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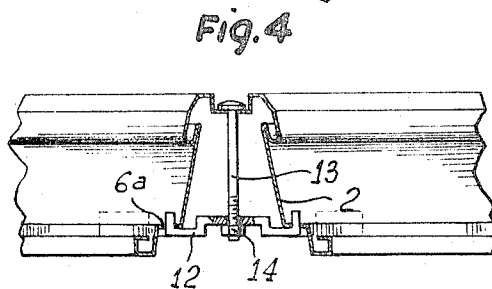
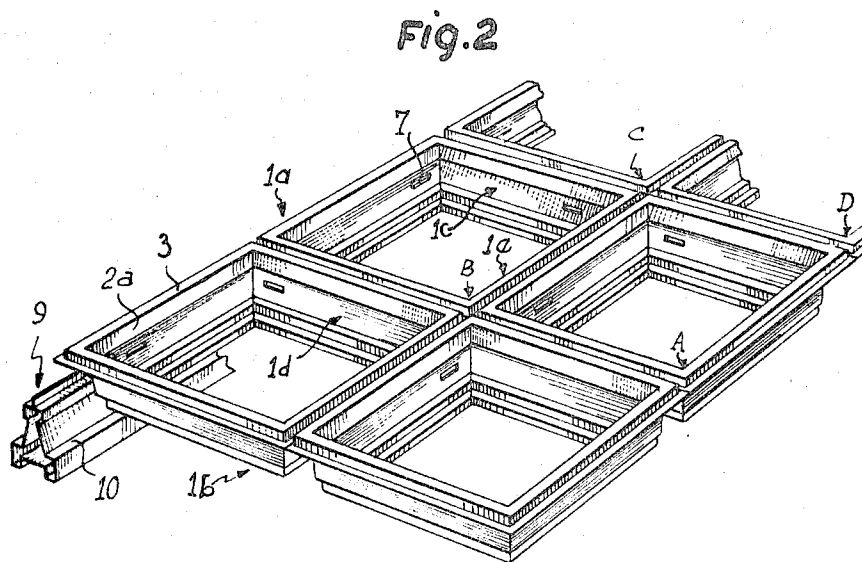
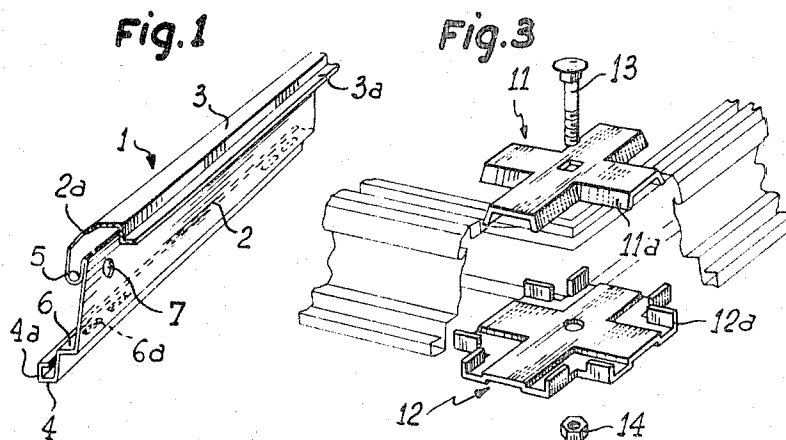
R. C. ROLLAND

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SECTIONAL FLOOR FRAME CONSTRUCTION

