United States Patent [19]

Vincens

[11] **3,757,485**

[45] **Sept. 11, 1973**

[54] **LIGHTWEIGHT COMPOSITE BUILDING CONSTRUCTION**

[75] Inventor: **Rene Vincens,** Ancourt Par Neuville Les Dieppe, France

[73] Assignee: **Societe d'Etude et de Promotion d'Entreprises**

[22] Filed: **Oct. 4, 1971**

[21] Appl. No.: **186,188**

[52] **U.S. Cl.** **52/731,** 52/632, 52/36, 52/238

[51] **Int. Cl.** **A47f 5/00**

[58] **Field of Search** 52/730, 731, 732, 52/238, 588, 580, 36, 632

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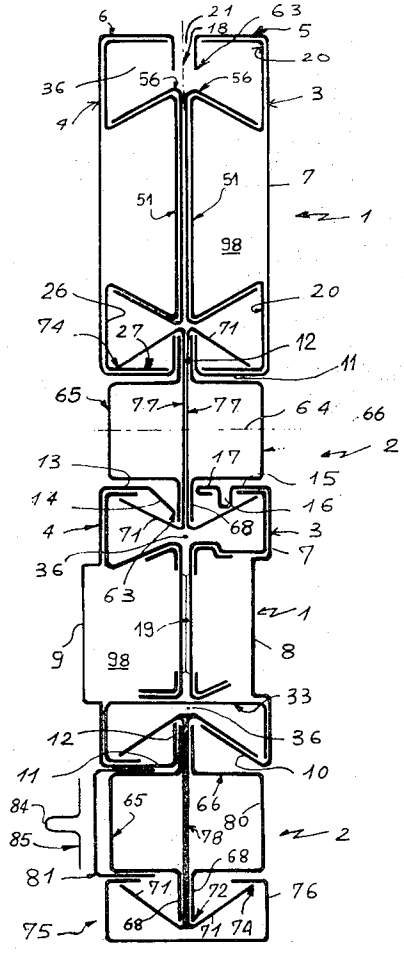
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Primary Examiner—Frank L. Abbott
Assistant Examiner—Henry E. Raduazo
Attorney—Robert E. Burns et al.

[57] **ABSTRACT**

Lightweight composite structures, mostly of profiled sheet metal, comprising a main joist formed from two outer sheaths interconnected by rigidifying bridges. Each sheath comprises a web with end flanges, the end flanges of one sheath being directed towards the flanges of the other sheath. Each mutually opposed pair of flanges are spaced apart to provide a slot providing access to a housing within the joist and defined by the bridge and the sheaths. The bridges also provide the means whereby the main joist and other similar joists and accessories may be interconnected to produce frameworks, divisions, walls, partitions, ceilings, shelving, articles of furniture and the like, for industrial and private use.

14 Claims, 87 Drawing Figures



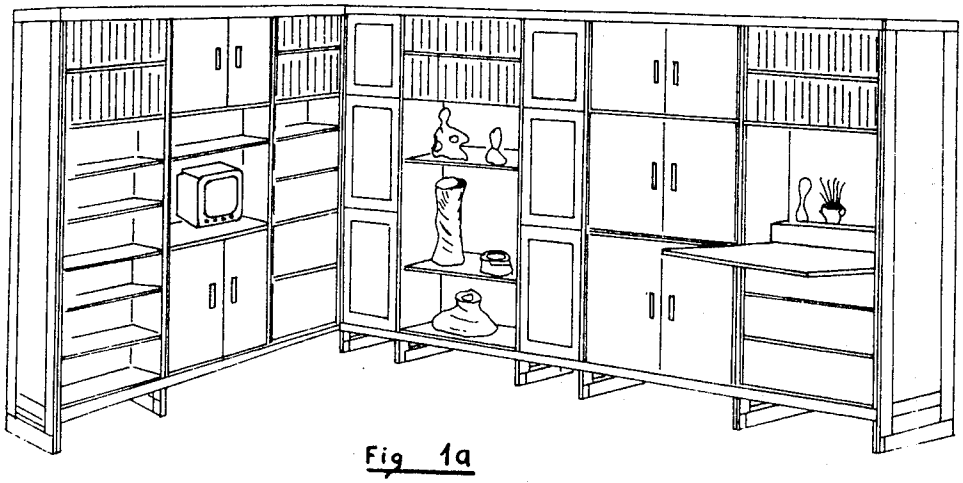


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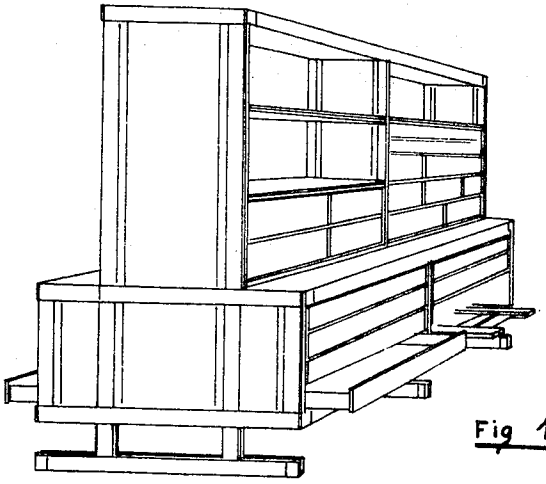


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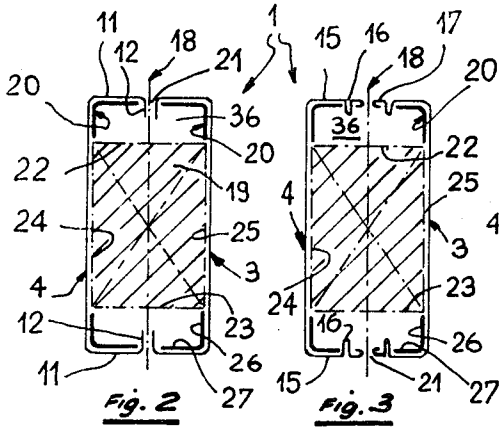


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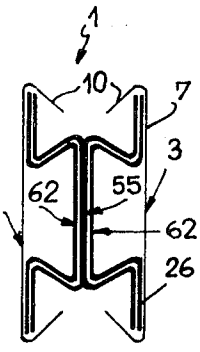


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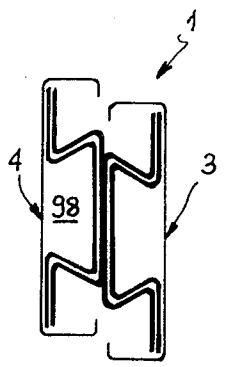


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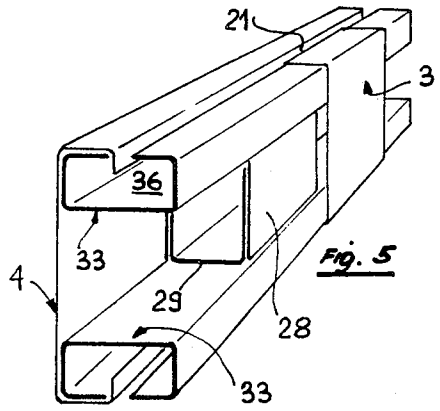


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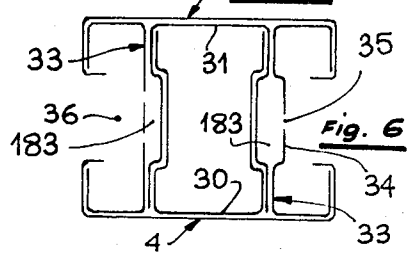


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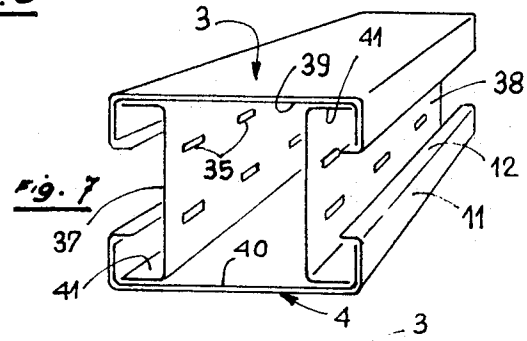


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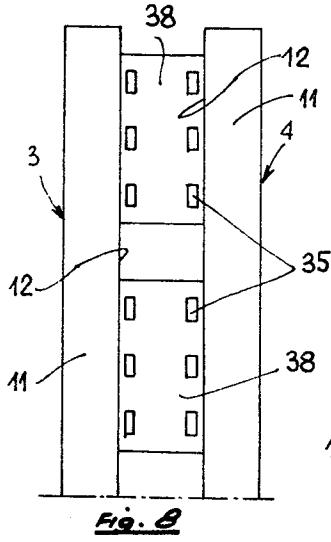


