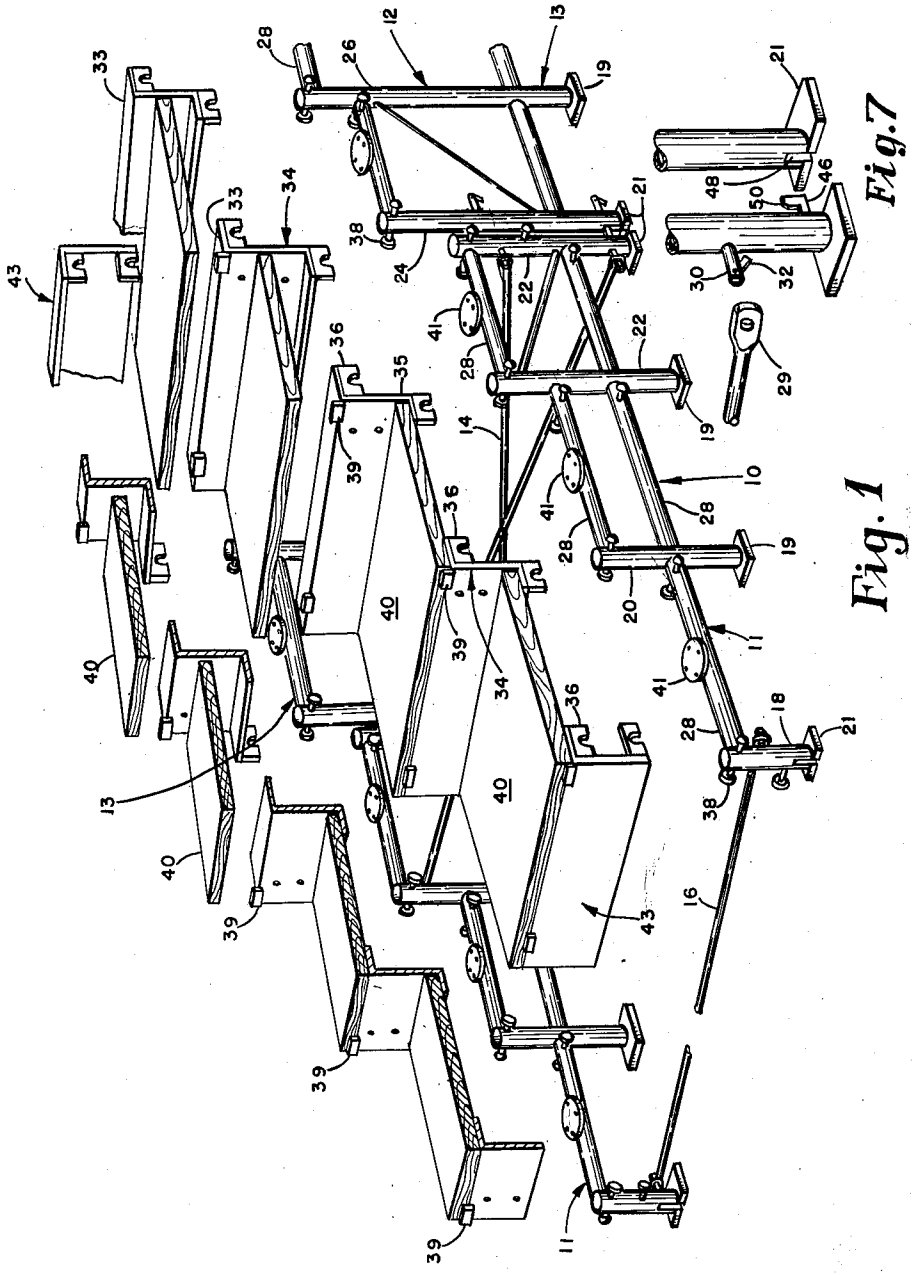


Fig. 1

Fig. 7

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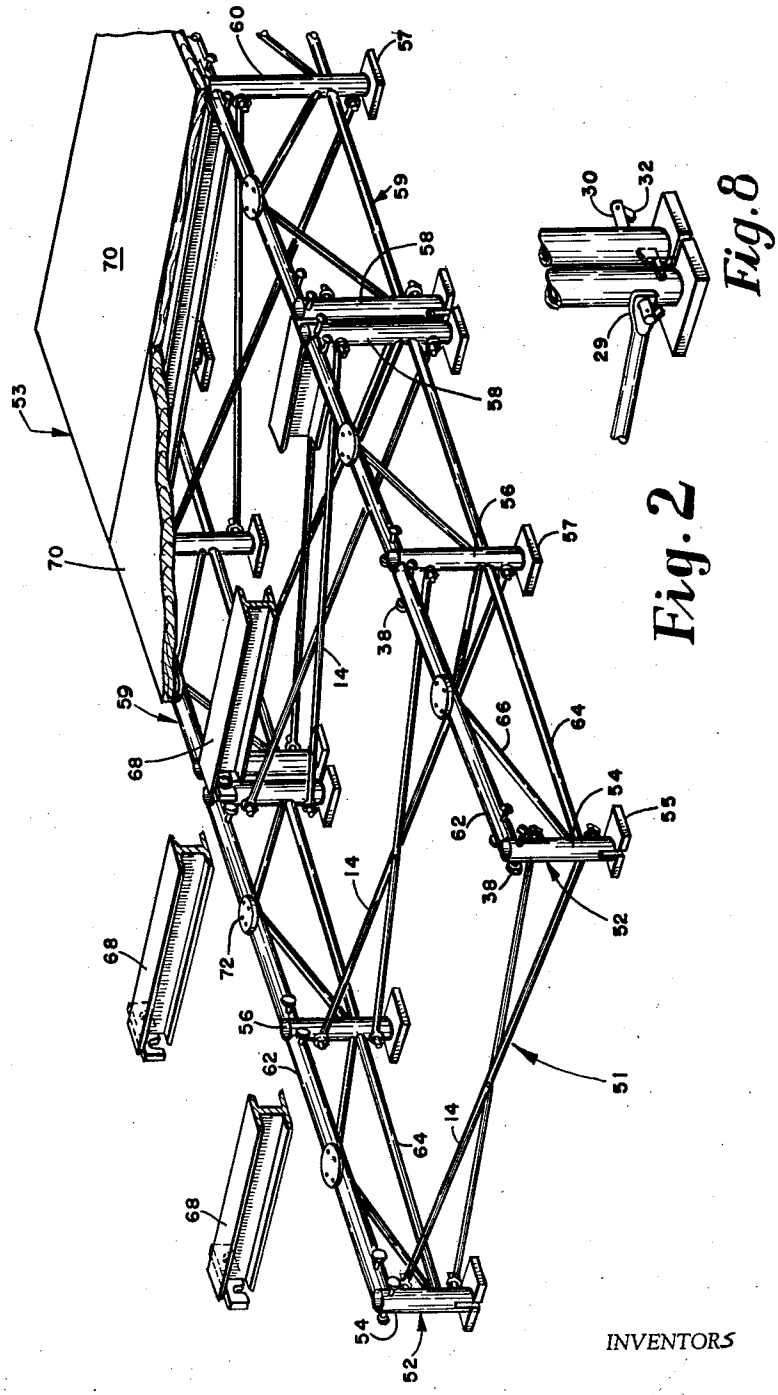


Fig. 2

Fig. 8

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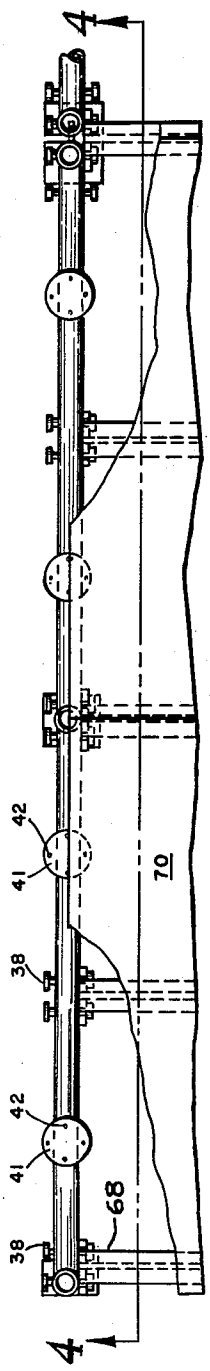