Filed Feb. 25, 1964

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Jan. 17, 1967

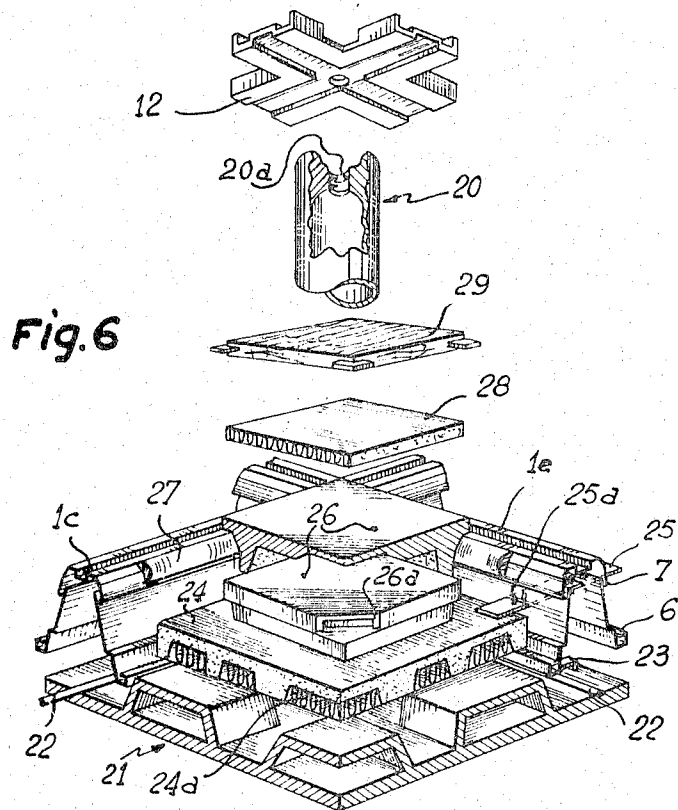
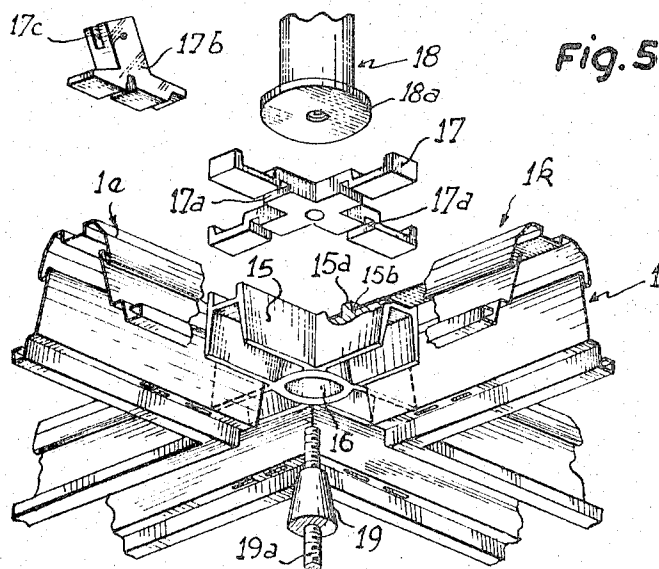
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1

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**SECTIONAL FLOOR FRAME CONSTRUCTION****Robert C. Rolland, 7 Place Stanislas, Cannes, France****Filed Feb. 25, 1964, Ser. No. 347,294****Claims priority, application Great Britain, Mar. 4, 1963, 8,623/63****6 Claims. (Cl. 52-663)**

This invention relates to frame structures for flooring and also comprises sectional members from which such structures can be conveniently constructed.

The main objects of the invention are to provide sectional members of improved shape and high rigidity for floor frame structures; to provide floor frames which can be easily and rapidly assembled and erected on a building site utilizing a minimum of labour and without time-consuming handling, welding and concrete-pouring operations, and which will be lightweight and easy to transport yet strong and rigid; to provide floor frames which can be easily stacked for maximum compactness in storage and transport; to provide improved cruciform joining members for interassembling the components of the improved floor frame and simultaneously to develop prestressing forces which will considerably increase the rigidity and strength of the resulting frame structure. Other objects will appear.

Exemplary embodiments of the invention will now be described for purposes of illustration but not of limitation with reference to the accompanying drawings wherein:

FIG. 1 is a broken-away perspective view of an improved profiled sectional member used in the invention;

FIG. 2 is an exploded perspective view of part of a prefabricated floor frame together with one of the supporting beams over which the frame is to be fitted;

FIG. 3 is an exploded perspective view of a cruciform joining device used in assembling and prestressing the square mesh components or cells of the frame shown in FIG. 2;

FIG. 4 is a view in vertical section showing one manner in which a cruciform joining and prestressing member according to the invention may be used;

FIG. 5 is a perspective view of part of a floor frame assembled on site in the area surrounding a joint thereof, and also shows in exploded view upper and lower column members as well as a cruciform joining and prestressing device;

FIG. 6 is a perspective view, broken away and partly exploded of part of a complete floor structure including panel filling means.