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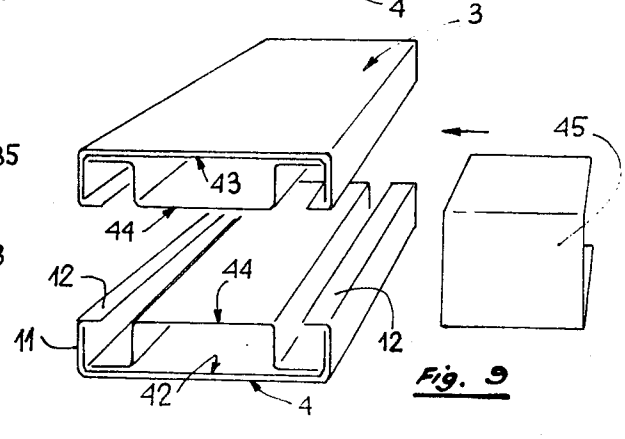
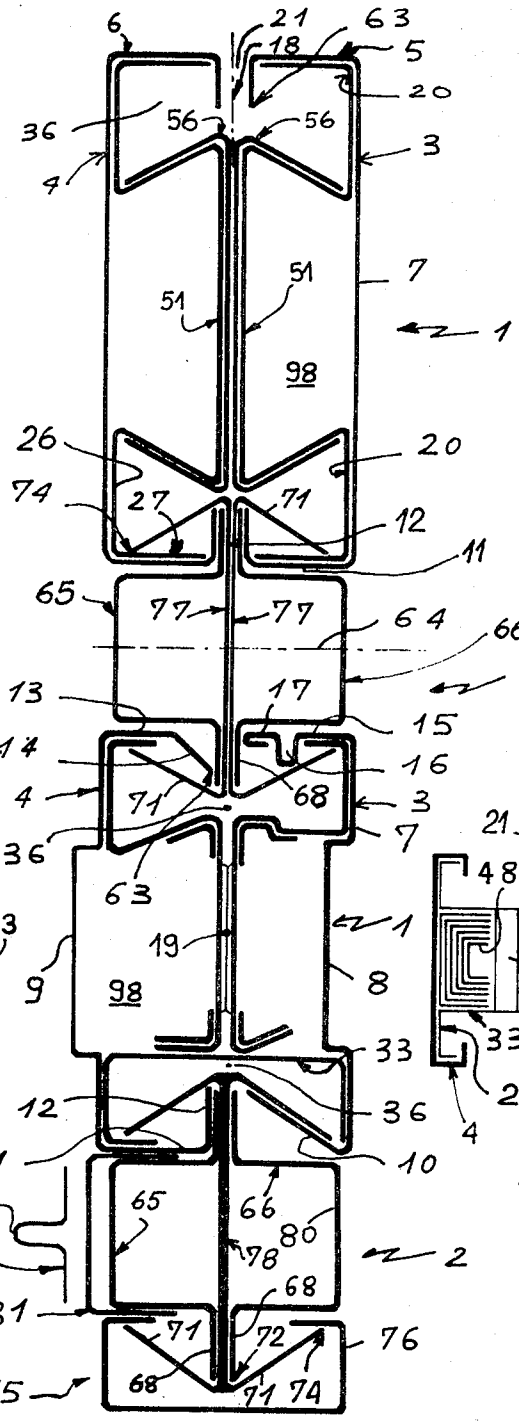


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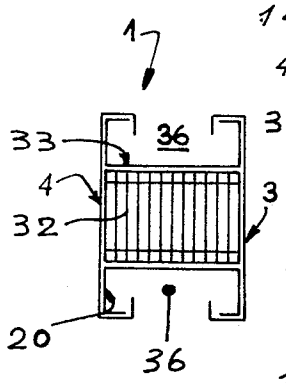


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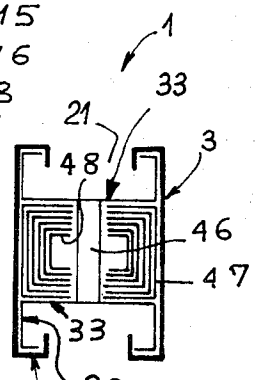


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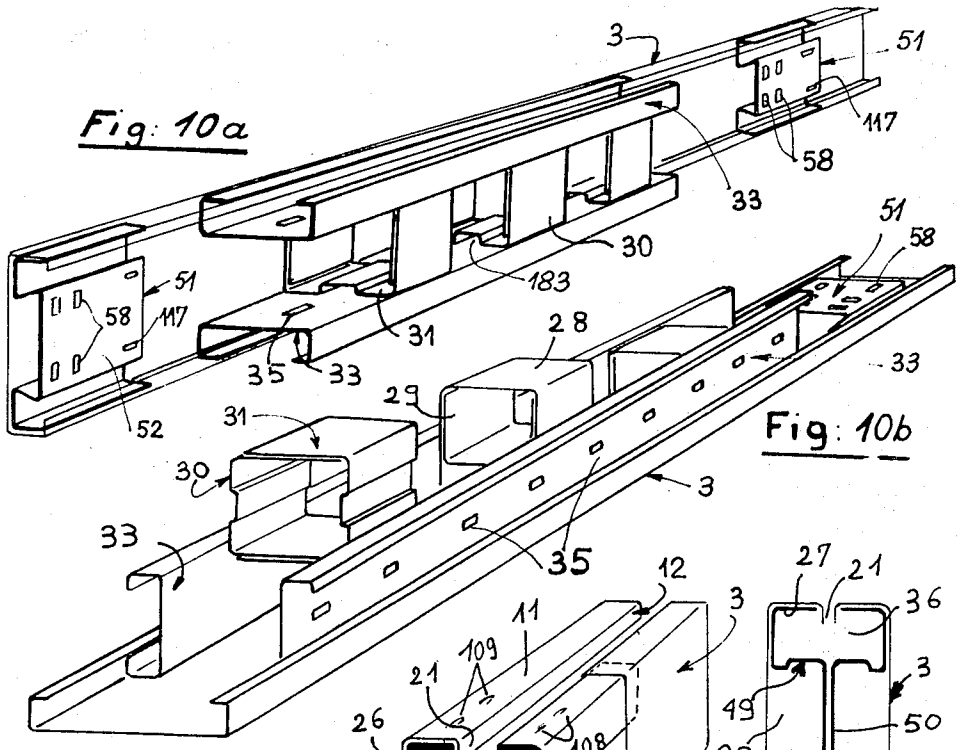


Fig: 10a

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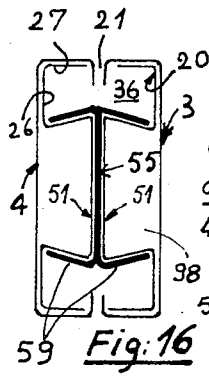


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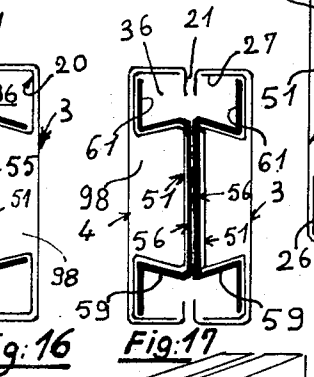


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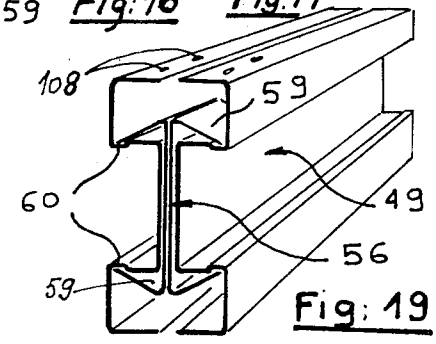


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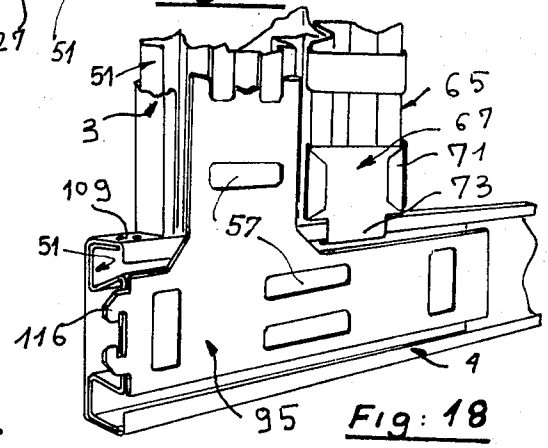