Fig. 3

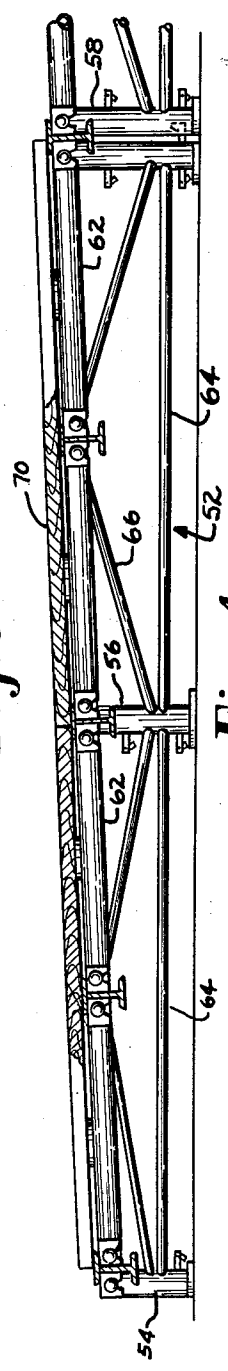


Fig. 4

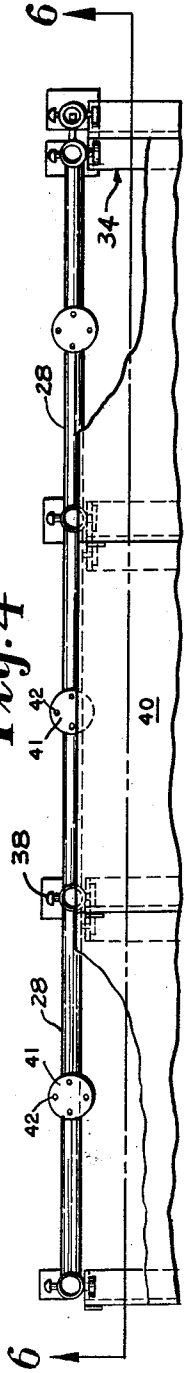


Fig. 5

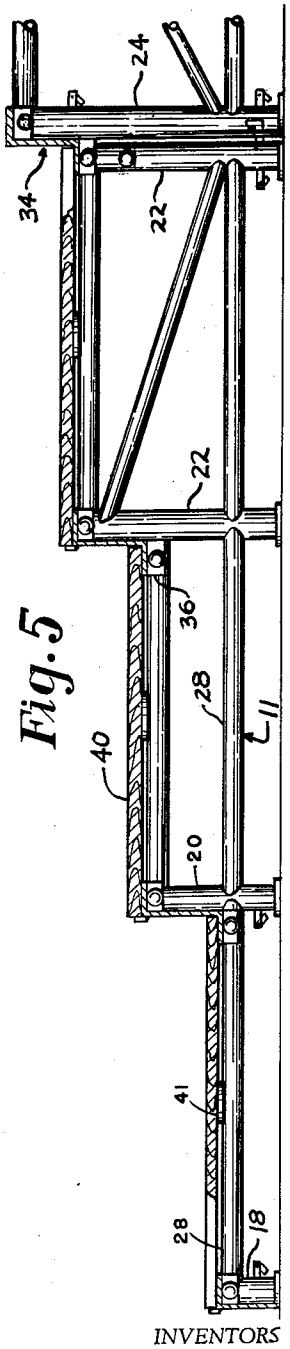


Fig. 6

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SELF-SUPPORTING STRUCTURE

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6 Claims. (Cl. 20—1.126)

This invention relates to a sectional platform which may have flat, stepped, or a rising ramp surface

Equipment of this type is used in auditoriums and arenas to provide temporary seating accommodations and must be rugged when assembled but still must permit of easy disassembly and must be stored in a minimum space. Over and above these basic requirements there is the added requirement that the assembled unit engender a feeling of security and stability. Finally, the structure must employ a minimum number of parts and avoid small, easily lost parts.

The principal object of this invention is to satisfy all the above requirements.

Another object is to provide a sectional ramp structure of the type described which has extreme flexibility of arrangement to suit many varied seating requirements.

A further object is to provide a novel method of tying end frames together to give superior support for the decking (flooring) to allow greater spans to be employed without sacrificing solidity.

Still another object is to provide a novel method of interlocking adjacent end frames to result in great stability.