In the exemplary form shown in FIG. 1 a profiled sectional member which constitutes a basic component of an improved floor frame according to the invention is shown as including a web 2 which in the normal erected condition of the member in a horizontal floor frame structure is canted to the vertical plane. The web 2 is formed with a step, shelf or ledge 6 extending longitudinally of it at an intermediate level somewhat nearer the base than the top of the web. Longitudinally elongated slots 6a are formed at spaced points of shelf 6. Integrally formed with the top of the web 2 is a flange portion which first bends downwardly along a forward (or inner) face of the web and then upwardly to provide a fold 5 defining a longitudinal groove; the upper side of the fold is extended back over the upper edge of the web 2 in spaced relation with it and includes a bevel portion 2a followed by a flat horizontal portion 3. The flat portion 3 of the flange is in turn followed by an L-shaped flange extension 3a projecting from the rear or outer face of the web.

At its lower end below the ledge 6 the web 2 has an inwardly projecting flat flange portion 4 which is extended by an inverted L-shaped formation 4a. Holes 7 are formed at spaced points of web 2.

2

It will be noted that the flat flange portions 3 and 4 which define the uppermost and lowermost planes of the sectional member 1 form angles greater than 90° with the plane of the canted web 2, so as to lie in parallel planes which are horizontal in the normal, erected condition of the member 1.

FIG. 2 illustrates a floor framework constructed from lengths of sectional members similar to the member just described. The framework comprises a regular lattice-work pattern of elementary cells or mesh elements of rectangular, preferably square, form. Each such cell such as ABCD is made up from four lengths of sectional members each similar to the member 1 described above, connected at their ends at welded mitre joints. It will be seen that each square cell thus provided has a sectional area as seen in plan which tapers down from the top to the bottom of the cell owing to the canted position of the webs 2 forming its sides. In other words each square cell is generally in the form of an inverted frustopyramid.

This provides for a convenient stacking of the cells in inter-fitted relation to facilitate storage and transportation, as well as other important functions that will later appear.

The square cells thus constructed are interconnected through means later described to provide a complete floor framework such as that partly shown in FIG. 2. When thus interconnected it will be seen that the resulting floor frame can be considered as including border or edging joists such as 1a, 1b, each similar in shape to a single one of the sectional members 1 shown in FIG. 1, and intermediate joists such as 1c, 1d, 1e, the intermediate joists thus provided each define inverted V's in cross section. The resulting frame is thus adapted to be fitted over a corresponding square framework of beams, the beams having upwardly tapering cross sections generally complementary to the V-shaped recesses defined by the joists such as 1b, 1c, 1d, whereupon the floor frame may be firmly supported in position. FIG. 2 illustrates one such supporting beam at 9, underlying the border joist 1a of the floor frame. The supporting beam 9 is shown as being of generally trapezoidal boxshaped configuration with side ledges 10 adapted, e.g., to underlie the ledges 6 of the sectional members comprising the border joist 1a.

The square cells of the floor frame of FIG. 2 are preferably interconnected at the joints between the cells by means of joining devices such as the one shown in FIG. 3.

Such a joining device essentially comprises a lower cruciform member 12 having each of its four equal branches formed with side depressions in its upper surface and bordered with upstanding lugs or flanges 12a which do not quite extend to the junction between adjacent branches. Referring to FIG. 4 it will be understood that such a cruciform member 12 may be engaged with under surfaces of the four joists meeting at a node or joint of the lattice frame shown in FIG. 2 with the flanges 12a of the cruciform member projecting upwardly through slots 6a formed in the ledges 6 of the respective sectional members 1 constituting said joists.

In the joining arrangement shown in FIG. 4, the joining member 12 is retained in position by means of a bolt 13 engaging the upper extension flanges 3a of the sectional members to be joined, and a nut 14 which can be screwed on to the lower end of the bolt to apply substantial tension thereto.