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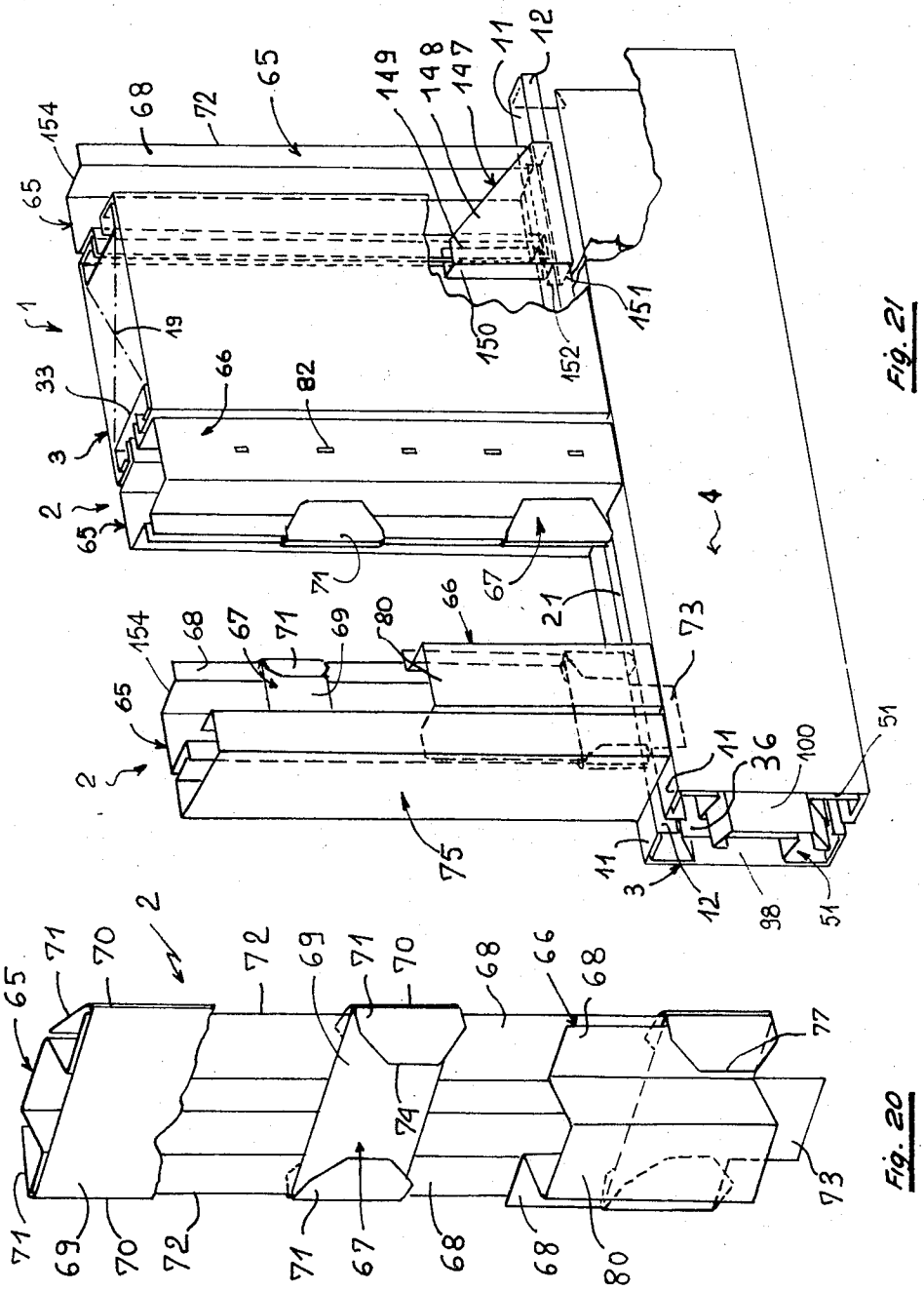
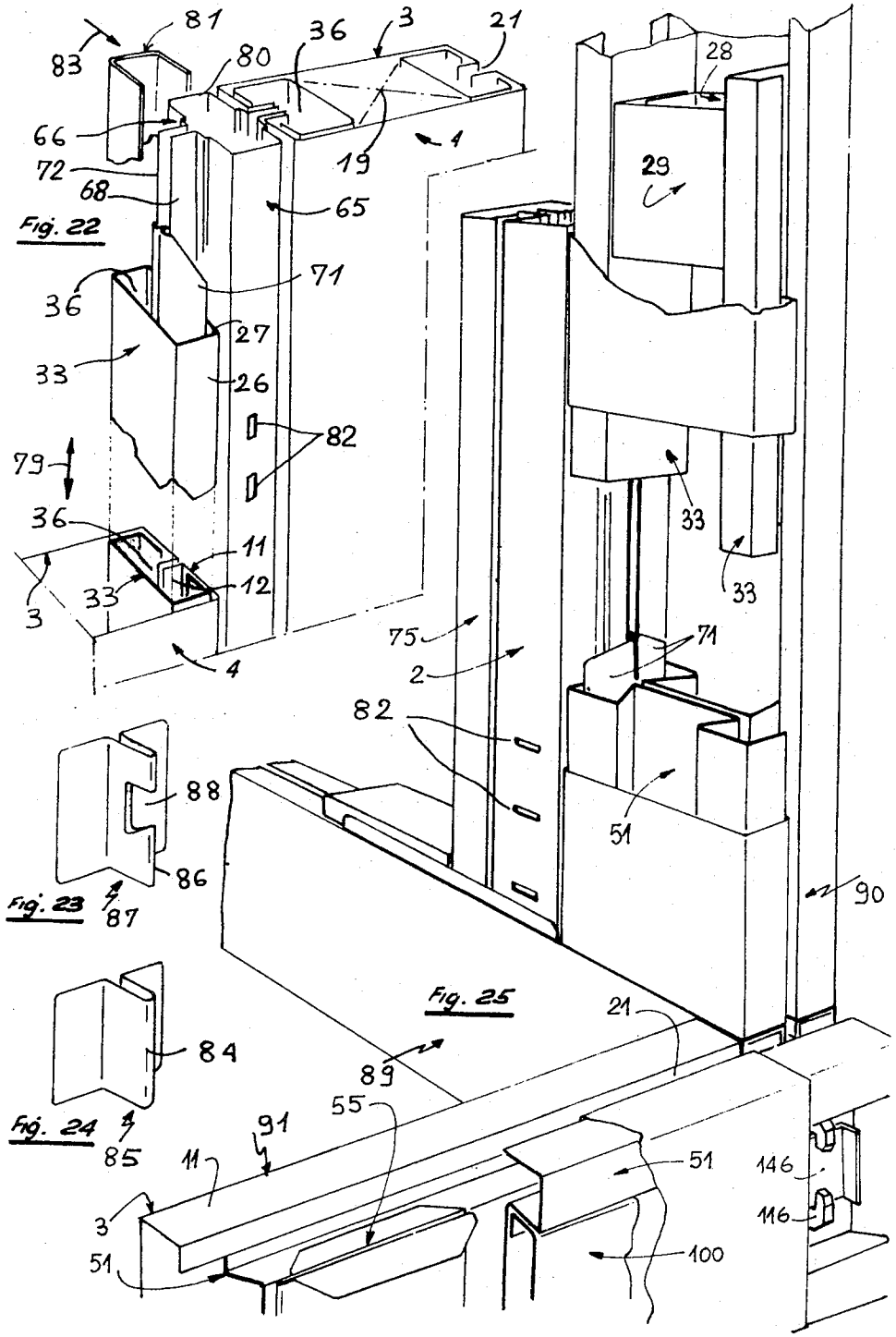

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Fig. 21

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Fig. 20


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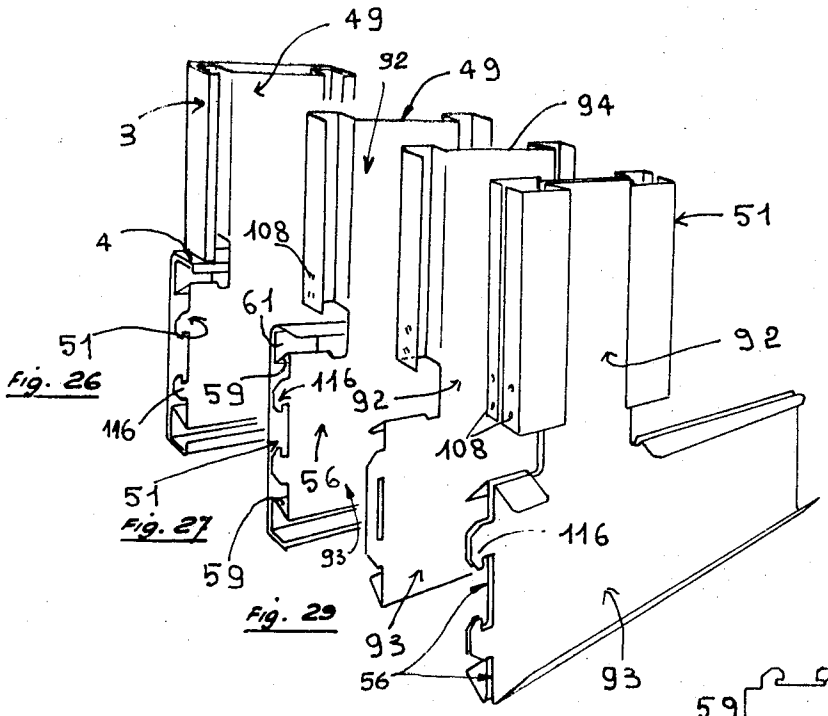


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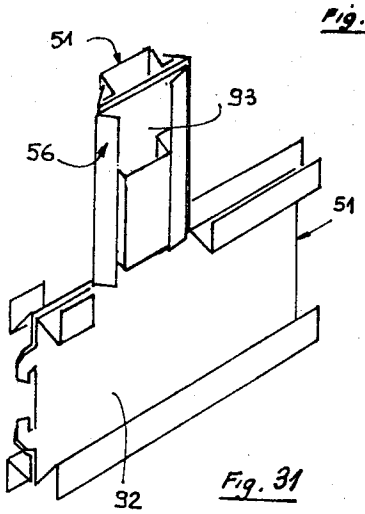


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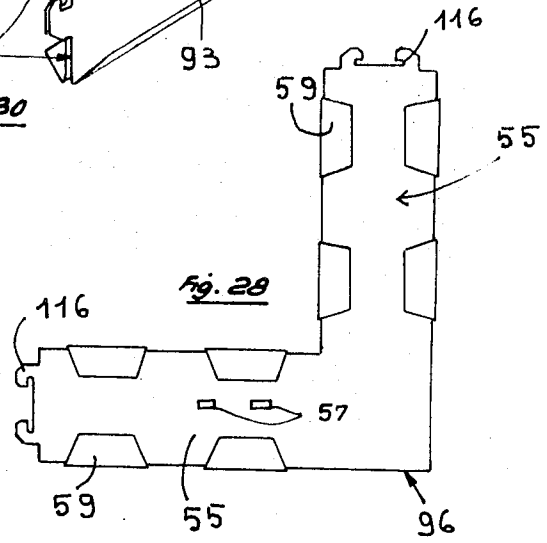


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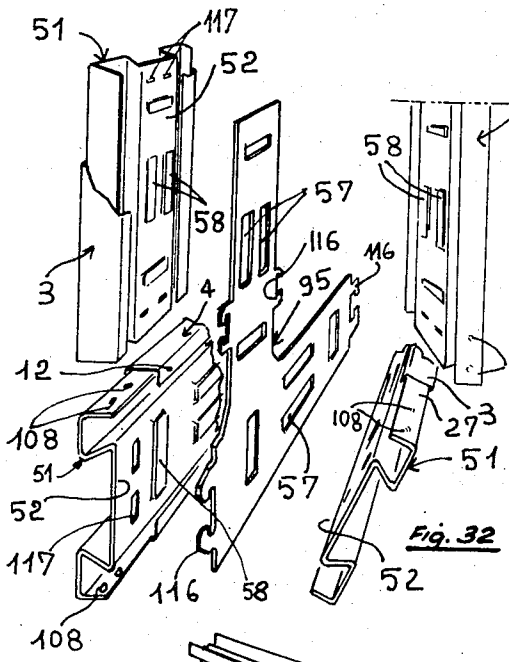


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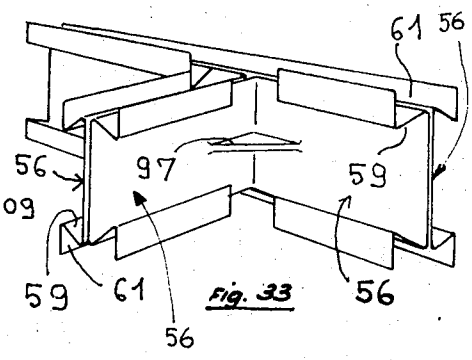


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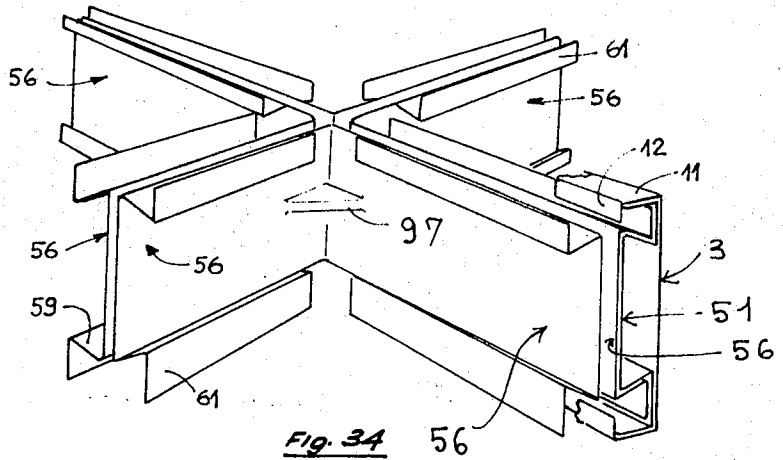