Each assembled unit according to this invention includes spaced end frames interconnected by cross braces and by beams which are designed to carry the decking and also connect adjacent end frames. The adjacent end frames are also interconnected by additional means which will be described in detail later. The beams may take various shapes depending upon the type structure desired—thus the beam cross-section may be in the form of a Z, an L, an I a T, or a rectangular tube. These beams, besides tying the end frames together, give continuous support to the decking between the end frames to permit use of relatively thin plywood sheets of a large size which is nevertheless, easily stored and handled.

Other objects and advantages will be pointed out in, or be apparent from the specification and claims, as will obvious modifications of the two embodiments shown in the drawings, in which:

FIG. 1 is an exploded fragmentary perspective view showing the present invention embodied in a step-type construction;

FIG. 2 is a fragmentary perspective view with parts broken away showing the invention embodied in a ramp-type construction;

FIG. 3 is a fragmentary plan view of the structure shown in FIG. 2 with parts of the flooring broken away;

FIG. 4 is a sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a fragmentary plan view of the structure shown in FIG. 1 with parts of the flooring broken away;

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5; and

FIGS. 7 and 8 are fragmentary perspective views showing the means of tying the bottom of the posts of adjacent units together and the quick-lock connections of the cross braces to the end frames.

Referring to the drawings, FIGS. 1, 5 and 6 show the step-type construction particularly adapted for steps and chair risers comprising self-supporting units **10** and **12** arranged front to back to provide support levels of gradually increasing elevation. Front unit **10** comprises a pair of

rigid end frames **11** connected at the rear by X or scissors cross braces **14** and a single member cross brace **16** at the front and having vertical posts **18**, **20** and **22** (with base plates **19** and **21**) of gradually increasing height (from front to rear) connected by tubular longitudinal braces **28** to form rigid end frames adapted to be set up or taken down as single members. Unit **12** (shown partially) includes end frames **13** having vertical posts **24** and **26** and longitudinal braces **28** with the increment of rise between posts equal to that of end frames **11** of unit **10**. Scissors cross braces **14** and single member cross brace **16** connected between the end frames are quickly attached (FIG. 7) by inserting the apertured ends **29** of the braces over quick-lock studs **30**. The braces may be quickly removed by raising gravity latch **32** (pivotally mounted in a slot in the studs **30**) which frees the braces for removal. No tools or threaded connections with loose, easily lost parts are required. It is noted that these cross braces locking the frames together in an upright position need only be attached to one of the two abutting posts at the connection between units **10** and **12** due to the connections between the posts themselves which will be discussed in detail hereinafter.

Although only two units are shown, it should be understood that additional units may be employed to the rear or at either side in various combinations depending on the job at hand. The end frames of a unit, which may be connected to the rear of unit **12**, are of similar construction to those previously described but have vertical posts of increased height to provide uniformly increasing increments of elevation. If it is desired to go higher by adding additional units to the rear of the third unit another series of end frames identical to the first three previously described are used on top of truss members to bring the end frames to the desired height. This is conventional practice in structures of this type and prevents the end frames from reaching a size whereby they become difficult to handle.

A plurality of beams **34** are connected between the end frames and perform a variety of functions formerly requiring several different parts to accomplish. In the step-type embodiment shown in FIG. 1, beams **34** are of substantially Z-shaped cross section with a web **35** and flanges **33** extending normal thereto. The beams are detachably connected between the end frames by slotted lugs **36** fastened to the ends of the flanges **33** for engagement with headed pins **38** fixed to the end frames. The beams are assembled by lowering the slotted ends into engagement with the headed pins producing a rigid connection between the longitudinally spaced pins to thereby provide longitudinal support to the structure. Beams **34** provide transverse support by restraining movement of the end frames toward and away from each other. Headed pins **38** extend from either side of the end frames to permit transverse extension of the units shown by connecting additional end frames and beams on either side of the units shown.

Another important function of the beams is to carry planking or flooring thereon for supporting chairs and people on the structure. The flooring members **40** are supported along their front and rear edges by flanges **33** of beams **34**. Cleats **39** fastened by welding or other suitable means to the front edge of the top flange of each beam hold the flooring members in assembled position. This continuous support over the span of the flooring members **40** permits the use of flooring of reduced thickness and increased span, and eliminates undesirable bounce and sag in the flooring under dynamic loading. The webs **35** of the beams cooperate with the flooring members to provide a completely closed riser from level to level. This construction has a more permanent appearance which engenders a feeling of safety and stability.