Returning to FIG. 3, the joining arrangement there shown further includes an upper cruciform retainer member 11 having each of its four branches formed with downwardly projecting flanges 11a canted at an angle corresponding to that of the webs 2. These flanges can be inserted into the inner grooves defined by the folds 5 of the related joist members meeting at the joint under consideration.

Both cruciform members 11 and 12 are formed with central holes, the hole in the upper member 11 preferably being square as shown. A bolt 13 is insertable through the holes in both cruciform members and preferably has a square locking section just below its head as shown, engageable in the square hole in upper member 11 so as to prevent relative rotation between the bolt and the member. A nut 14 is engageable over the lower end of the bolt 13.

The resulting cruciform joining assembly as shown in FIG. 3 or 4 not only provides a simple and convenient means of quickly interconnecting the square cells into a lattice-like floor frame of the type shown in FIG. 2, but serves at the same time to prestress said frame at each node or joint thereof by simply applying a suitable screwing torque to the nut 14. Such a prestressing of the framework at each node thereof greatly strengthens and rigidifies the resulting frame and thus makes it possible substantially to reduce the gauge thickness of the component sectional members 1 with respect to what would be necessary in the absence of such prestressing means.

In the embodiment shown in FIG. 5, there is illustrated a node of a floor frame which may be generally similar to the one shown in FIG. 2. It is here assumed however that a vertical column is to be assembled to the node of the frame under consideration and is to extend upward and downward therefrom. The column is shown as being composed of aligned upper and lower sections 18 and 20 which are generally tubular, and the upper section 18 is provided at its lower end with a centrally perforate, flanged baseplate 18a. The lower column section 20 similarly has an upper end wall formed with a threaded hole 20a. The joining device used in this case includes a lower cruciform member 12 similar to the member 12 shown in FIG. 3 and similarly disposed. The upper cruciform member 11 of FIG. 3, however, is replaced with a cruciform member 15 of modified shape. Each branch of the member 15 is provided with side flanges of relatively long vertical extent canted at an angle corresponding to that of the webs 2 in the joist members to be joined and adapted to engage between such webs of the mutually opposed members 1 constituting said joists. Lugs 15a project from the upper surfaces of the branches. Further, the cruciform member 15 is here provided at the central junction of its branches with an integral upwardly tapered frustoconical bush 16.

In this arrangement there is further provided an uppermost cruciform clamping member 17, the four branches of which have transverse notches 17a formed in their under surfaces. The clamping member 17 is adapted to overlie the joists of the node, and the lugs 15a projecting from the member 15 are adapted to pass through notches (not shown) provided in the flange portion 3 of the joists adjacent a joint of the type being described, and to engage upwardly into the notches 17a of the clamping member 17. A screw rod 19a provided with a frustoconical wedging block 19 secured thereon is adapted at its lower end to pass through the central hole in lower cruciform member 12 and to engage the threaded hole 20a provided in the upper end of the lower column member 20.

With the wedging block 19 engaged in the complementary frustoconical bushing 16, the upper end of screw rod 19a extends up through a central hole in the upper cruciform clamping member 17 and is screwable into the threaded hole provided in the baseplate 18a of the upper column member 18.

If desired, there may here be additionally used a socketted shoe member 17b formed with a suitable contour at its under surface so as to be clampable between the upper surface of one arm of the upper clamping member 17 and the lower surface of flange plate 18a. The shoe member 17b has a canted leg projecting upward from it and socketted as at 17c for connection to the lower end of an angular brace member, not shown, which may be used for interconnecting under tension the frame node

shown in FIG. 5 with another node, forming part of a different floor level and horizontally displaced from the first. More than one shoe member such as 17b may of course be provided where necessary.