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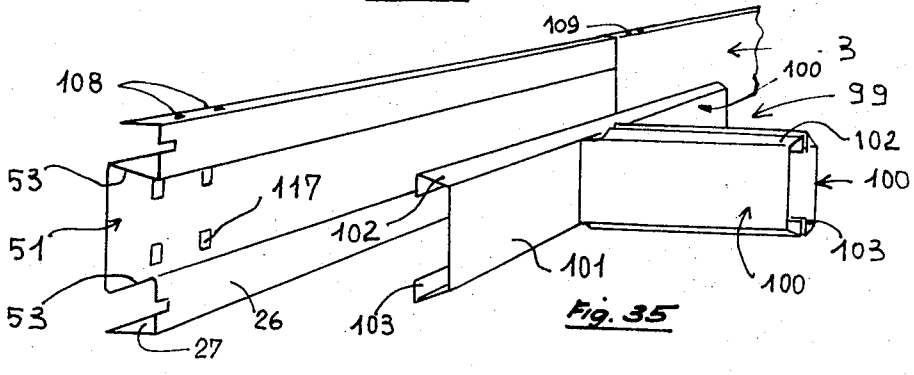
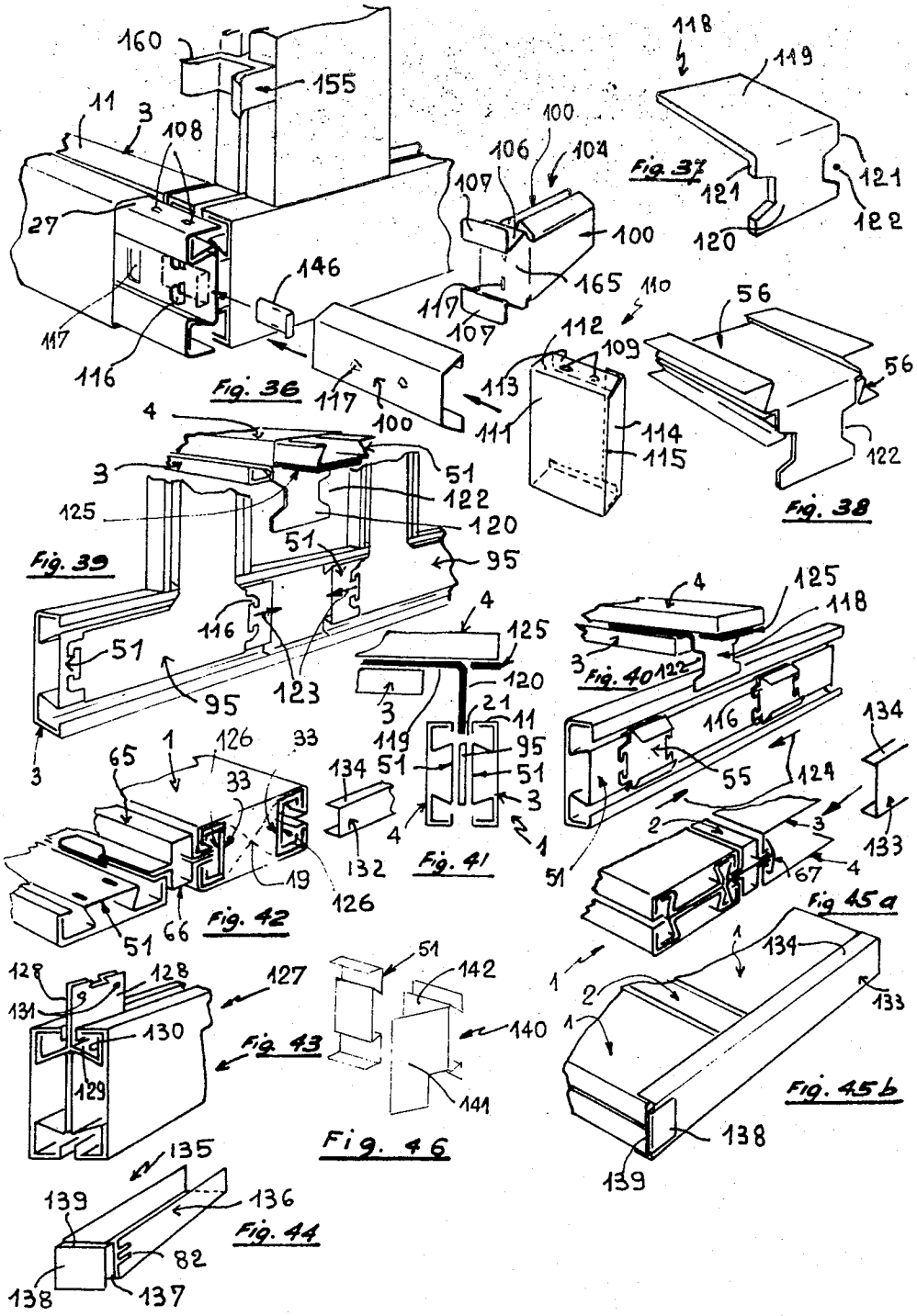
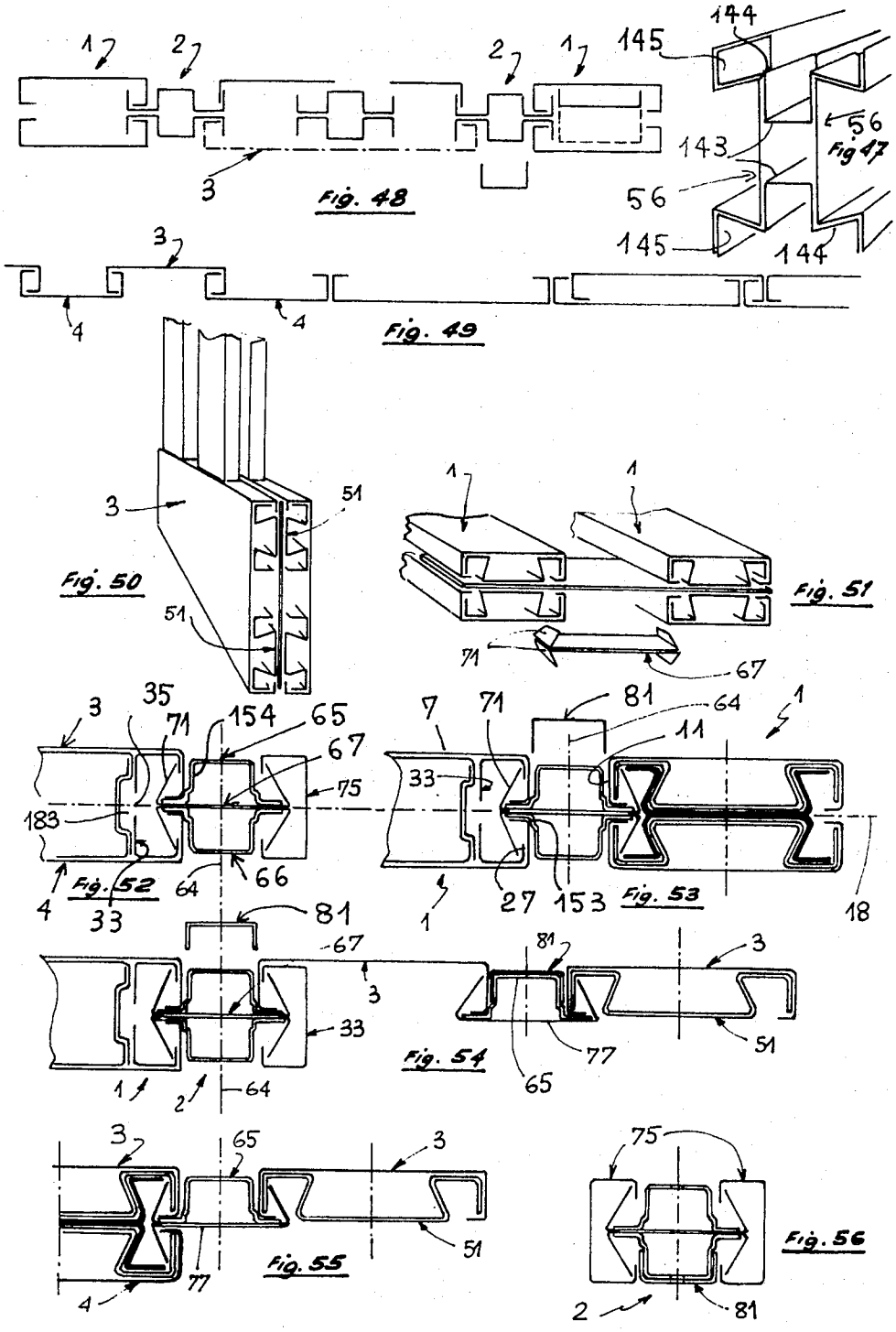


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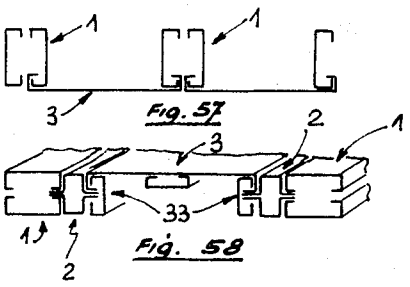


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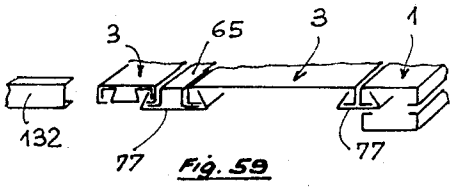