Additional support may be provided at each end frame by pads 41 fastened to the top horizontal braces 28. In this instance the top braces 28 serve as support members as well as bracing. Cleats (not shown) may be fastened to pads 41 on end frames at either end of the structure by means of apertures 42 therein to prevent flooring members 40 from sliding transversely off the end of the structure.

Beams 43 of slightly different construction are used at the front and rear of the structure. As shown in FIG. 1, an L-shaped beam 43 with vertically aligned lugs is used to provide a flush surface at the front and rear of the structure.

Each unit may be fastened to additional units at the front and rear. The rear of unit 10 (FIG. 1) is connected to the front of unit 12 to provide a structure of gradually increasing height. The rear posts 22 of end frames 10 are placed adjacent the front posts 24 of end frames 12 and connected together at both the top and bottom. The units are tied together at the top by beams 34 which engage pins 38 on adjacent posts. The bottom connection (FIG. 7) includes a finger 46 extending from one post into a slot 48 in the adjacent post with a lug 50 fastened to the end of the finger for engagement with the inside of the slotted post preventing movement of the posts away from each other. Slots 48 are of sufficient length to permit vertical movement of the finger in the slot for rapid connection of adjacent units. No tools or small parts are required. Base plates 21 on the front and rear posts of each end frame are cut off to allow flush connection of adjacent posts and have slots in alignment with slots 48 in the posts to facilitate rapid connection of adjacent units.

The ramp-type construction is shown in FIGS. 2, 3 and 4 and includes a unit 51 (shown fully) and a unit 53 (shown partially). End frames 52 of unit 51 comprise vertical posts 54, 56 and 58 of gradually increasing height having base plates 55 and 57. The tops of the posts are connected by tubular braces 62 which slope upwardly from front to rear and at the bottoms of horizontal tubular braces 64 of smaller diameter. A pair of diagonal braces 66 are fastened between the top and bottom braces between each post. The members are integrally connected by welding or other suitable means to provide a rigid frame which can be assembled and disassembled as a single member. End frames 59 (shown partially) with vertical posts 58 and 60 are of similar construction. The end frames are connected by X or scissor braces 14 by means of quick-lock studs 30 (FIG. 8) as previously described with respect to the step-type structure shown in FIG. 1.

Additional longitudinal and transverse support and means for supporting planking or flooring are provided by I-beams 68 with notched lugs 36 fastened to the underside of the top flange for detachable connection to headed pins 38 on the end frames in the manner described with respect to the beams 34 shown in FIG. 1. These I-beams, as in the structure previously described, provide continuous support for the flooring members 70 throughout the entire distance between the end frames resulting in lower thickness requirements and greater stability. Additional support is provided for the flooring member 70 by pads 41 fastened to connecting braces 62. While I-beams are shown in the ramp-type structure it should be understood that other type beams such as a T-beam could be used. It is noted that at the front and rear of each end frame in the ramp-type structure there are a pair of spaced headed pins 38. While only one of each pair of pins is used where adjacent units are fastened together a pair is provided to permit connection of an I-beam 68 at the front and rear of the structure which will not extend out beyond the structure.

Units 51 and 53 are connected together at the top and bottom (FIG. 8) in a manner previously described with respect to the structure shown in FIG. 1. While the two units shown slope gradually upwardly from front to back it should be understood that the structure shown and described may be embodied in a flat ramp having a fixed elevation.

Although two embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

We claim:

1. A self-supporting structure of the character described, comprising in combination a first pair of end frames, a second pair of end frames, each of said end frames of said pairs of end frames including a front post and a rear post, the respective end frames of said first and second pairs of end frames being positioned in general longitudinal alignment with the rear posts of said first pair of said end frames positioned adjacent to the front posts of the second pair of end frames, and means connecting the first-named rear posts with said second-named front posts including a transversely extending beam member having horizontally disposed floor supporting flanges extending lengthwise thereof, said beam member being provided with means for detachably connecting the same to each of the end frames of said pairs of end frames, said connection means including a pair of longitudinally spaced downwardly opening vertical slots at each end of the beam member, and a transversely extending pin provided on each of the rear posts of said first pair of spaced end frames and on each of the front posts of said second pair of end frames, said pins on the adjacent front and rear posts of the respective end frames being engaged within the vertical slots of the beam member.