FIG. 6 illustrates how a complete floor including panel filling can be constructed from a framework such as the one described with reference to the previous figures. FIG. 6 shows parts of two intermediate joist members 1c, 1e interconnected at a node or joint of the frame. Underneath the joists is positioned a ceiling slab 21 of expanded concrete or the like provided along each edge with a metallic supporting strip 22 having hooking lugs 23 attached to it for engagement with the bottom flanges 4 of the members 1 so as to support the slab 21 in position. Resting on the upper surfaces of the ledges 6 of the members 1 is a slab 24 of expended concrete provided on its under surface with a coating of suitable sound—and heat—insulating material 24a. The upper slab 24 is held in position by means of metal strips 25 inserted through the slots 7 in the webs 2 of the joist members and permanently locked in position by means of pins 25a. Overlying the slab 24 is a slab 26 the edges of which are provided with a chamfer surface adapted to bear against the upper bevel portion 2a of a related joist member by way of an interposed sealing strip 27. The corner of the slab 26 may be cut away as at 26a so as to provide a recess facilitating handling operations. Overlying the slab 26 is a sound—and heat—proofing plate 28 capped in turn with a topmost facing panel 29 provided at its side edge surfaces with lugs and slots for interengagement with corresponding slots and lugs of similar adjacent panels.

The floor described above with especial reference to FIG. 2 is intended to be preferably prefabricated in a workshop. For this purpose the sectional members constituting the edging joists and intermediate joists are first cut to their predetermined equal lengths with their ends cut at an angle to provide the requisite mitre joints. The cut sections are then secured in a suitable jig to maintain them in position with their mitre-cut end surfaces in engagement and are welded to one another to provide the framework. A large number of such frameworks can in this way be quickly and economically assembled in sequence on a single jig.

In accordance with one desirable embodiment of the invention, the cut sections are secured in groups of four in a square jig which holds them in the proper relationship to provide the square cell or mesh elements of the framework, and the four members in each group are welded to one another at their ends. There may thus be provided a plurality of identical square cell elements, of the frustopyramidal form earlier described, which can be interfitted into stacks for convenient storage and transport to the building site. At the site the square cell elements may then be interassembled into the framework by means of joining devices similar to the one shown in FIG. 3.

Thus the flanges 12a of the lower cruciform member 12 may be engaged through the slots 6a in the ledges 6 of the joist members 1 (shown in phantom in FIG. 3) and the flanges 11a of the upper cruciform member 11 engaged into the inner grooves 5, as earlier described. The bolt 13 is then inserted through the aligned holes of the cruciform members whereupon it is held against rotation owing to the engagement of the square section under the head of the bolt in the square hole of member 11, and the nut 14 is screwed on to the lower end of the bolt. As earlier explained tightening the nut on the bolt subjects the frame components to tension forces locally at the nodes or joints of the frame, thereby stiffening the frame.

Frameworks of the type described above can be constructed in the shop to large over-all sizes, e.g., 5 meters to a side, and then transported to the building yard. Transport is facilitated since a number of such frameworks can be stacked by interfitting the frustopyramidal cells so as to take up minimum space on a lorry or other

vehicle. The unitary weight of each frame is relatively small since the section elements can be made from thin metal sheet due to the great rigidity imparted to the erected framework by the prestressing or tensioning feature just described.

The erecting operations also are simple and practical to perform. The framework in its upright position shown in FIG. 2 is positioned so that the lower flanges 4 of the border joist such as 1a are supported on the ledges 10 of border beams such as 9 of the building framework. If desired, intermediate joist such as 1d, 1e, may also be similarly supported on intermediate beams of the building, not shown, which then would also have a suitable cross section complementary to that of the inverted-V recesses defined between the adjacent section members of said intermediate joists. Flexible sealing strips are preferably interposed between the mating flange surfaces to improve the seal, the load distribution and isolation. Flexible sealing strips may also be interposed between the mating flanges 3a of the adjacent sectional members 1 constituting adjacent sides of the square cells; such strips may have longitudinal grooves fittable about the longitudinal marginal edges of the flanges 3a.

With the floor framework thus erected the flooring is completed by placing the various filling elements as illustrated in FIG. 6 described above. Thus the sound—and heat—proofing slabs 24 are inserted so as to rest upon the upper surfaces of flanges 3. The retainer strips 25 are inserted through the slots 7 and are locked to the joist structure each by means of the pins 25a positioned inside and outside the joist. It will be noted that the slots 7 are positioned substantially at the corners of each square cell. This distribution of the retainer slots and strips prevents disengagements of a slab 24 from the cavity in which it is received even if the slab is inclined along a diagonal of the square cell. In fact when the slab 24 is in position the pins 25a prevent removal of the strip 25 from above or below the floor structure, so that unauthorized access between adjacent floors of a building is prevented. The top slabs 26 may then be placed in position followed by the facing panels or tiles 28 and 29. It will be noted that the slabs 26 are not in engagement with the strips 25 but, owing to the taper of the laterally projecting flanges of the slabs, engage the correspondingly tapered upper portions of the joist members. Thus the over-all rigidity and strength of the complete floor structure including both the metallic structural frame and the filling and covering means associated with it are considerably increased. If required, the ceiling slabs 21 are placed with their lugs 23 engaging the lower side flanges 4 of the joists.