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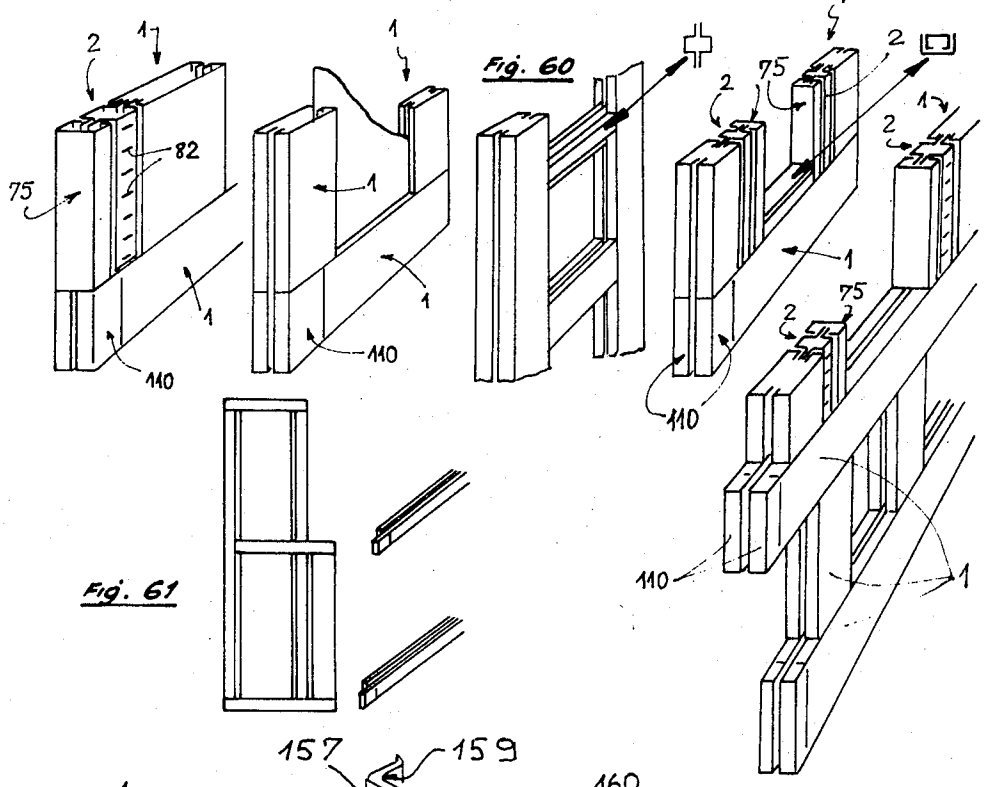


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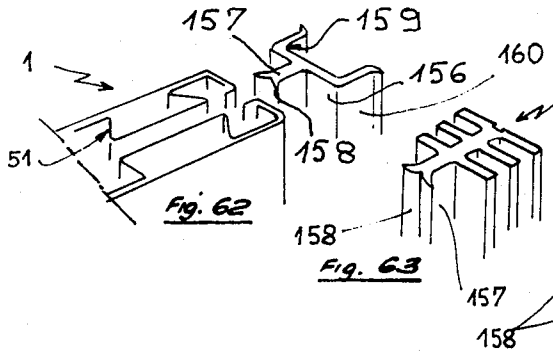


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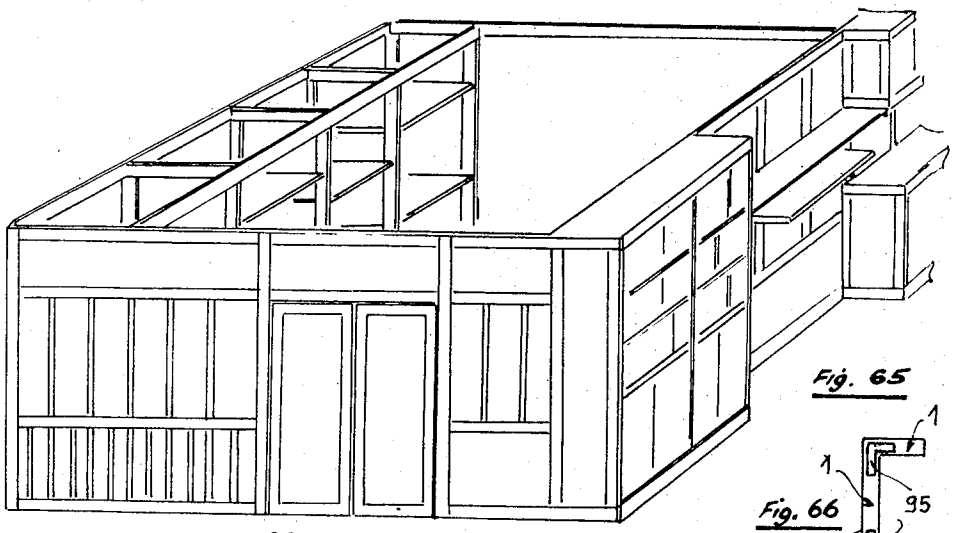


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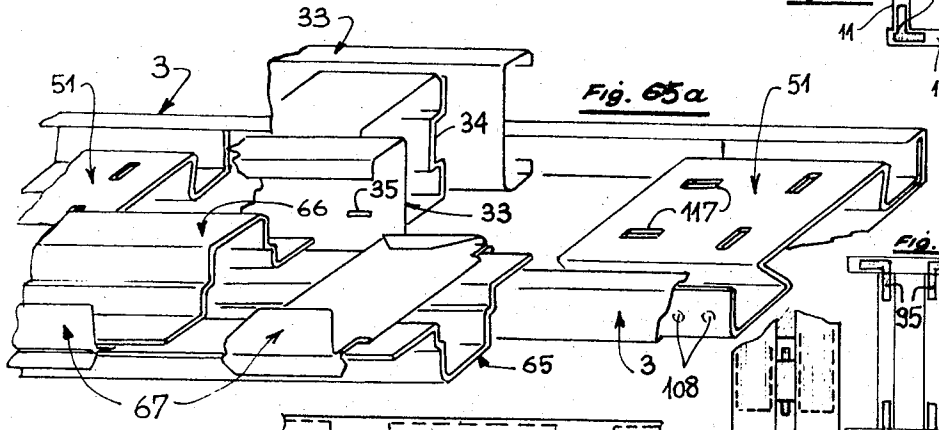


Fig. 65a

Fig. 67

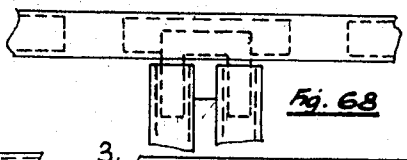


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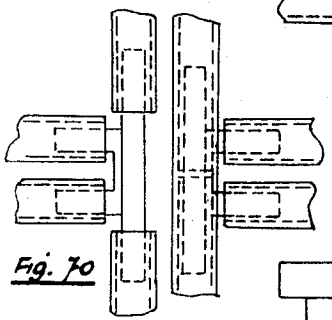


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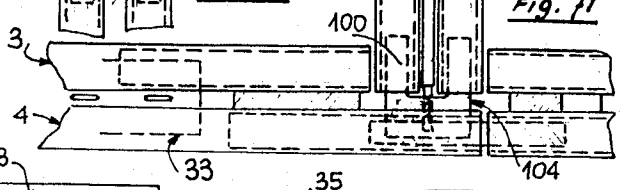


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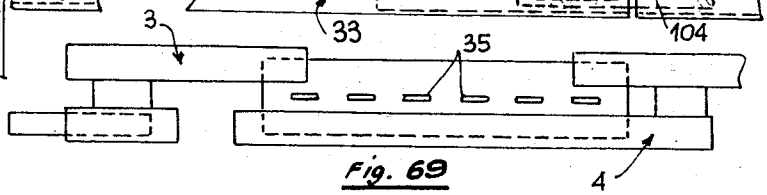


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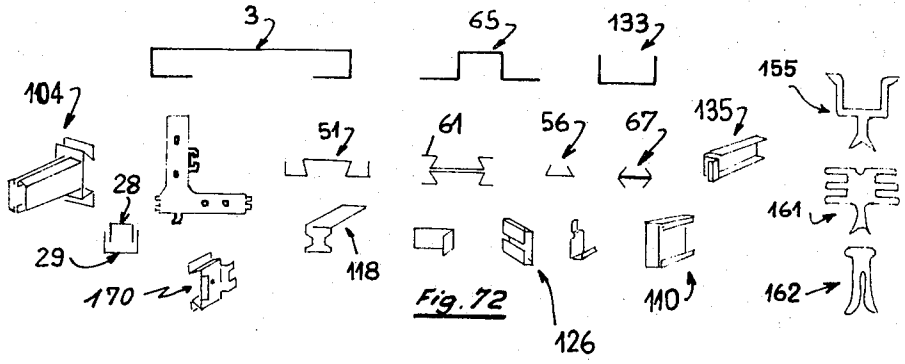


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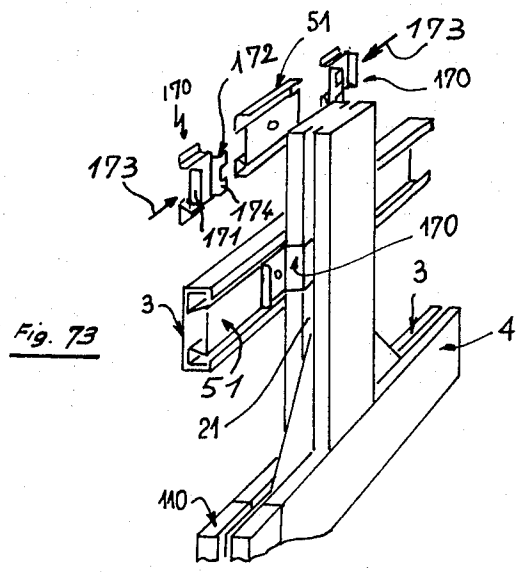


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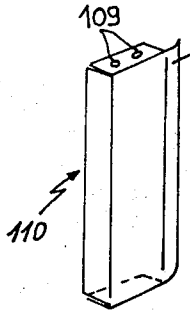


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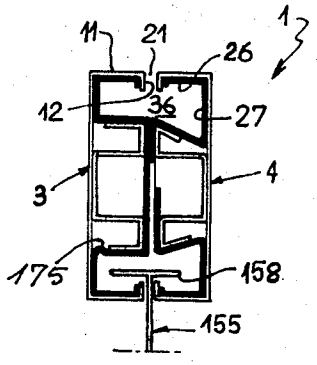