2. A self-supporting structure of the character described comprising in combination a first pair of transversely spaced end frames each having a front post and a rear post, a second pair of transversely spaced end frames each having a front post and a rear post, said pairs of end frames positioned in longitudinal alignment with the rear posts of said first pair positioned adjacent to the front posts of said second pair, and means connecting said first-named rear posts with said second-named front posts and including a transversely extending beam connected between said pairs of transversely spaced end frames, said beam being detachably connected between said pairs of transversely spaced end frames by a pair of longitudinally spaced downwardly opening vertical slots at each end of said beam which engage transversely extending pins provided on each of the rear posts of said first pair of spaced end frames and the front posts of said second pair of spaced end frames.

3. A self-supporting structure of the character described, comprising in combination a pair of elongated spaced end frames, transversely extending pins carried by said end frames and offset longitudinally and vertically thereon, with the pins on the respective end frames substantially transversely aligned, a plurality of transversely extending beam members for connecting said end frames together in spaced relation, each beam member having a generally vertical web with generally horizontal upper and lower laterally extending flanges disposed normal to said web and extending lengthwise thereof and arranged with the upper flange of one beam member disposed in substantially coplanar relation to the lower flange of an adjacent beam member, each of said beam members being provided at opposite ends thereof with a pair of longitudinally spaced vertically offset downwardly opening slots, the slots of each of said pairs of slots being engaged by the pins of said frame members to secure respective end frame members together at longitudinally spaced vertically offset points, and a plurality of flooring members supported by said beam members, with the upper flange of one of said beam members supporting a transverse edge of a floor member, the opposite transverse edge of which is supported on the lower flange of an adjacent beam member.

4. A self-supporting structure of the character described comprising, a pair of spaced elongated end frames, transversely extending pins connected to the end frames and spaced longitudinally thereon, a plurality of transversely extending beams each having a generally vertical web with flanges disposed normal thereto, a pair of longitudinally spaced, downwardly opening slots at each end of each beam engaging respective ones of said pins so that said beams are detachably connected between said spaced end frames to provide transverse support to the structure, and a plurality of flooring members carried by said beams, each beam supporting one transverse edge of longitudinally adjacent floor members, said flanges projecting from the beam in opposite directions and in vertically offset relation on the beam, said longitudinally adjacent floor members being supported on said flanges in vertically offset relation with the beam web forming a riser.

5. A self-supporting building structure of the character described comprising in combination a first pair of elongated end frames, a second pair of elongated end frames, means for connecting one end frame of each pair of end frames in longitudinal alignment, and the aligned end frames of said pairs of end frames in transversely spaced relation comprising transversely extending pins connected to said end frames with the pins on one end frame extending towards the pins on the other end frame of the respective pairs of end frames, and at least one transversely extending beam detachably connected between the aligned end frames of the respective pairs of end frames by a pair of longitudinally spaced downwardly opening slots provided at each end of said beam, the slots at opposite ends of the respective beams fitting over and engaging adjacent pins of the respective aligned end frame members of the spaced pairs of end frame members.

6. A self-supporting grandstand structure comprising a series of longitudinally aligned end frame members, a second series of longitudinally aligned end frame members arranged in spaced relation to said first series of end frame members, a plurality of transversely extending beam members connecting and supporting said first and second series of end frame members in spaced relation, said beam members including an upright web member having longitudinally extending, vertically offset floor supporting flanges projecting laterally therefrom in opposite directions, releasable connection means for connecting the beam members and the end frame members together including complementary interengaging fastener elements carried by the beam members and the end frame members in correspondingly longitudinally spaced, vertically offset relation, said fastener elements when operatively engaged releasably securing the members together with a high flange of one of said beam members substantially coplanar with a low flange on an adjacent beam member, said fastener elements comprising pin and aperture elements, said apertures including elongated wall portions for guiding the respective pin elements interfitted therewith into locked position simply by downward vertical movement of said beam members to their assembled position on the end frame members in which position the joined members are stabilized against relative movement in all directions except upward vertical movement of the beam members, and vertically offset longitudinally extending floor sections extending between and supported on adjacent beam members with the adjacent transverse end edges of longitudinally adjacent vertically offset floor sections supported respectively on the vertically offset flanges of one of said beam members, with the web member of said one beam member functioning as a riser between the floor sections supported thereby.

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