The sound—and heat—insulating characteristics of the resulting flooring are very high. The grooves defined by the mating flange portions 3a in the tops of the profiled joist members 1, and which run continuously the length of the frame as will be seen from FIG. 2, provide a convenient means of laying conduits for the flow of water, gas and electric current. The entire floor structure can be dismantled if required and its elements reused elsewhere.

As an alternative to the method of construction and erection described with reference to FIGS. 2 and 3, the method shown in FIG. 5 and described above can be used, this method being especially designed for direct construction on the building site starting with individual lengths of profiled sectional members 1 not previously assembled with one another. In this case the cut lengths of sectional members 1 may be positioned in symmetrical pairs with the free longitudinal edges of their respective upper flanges 3a in mating engagement and the mating edge surfaces may then be welded together if necessary. There are thus provided the inverted-V shaped intermediate joist members of the frame. Alternatively, as later described, such intermediate joist members may be directly provided in the form of inverted-V section members each corresponding in shape to a pair of members

such as 1 (FIG. 1) integrally connected along the margins of their flanges 3a.

Four inverted-V joist members which are to meet at the node of the frame under consideration are positioned in the cross-like relationship shown in FIG. 5 and their inner ends are fitted around the respective four arms of the upper cruciform member 15, earlier described, so that the lugs 15a project through slots (not shown) in the upper flanges 3 and into the notches 17a of the overlying clamping cruciform member 17. The inner ends of the four joist members will thus be clamped firmly between the cruciform members 15 and 17 when the wedge block 19 has been inserted into sleeve 16 and the screw rod 19a screwed into the threaded end holes in the respective column members 18, 20.

It will be understood that the joining means just described and shown in FIG. 5 are used at an inner node of the lattice framework, i.e. at the interconnection between four intermediate joists. At the interconnection of an intermediate joist with a border joist at a side of the frame, similar joining means would be used except that one of the four arms of each of the cruciform members such as 12, 15 and 17 would be missing; in other words the corresponding members would then be T-shaped rather than cruciform. Similarly the corner joining devices for assembling two border joists would again be generally similar except that they would lack two adjacent arms, and would hence be L-shaped. Similar statements apply to the joining device illustrated in FIG. 3.

The joining arrangement shown in FIG. 5 will serve to apply local tension stress to the nodes of the framework in a manner similar to what was described with reference to the joining device of FIG. 3. In addition however, it will be noticed that the joining arrangement of FIG. 5 can serve to interconnect under tension and hence in rigid prestressed relationship not only the intersecting joist members of the floor frame but also the vertical columns 18-20 and, where necessary, diagonal cross-bracing members or ties such as earlier described as being connected to the node by way of shoe members such as 17b. It will be evident that such a tensioned node will provide for an extremely efficient distribution and transfer of the load forces of the structural frame in all directions extending to and from such a node, and thereby increase the strength of the structural frame as a whole.

The arrangement shown in FIG. 5 further differs from that described with reference to FIGS. 2 and 3 in that the floor frame is shown in FIG. 5 as being supported by columns whereas the floor frame in FIG. 2 is primarily designed to be supported on beams such as 9 over which the inverted-V section joists may be fitted as earlier described. It should be understood however that the arrangements shown in FIGS. 2-3 on the one hand, and in FIG. 5 on the other, possess features which are largely interchangeable according to requirements. Thus a joining device similar to the one shown in FIG. 5 and including a central frustoconical bush such as 16 may be used in conjunction with the floor frame structure of FIG. 2 in situations where columns may be desirable.