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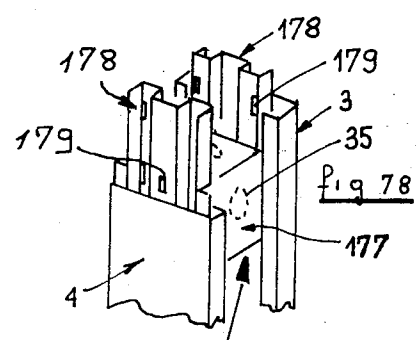


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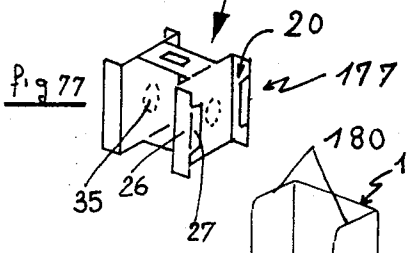


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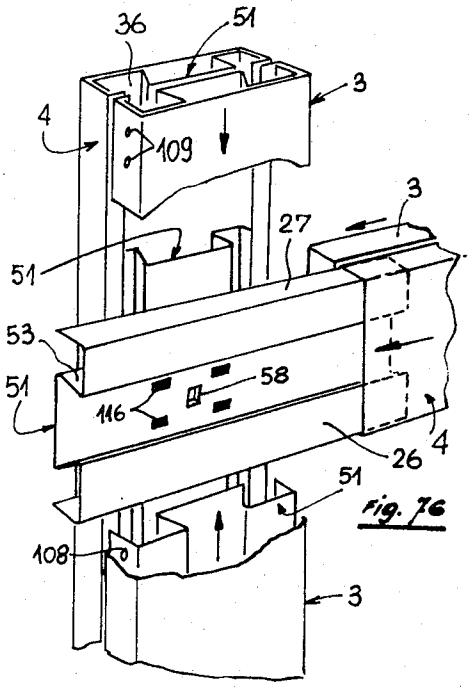


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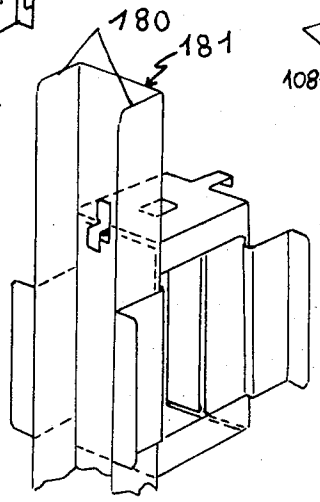


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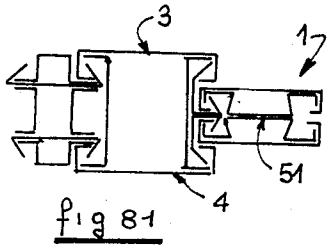


Fig 81

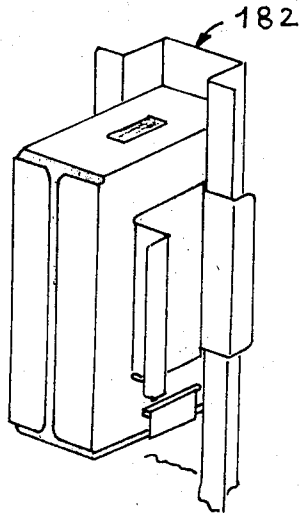


Fig 80

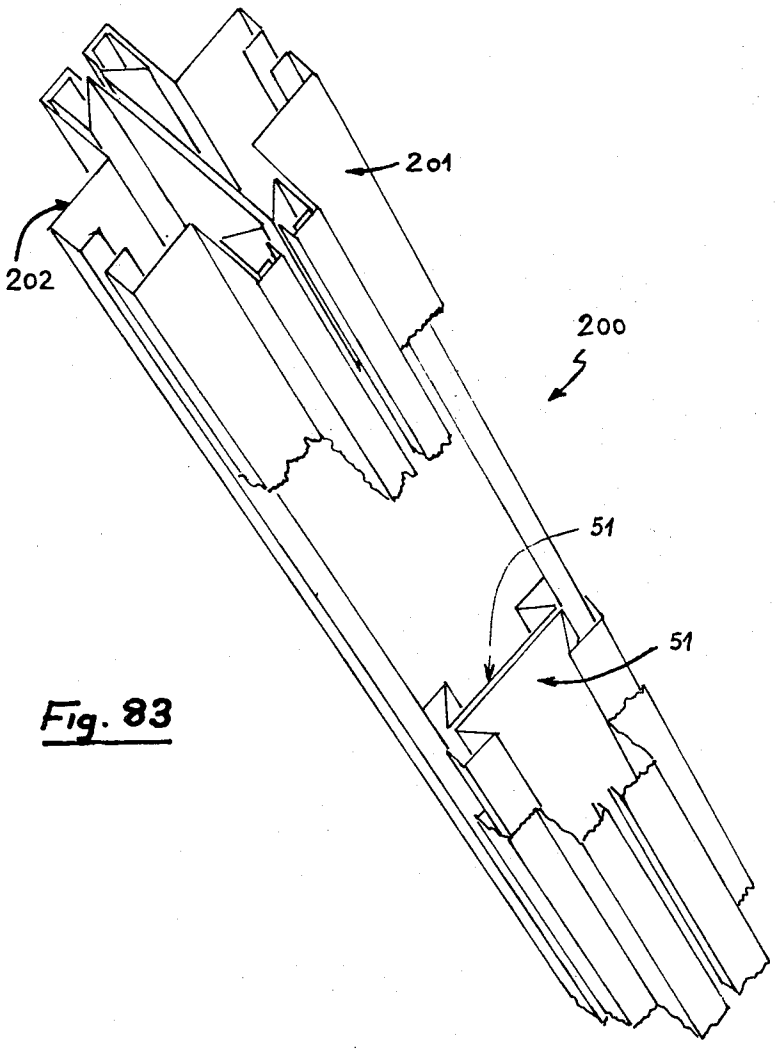


Fig. 83

LIGHTWEIGHT COMPOSITE BUILDING CONSTRUCTION

The present invention relates to light-weight composite structures formed by the combination of standardized elements, structures which concern the building industry, its fittings and equipment, made of rigid and semi-rigid materials, to supply composite structures enabling homogeneous panels to be produced in the most widely varying shapes, these panels being themselves combinable for the purpose of creating homogeneous assemblies. The light-weight composite structures produced from the standardized elements according to the invention may equally well consist of light frames, devisions, partitions, ceilings, false ceilings, walls, fixed or movable joinery units for building proper, industrial fittings, commercial or private furnishings in general.

In the sphere of construction, buildings, of light weight and preferably prefabricated, as well as all their fittings, require materials having the following characteristics: the structures must be rigid, elegant in appearance, as light in weight as possible, economical and with as few points as possible where the various types of corrosion can occur, an object which must be achieved, in particular, by the elimination of welds between external sections. Furthermore, these structures must be capable of being assembled rapidly, to form panels, at the assembly workshop stage, and the panels and their accessories must be such that they can as far as possible be erected immediately on the user's premises, by means of rigid connections, without recourse to screws or bolts, thus facilitating the storage, packing and transport problems.

For this purpose, one of the first aims of the invention is to use composite structures formed from elements of which the manufacture is as simple and as standardized as possible, these elements being of a modular nature and preferably making use of the thin-metal profiling technique, making evident the quality of the surface treatment undergone by the metals employed and the dimensional stability of these sections, which do not have to be welded together. Finally, thanks to the extremely small number of accessories, the elements can be stored and transported, causing only a minimum volumetric loss and entailing no risk of corrosion whatever. All the profiled elements and accessories can be manufactured continuously and in large quantities, either on a regionsl or on a national basis, and thus at very low cost.

The elementary profiles which make up the bearing, fastening and binding supporting structure, likewise serve to make up bearing, fastening and binding panels, of variable sizes and shapes, of which the external and visible surfaces are functionally and aesthetically coordinated, at the same time enabling assemblies of a homogeneous and harmonious style and design to be produced. The panels are also so designed that they can accommodate removable and/or mobile fittings, such as doors, drawers or brackets, these fittings being themselves produced from elements forming the bearing, fastenings and binding supporting structure, which can likewise accommodate or comprise functional and decorative materials in the form of slabs of modular dimensions, thus rendering the assemblies still more attractive and economical.

Thanks to the elimination of the welds on the external sections, any desired materials can be used, such as

prelacquered steel, stainless steel, aluminium or plastics. This use of new materials enables an infinite variety of ornamental combinations to be obtained by the different ways in which the materials and colours can be combined, and by the solely functional combinations obtained by the inclusion of plastics, wood and fabrics, for example, inter alia for sound-proofing and heat-insulating purposes.

A further advantage offered by the standardized constructional elements forming the light-weight structures to which the invention relates resides in the fact that, regarded as essential elements of a structure, they can be reutilized as essential elements of all the composite structural combinations required for the purpose in view, and also closely combined, in order to utilize them in the optimum manner in each of these cases.

The multi-purpose use of the composite structures to which this invention relates, as well as their applications in fittings and furnishings of buildings, show the proportional and modular character of the dimensions, since the said structures, among other advantages, enable the assemblies to be constructed to be given a certain minimum weight, combined with the use of very light sections, even if the material consists of steel, and also make it possible to obtain a certain minimum rigidity, partly thanks to the profiling, which also enables use to be made of the functional character of the folds in the metal, and the said limits to be modified by gradually increasing the strength and rigidity of the structures without thereby altering their external appearance, the assemblies consequently being standardized, whatever the dimensions of the homogeneous assemblies obtained, and particularly in accordance with the fittings or furnishings adopted as a typical example for the application of the present invention.

Thus, on the basis of the same modular profiled sections, the production of a very light assembly of 0.8m in height, for example, can be considered just as easily as that of a high assembly, e.g. of 4 metres, without the need for any alteration to the appearance of these modular profiled sections, the difference merely occurring at the level of the core of the composite structure, this latter being reinforced to a greater or smaller extent according to the circumstances of the adaptation required.

A further essential object of these structures, which, owing to the conception on which they are based, have been termed "light composite structures" throughout the present description, is both economical and social. The fact is that they enable small or medium local concerns, only having moderate overheads, and even having a limited amount of equipment, space or skilled labour, to construct and produce, close to the users' premises, definite assemblies in the form of light buildings, their fittings and furnishings, with a small number of rudimentary standardized constructional elements, defined according to the present invention; they also enable the said concerns to be more or less competitive in relation to the current standardized products of large concerns and also to offer their clientele the possibility of producing assemblies of exceptional dimensions from the same standardized elements, of very high quality, at a cost almost as low as that of mass products of more limited presentation and dimensions.

To sum up, the multi-purpose utilization of the basic units is rendered possible by the invention, which consists:

a. of bearing composite structures proper;
b. of intermediate and low connections, of the fastening and binding, also of the squaring type, between the said original composite structures, the said connections likewise based on rudimentary standardized constructional elements forming the bearing supporting structures;
c. vertical, horizontal, lateral, fixed or mobile walls, adaptable to the aforementioned composite structures, and consisting, in their main parts, of standardized elements constituting the said composite structures of (a) and (b).

To these constituent elements, needless to say, it is possible to add complementary fillings of different dimensions but of a strictly similar design, in order to maintain the homogeneity and the design of the entire system. Any complementary and standard filling, however, could be adopted on the basis of other materials not mentioned.

The production of standardized elements by profiling, in order to obtain a rigid structure of use in the manufacture of furniture or in the construction buildings, is obviously very well known, and existing prior art in this sphere is extensive.

For example, use is currently made of metallic elements, but these latter suffer from the drawback of consisting of comparatively thick sheet metal, to ensure the desired strength, in the various applications. These elements and consequently the structures produced from there are of considerable weight. In the present case, thanks to the original method of assembly according to the invention, and also to the special cross section presented by the various composite joists, the principal and the secondary one, use is made of thin metal elements, since the sheet metal of which they consist generally measures four to five tenths of a millimetre; the special way in which the various standardized elements fit into one another, according to the present invention, enables excellent physical characteristics to be obtained, particularly as regards strength.

Now that plastic materials are available, all possible profiled shaped can be considered, owing to the main characteristic of the said materials, i.e., the fact that they can be extruded. In actual fact, however, plastics are only of advantage for small items in which problems of shaping play an important part, but their use cannot be seriously considered in simple profiling operations for which metal, of equivalent strength, costs less; the fact is that, assuming equal strength, plastics of two or three mm in thickness are required to replace steel plates of only three to four tenths of an mm in thickness, a circumstances which is by no means in favour of plastic.

In conclusion, assemblies according to the invention can in theory be produced on the basis of profiled sections obtained by the extrusion of a plastic material, but these sections would not have the required physical characteristics or else would prove far too expensive; within the framework of the present invention, therefore, use is made of metallic profiled sections of a thickness substantially equal to four or five tenths, for a large number of applications, and the said sections, if it proves necessary, can be assembled more firmly by means of adhesives, the setting and even the welding process (as in the case of galvanized steel). In some cases, for reasons of economy or simplification, one or more parts of the said profiled section can be obtained on the basis of a plastic material, provided the demands made on the said parts where their physical properties are concerned are very moderate.

Among the best known previous techniques and similar partial applications, some of the said techniques necessitate cuts in slabs of material or profiled sections, the said plates and profiles being assembled by welding when they are of metal. A feature common to these techniques is that after the preparation of the elements or assembled articles of furniture they are given a surface finish, which in the nature of things necessitates considerable investments and the setting up of large factories. The fact remains, however, that the sheathings obtained with these latter techniques are mediocre from the point of view of quality, or else very expensive, and sometimes very difficult to produce.

Closed tubular profiles are also known, interconnected by means of standard angular parts, which may or may not be visible; this technique precludes the treatment of the surfaces by the continuous belt system and does not enable binding and squaring panels to be produced, an important characteristic of the composite structures produced by the present invention. (French Pat. Nos. 1,561,389 and 1,561,562 illustrate this previous technique).

A common application, which is, in fact, extremely usual in Europe, consists of the use, for furniture, of a framework in the form of drawn joists of a luminium, which are either quadrangular or octagonal, forming on each surface Ω's - or dovetails, to which, by means of screws or bolts, initial devices can be affixed for angle(L) connections. These units may or may not fit the hollow retaining part in the joists. A common feature of all these latter is a not easily modifiable appearance and the fact that they are not designed to form homogeneous panels from which it is possible to produce, when desired, not only joists but also walls and shelves etc., which can be interconnected without either screws or bolts. Furthermore, for a certain particular modular type, these joists are either too heavy or too light, according to their purpose.

Among the large number of types of shelf at present in existence, some consist of more or less perforated uprights, which necessitate, owing to the weakening caused by these holes, the use of steel of about 2–5 mm in thickness, while others consist of solid uprights of a certain width, necessitating the use of steel of eight to 15 tenths of an mm in thickness. In both cases, whether the units are solid or hollowed out, the uprights are not designed to form panels which can be combined with one another longitudinally and thus varied in width. These shelf uprights are generally rectangular, while the invention enables homogeneous, combinable panels to be constructed of which the base can be of a different width from that of the central zone, which itself differs in width from the top. Furthermore, the shelf systems are characterized by connections which prevent them from being suitable, for example, for a living room, whereas the invention, thanks to the aesthetically satisfactory invisible nature of its rigid and economical connections, can fit conveniently into a living room without being thereby rendered unsuitable for industrial use. Finally, the invention gives preference to the use of profiled external plates of a thickness of 4-5/10 mm, the economy of which could not easily be surpassed. This invention, of which certain elements can form a shelf system, is thus more similar to a kind

of metal cabinet-making system for industrial purposes, thanks to the possibility of including standard profiled sections, of varied colours and with ornamental sheathing, thus differing completely from the known industrial shelf systems.

Existing prior art can be advantageously completed by a study of the following main patents:

Brit. Pat. No. 125,748 describes a joist consisting of two parallel longitudinal castellated channel-sections, symmetrical and back to back, necessarily interconnected by welding, riveting or bolting along the central web of these profiles. These joints, however constructed (e.g. two U-sections with a concave web with turned flanges, or two C-sections placed back to back with a tubular bridging), are not provided, on a level with the flanges of the section, with any retaining means, so that between the extremities of these profiled sections, face to face, it is impossible for devices constituting an initial basis for orthogonal connections to be rigidly locked in position. Furthermore, the joists thus formed are unaesthetic, as the sections and bridges(-stuts) are completely visible; their use thus cannot be considered for a high-quality article of furniture, in which every joist and every panel consisting of elements similar to the joist must have an impeccable finish. In conclusion, particularly owing to the impossibility of considering orthogonal lateral connections based on the struts of the joist, the latter must be regarded as a unit having an unfortunate passivity, so that it can under no circumstances consitutute a composite structure for the construction of fittings and furniture in the building industry.

Brit. Pat. No. 381,771 describes an assembly of S-channels arranged face to face, for the production of a joist which similarly lacks the aesthetic and technological advantages of the present invention. The C-sheaths are assembled by means of a totally internal connection piece taking the form of a very thin lightweight strut, which thus cannot serve as an efficient base for squaring-connections. The resulting joist consists of continuous profiles describing an enclosed space, inaccessible from outside and not allowing of any other cooperation than that obtained by means of screws, bolts, gudgeons etc. Finally, the continuous sheaths, mainly of metalqare necessarily of considerable thickness, in order to give the joist as a whole a sufficient rigidity over its entire length, the said joist having no internal stiffener, since the struts are too thin to fulfil this purpose.

Brit. Pat. No. 636,517 describes a joist produced by assembling two C-sections face to face, similarly to the method of assembly mentioned in the preceding paragraph. In this case the continuous external sheaths are interconnected by a likewise continuous central core which delimits, between the extremities of the sheaths, two symmetrical longitudinal housings, but since no longitudinal cavity freely accessible from outside the joist is set back from each space, it is impossible to provide perpendicular or parallel connections between two joists. Each joist claimed in the present patent is solely designed to accommodate a furnishing wall (furniture panel) in each of its longitudinal spaces; no lateral extension at the same level as the joist is feasible; finally, it suffers from the drawback that the assembly of a joist and of a wall introduced into a space therein can only be effected with screws and bolts, since this joist, like the others mentioned, has no retaining device and is absolutely passive.

French Pat. No. 1,285,261 describes a joist produced by assembling cast aluminium profiled sections provided with longitudinal racks. Here again, owing to the inaccessibility of the core of the joist, it is impossible to define squaring-connections at any level, and the unions between the joists become impossible except at the top and bottom ends. Furthermore, the locking systems of the unions are complex, as they are based on the use of screws, nuts and gudgeons. All along the joist, both the external sheaths and the core are uninterrupted, so that each joist is heavy. Finally, unlike the assembly produced by the present invention, the core only functions as an internal stiffening device for the sheaths and plays no part in the orthogonal lateral connections.

Finally, French Pat. No. 1,381,274 describes a quadrangular column obtained by the interconnection of two castellated profiled sections at the level of their webs, and to this extent it resembles the joist covered by Brit. Pat. No. 1,257,481. The fact is that the profiled sections are welded together by their webs and do not comprise any retaining flanges enabling any other joist, whether parallel or orthogonal, to be fixed. Articles of furniture produced from such joists do not fulfil the aesthetic requirements of the present invention, since the castellated profiles, and the dovetails included therein, are totally visible, and this could not form an article of furniture of impeccable finish. The joist in U.S. Pat. No. 1,381,274, furthermore, does not have the property of modifying its resistance in accordance with a certain standard, since, being continuous, it is of the same thickness from one end to the other; neither does it enable the density to be varied along the joist. In the corners of the structure, free accessibility to the spaces provided between two profiled sections is rendered impossible by the presence of lateral connection devices; free accessibility, when provided in other parts of the joist, is at all events limited to the use of the dovetail and of the longitudinal space of the castellated profile, mainly to enable wooden panels to be introduced. The connections in themselves are fairly complex, since most of them are provided by means of screws, gudgeons and even jacks. To conclude, the sole purpose of a joist of this kind is to construct a homogeneous panel in which the profiled sections used for the said joist are at the same time the elements of which the panels consist. Taken as a whole, the purpose served by the said patent is only part of that served by the present invention, which is of a general nature and applicable to all buildings and their fittings.