Conversely, referring to the structure shown in FIG. 5, at points where no columns are to be provided, the joining device may be modified to resemble the joining device of FIG. 4 with the sleeve 16 omitted and a simple bolt and nut arrangement substituted for the screw-rod and wedging block arrangement 19-19a.

It will also be understood that the panel filling means shown in FIG. 6 is applicable indiscriminately to either the floor structure shown in FIGS. 2-3 or to that shown in FIG. 6.

The erection of the floor frame structures especially as described with reference to FIG. 5 need not involve welding operations on site. The structural members can thus readily be provided with suitable corrosion pro-

tecting coatings in the manufacturing plant. Moreover, the structures can be dismantled in whole or in part and reused elsewhere, or they may be retained in place and reassembled according to some different pattern. Thus edging joists of the structure may at any time be removed together with the related incomplete (T- or L-shaped) joining devices. These latter can then be replaced with complete four-armed cruciform joining devices and additional joist can thereupon be mounted in order to extend the flooring in the requisite direction.

It will be noted that in the complete floor structure shown in FIG. 6 the various slabs and panels are not stacked on top of one another but are supported in spaced superimposed relationship through the means described, thereby improving the strength of the assembly. The spaces defined between the superimposed elements can be used to house conduits and the like which may be passed from one space to another by way of the openings such as 7 in the webs of the members.

It will be clear that various changes may be introduced into the structures shown and described without exceeding the scope of the invention.

One modification that is expressly contemplated and was briefly mentioned above, is to provide the intermediate joist members, e.g., in the floor structure shown in FIG. 5, in the form of a complete, inverted-V section member similar in shape to a pair of symmetrically arranged sectional members such as 1 (FIG. 1) disposed symmetrically and with their upper flanges 3a integrally connected. Such an arrangement is especially desirable because it eliminates on-site welding operations and is economical also for the following reasons.

A sectional member such as 1 (FIG. 1) can be conveniently manufactured by means of a shaping bench using appropriate contoured rollers to form the flanges and other features of the contour of the member 1. In the interests of a better balancing of the high pressure forces developed on such a shaping bench it is desirable to provide two symmetrical sets of such rollers and to shape simultaneously two similar and symmetrical sectional members such as 1 from a common metal strip having twice the requisite width corresponding to one such member.

Thus such a method of manufacture will per se provide the dual or inverted-V section members referred to above and illustrated in FIG. 5. On completion of the shaping process, a majority of the resulting members may then be retained unchanged to provide intermediate joist members, while some of said members may be cut in half along their mating flange portions in order to provide the single sectional members similar to 1 (FIG. 1), required for the edging joists of the floor frame.

The precise contour of the sectional member as here disclosed may be altered in various ways without exceeding the scope of the invention. Thus, the folded-over portion 5 may be omitted and the upper flange 3 directly connected to the upper edge of web 2. Conversely, an additional fold similar to fold 5 but in inverted relation to it may be provided as a substitute for the shelf 6 at the lower part of the member.

Floor structures constructed according to the invention may have many uses, especially as floors for large buildings, warehouses and workshops since they are capable of supporting very high loads, such as industrial trucks and other handling and hoisting equipment.

What I claim is:

1. A sectional member for use in floor structure comprising two oppositely canted webs diverging in a downward direction, upper flange portions extending towards each other from the tops of said webs and integrally interconnected at the marginal edges, lower flange portions extending away from each other from the bottom of said webs, said upper and lower flange portions including integral extensions respectively in the form of an upright and an inverted L, and means intermediate the vertical

extent of each said web for longitudinally supporting a related edge of a filling panel.

2. A sectional member as defined in claim 1 wherein said supporting means comprises a ledge formation extending longitudinally of each said web.

3. A floor structure comprising an array of juxtaposed rectangular, e.g., square, cells wherein the sides of said cells are provided by sectional members having a cross sectional contour shaped to impart to the inner spaces defined by each cell a cross section in the general form of an inverted frusto-pyramid adapted to support filling panel means therein, and means joining the adjacent cells into a rigid lattice frame structure, said joining means comprising joining members disposed at each joint between at least two cell sides, each member having orthogonal radial arms equal in number to the number of cell sides meeting at said joint, means on said arms engageable with the sectional members constituting said meeting cell sides, and screw threaded means engageable with said joining member and tensionable to apply the joining member under pressure against said section members so as to subject the sectional members meeting at said joint to a vertical compression stress between the top and bottom thereof, said sectional members having canted web portions formed with longitudinal ledges intermediate their vertical extent, and said joining members being engaged with the under surfaces of said ledges of the sectional members meeting at said joint and having upwardly directed projections engaged with said perforations in the ledges.

4. A floor structure comprising an array of juxtaposed rectangular, e.g., square, cells wherein the sides of said cells are provided by sectional members having a cross sectional contour shaped to impart to the inner spaces defined by each cell a cross section in the general form of an inverted frusto-pyramid adapted to support filling panel means therein, and means joining the adjacent cells into a rigid lattice frame structure, said joining means comprising joining members disposed at each joint between at least two cell sides, each member having orthogonal radial arms equal in number to the number of cell sides meeting at said joint, means on said arms engageable with the sectional members constituting said meeting cell sides, and screw threaded means engageable with said joining member and tensionable to apply the joining member under pressure against said section members so as to subject the sectional members meeting at said joint to a vertical compression stress between the top and bottom thereof, each joining means including a lower joining member and an upper joining member respectively engageable with lower and upper surfaces of said sectional members and said screw threaded means comprising a screw rod engageable with both joining members and tensionable to draw them vertically toward each other, said sectional members having canted web portions formed with longitudinal ledges intermediate their vertical extent and inwardly directed upper flange portions defining grooves extending longitudinally of said web portions above said ledges therein, and said lower joining members being engaged with the under surfaces of said ledges of the sectional members meeting at said joint and said upper joining members having their arms seatable in said grooves.

5. A floor structure comprising an array of juxtaposed rectangular, e.g., square, cells wherein the sides of said cells are provided by sectional members having a cross sectional contour shaped to impart to the inner spaces defined by each cell a cross section in the general form of an inverted frusto-pyramid adapted to support filling panel means therein, and means joining the adjacent cells into a rigid lattice frame structure, said joining means comprising joining members disposed at each joint between at least two cell sides, each member having orthogonal radial arms equal in number to the number of cell sides meeting at said joint, means on said arms engageable with the sectional members constituting said meeting cell sides, and screw threaded means engageable with said joining mem-

9

ber and tensionable to apply the joining member under pressure against said section members so as to subject the sectional members meeting at said joint to a vertical compression stress between the top and bottom thereof, said joining means being provided with means connecting vertically aligned upper and lower column sections with said sectional members at said joint and said threaded means being engageable with said upper and lower column sections to tension them into load-transmitting relationship with each other and with said sectional members meeting at said joint.

6. A floor structure comprising an array of juxtaposed rectangular, e.g., square, cells wherein the sides of said cells are provided by sectional members having a cross sectional contour shaped to impart to the inner spaces defined by each cell a cross section in the general form of an inverted frusto-pyramid adapted to support filling panel means therein, and means joining the adjacent cells into a rigid lattice frame structure, said joining means comprising joining members disposed at each joint between at least two cell sides, each member having orthogonal radial arms equal in number to the number of cell sides meeting at said joint, means on said arms engageable with the sectional members constituting said meeting cell sides, and screw threaded means engageable with said joining member and tensionable to apply the joining member under pressure against said section members so as to subject the sectional members meeting at said joint to a vertical compression stress between the top and bottom thereof, said sectional members having canted web portions formed with longitudinal ledges intermediate their vertical extent, and said joining members being engaged with the under surfaces of said ledges of the sectional members meeting at

10

said joint and having upwardly directed projections engaged with said perforations in the ledges, each joining means including a lower joining member and an upper joining members respectively engageable with lower and upper surfaces of said sectional members and said screw threaded means comprising a screw rod engageable with both joining members and tensionable to draw them vertically toward each other, said joining means being provided with means connecting vertically aligned upper and lower column sections with said sectional members at said joint and said upper joining member having an upwardly tapered frusto-conical bush disposed centrally thereof and said screw rod having a complementary frusto-conical wedging block secured thereto and seatable in said bush, and said column sections having threaded holes at their adjacent ends engageable by the opposite ends of said screw rod.

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