Among the numerous advantages of the construction to which the present invention relates, particular mention may be made of the following:

— constant free access to the longitudinal housings, even in the corners of the structure, whether in a panel or a joist or from one panel to another or from one joist to another;

— external sheaths covering each joist, creating an aesthetic uniformity and at the same time establishing the minimum rigidity for materials of small dimensions;

— the assembly of the sheaths to the central core is provided without screws, bolts or welding, so that the sheaths on the one hand and the stiffening cores on the other are rendered totally independent. Consequently, and whatever the material used, since there is no longer

any limit, the only study required for the material relates to sufficient rigidity and mechanical strength, and this in no way prevents each joist and each panel from constituting an assembly nevertheless remaining entirely homogeneous.

— the presence of sheaths renders the central core, provided in the form of a bridging, and the orthogonal connecting elements, absolutely invisible;

— the stiffening core may, if required, form a swuaring-base towards all sides, in the plane perpendicular to the axis of the joist;

— all the visible surfaces are aesthetically acceptable: the system defines two plane surfaces prolonged by the continuous webs of thw two external sheaths, and two continuous and even longitudinal spaces between the extremities of the said sheaths;

— the core of the joist is non-continuous, and this reduces the weight of the latter in addition to enabling the density to be varied in the longitudinal direction, which is in accordance with the main technological purpose of the invention. The special cut presented by the central core renders the joist very rigid but at the same time very light in weight, and extremely thin and light material can be used for the said joist. According to circumstances and the central core used, the strength and rigidity of each joist can be varied, zone by zone, in accordance with the needs arising;

— the light composite joists thus constructed enable a great variety of articles of furniture to be assembled, and conversely, the said articles can be dismantled without loss of time, either to reconstruct an exact model of the article of furniture required or to convey the material to premises where the initial article of furniture can be re-assembled without difficulty. Transformations of articles of furniture, particularly extensions thereto, are effected in accordance with the user's exact requirements, owing to the easy method of assembly;

— owing to the standardization and ease of assembly, any town or city can have, on the spot, an assembly workshop equivalent to a factory.

According to the main characteristic of the invention, a light-weight composite structure, formed by the combination of standardized metallic elements and possibly including at least one part made of a plastic material, the said elements being themselves homogeneous and combinable, the said structure being intended for building construction and for the relevant fittings and furnishings, is characterized by the fact that it comprises at least one main composite joist consisting of two external parallel sheaths, each comprising a central web and two flanges constituting projecting retaining devices and arranged face to face in such a manner that their projections are directed towards one another, while independent elements, acting as stiffeners for the sheaths and constructed as initial bridges of variable length, spaced out from one another in the longitudinal direction, function as symmetrical struts for the said sheaths, in such a way that they delimit, between each pair of mutually opposite projections, a functionally and aesthetically satisfactory longitudinal space, of regular width, the first two bridges delimiting two longitudinal housings between the external sheaths, each positioned to the rear of each space, in such a way that each housing is freely accessible from outside the said joist, each bridge being also capable of constituting a squaring-connection, in a plane perpendicular to the axis of the main joist, with a second joist.

According to a second characteristic, the light-weight composite structure comprises, in combination with at least one main joist, a secondary composite joist, parallel and complementary to the main joist, consisting of two parallel external profiled sections arranged face to face and each having a central web, substantially flat, contacting the plane of the external sheath of the main joist and two marginal retaining flanges, the gap between the pairs of flanges opposite the said profiles being at least equal to the said space, while second bridges of variable length, spaced out from one another in the longitudinal direction symmetrically strut the sad profiles, the said second bridges each comprising a central web provided, beyond each web of the profiles, two flexible symmetrical longitudinal returns, gripping the extremities of the marginal retaining flanges of the two external profiles, introduced longitudinally into one of the two housings of the main joist, the flanges of the external profiles being gripped between two projecting retaining devices opposite the external sheaths of the main joist, each second bridge being also capable of forming a squaring-connection.

A description will be given hereunder, by way of an example, without any limitative effect, of various ways in which the present invention can be designed and constructed, by reference to the accompanying drawings, wherein:

FIGS. **1***a* and **1***b* are views in perspective, showing examples of models of furniture constructed with composite structures in accordance with the invention.

FIG. **2** is a view in cross section of the preferred main joist for the invention.

FIG. **3** is a cross section through a variant of the main joist shown in FIG. **2**, in which said variant the flanges forming the projecting retaining devices are constructed in the form of flanges possessing longitudinal ribs.

FIG. **4** is a cross section through a version of the main joist in which each projecting retaining device takes the form of one single squaring flange which is thin by comparison with the web of the external sheath.

FIG. **5** is a view, in perspective, of a main joist in which the internal strut consists of two lateral clamps of a C profile, interconnected by means of a tubular quqdrangular enclosure.

FIG. **6** is a cross section through a variant of the main joist shown in FIG. **5**.

FIGS. **7** and **8** are a view in perspective and in profile, respectively, of a main joist, in which the internal strut consists of **4** U-channels themselves defining the tubular central enclosure.

FIG. **9** is a view, in perspective, of a variant of the main joist of FIG. **7**.

FIGS. **10***a* and **10***b* are views, in perspective, of an external sheath of the main joist along which the two possible contructional versions of the bridging struts are arranged modularly.

FIG. **11** is a view of the extremity cross section of an assembly of main and secondary joists, in which assembly the main joist, situated at the top, is the preferred constructional version of the present invention.

FIG. **12** is a cross section of a main joist of which the internal strut is solid.

FIG. **13** is a cross section of a variant of the joist of FIG. **12**, in which variant the strut, constructed as a juxtaposition of U-channels, is substantially solid.

FIG. 14 is a cross section of a main joist of which the two external sheaths are strutted by two castellated profiled sections with a rectangular central zone, the said profiled being connected together back to back.

FIG. 15 is a view, in perspective, of a main joist in which the two external sheaths are interconnected by means of two castellated profiled sections with a trapezoidal central zone, the said castellated profiles being combined with each other back to back by means of an intermediate connecting piece.

FIG. 16 is a cross section of the joist of FIG. 15, in which the connection piece for the two castellated profiled sections consists of a piece with four hooks.

FIG. 17 is a cross section of a variant of FIG. 16, in which variant the connection between the two castellated profiled sections is provided by means of two pieces, each with two hooks, and placed back to back.

FIG. 18 is a view in perspective, and distorted, of an orthogonal connection of the "squaring" type between a main joist and a parallel secondary joist, on the one hand, and a second orthogonal main joist, on the other.

FIG. 19 is a view, in perspective, of a variant of the main joist of FIG. 14, in which the internal strut substantially consists of two castelled profiled sections with a rectangular central zone.

FIG. 20 is a view, in perspective, of the assembly of a secondary joist.

FIG. 21 is a view, in perspective, showing the assembly, firstly, of a first secondary joist on an orthogonal first main joist, and then of a secondary secondary joist on a parallel second main joist.

FIG. 22 is a view, in perspective, showing the assembly of a secondary joist and of a parallel main joist, of which assembly the extremity section if identical to that illustrated at the top of the assembly shown in FIG. 11.

FIG. 23 is a variant of the external profile of the secondary joist in which the web is perforated.

FIG. 24 is a second variant of the external profile of the secondary joist in which the web on this occasion is solid.

FIG. 25 is a view, in perspective, of an assembly of a number of main and secondary joists, in which are shown: a parallel squaring-connection between a first main joist and a secondary joist, an orthogonal squaring connection between a first and a second main joist, a perpendicular orthogonal connection between a second and a third main joist.

FIGS. 26–31 are views, in perspective, of angles enabling squaring orthogonal connections to be obtained between at least two main joists.

FIG. 32 is a view, in perspective, and "exploded," of an orthogonal connection of the "squaring" type.

FIGS. 33 and 34 are views, in perspective, of a connecting angle, of the T and X type respectively, enabling orthogonal connections of the "perpendicular" type to be obtained.

FIG. 35 is a view, in perspective, of an alternative version of the angle shown in FIGS. 33 and 34, for a "perpendicular" connection.

FIG. 36 is a view, in perspective, and partly "exploded," of an assembly of main joists, in which an alternative version of the "perpendicular" connecting angle is used for an assembly system of this kind.

FIG. 37 is a view, in perspective, of an angle for the production of a "lateral" orthogonal connection.

FIG. 38 is a view, in perspective, of a variant of the said angle.

FIGS. 39 and 40 are views, in perspective, and distorted, of an assembly between main joists, of the "lateral connection" type.

FIG. 41 is a cross section of the assembly shown in FIG. 39.

FIG. 42 is a view, in perspective, of an assembly of parallel juxtaposed composite joists, this assembly being locked at its free transversal end by means of a "half-covering bonnet."

FIG. 43 represents a piece enabling two parallel main joists to be placed edge to edge.

FIG. 44 is a view of a piece for the locking of the "half-covering bonnet" used in FIG. 42.

FIG. 45*a* is a view, in perspective, of an assembly similar to that of FIG. 42, this assembly being locked at its free transversal extremity by means of a "total-covering bonnet."

FIG. 45*b* is a view, in perspective, of the assembly of FIG. 45*a*, in which the locking bonnet is applied to the juxtaposed joists, the said bonnet being itself blocked by means of the locking piece shown in FIG. 44.

FIG. 46 represents a lateral gripping piece, with a right angle, on a main joist.

FIG. 47 is a view, in perspective, of two connecting pieces with two hooks, each suitable for the connection of two castellated profiled sections having a trapezoidal central zone, the said connecting pieces being themselves combined by means of struts of considerable thickness.

FIG. 48 is an end cross section of an assembly of parallel juxtaposed composite joists, with the view to the production of a wall.

FIG. 49 is a schematic diagram of the assembly of straight C-shaped cross section, for the production of a wall.

FIGS. 50–53 are alternative versions of walls.

FIG. 54 is a cross section of a single-surface shelf.

FIG. 55 is a cross section of a shelf forming an alternative version of that shown in FIG. 54.

FIG. 56 is a version of the method of assembly for the extremity.

FIG. 57 is a cross section through a ceiling or false ceiling.

FIG. 58 represents a horizontal shelf.

FIG. 59 represents a single-surface shelf.

FIG. 60 illustrates various versions of show cases, shop furniture or show windows.

FIG. 61 represents an independent panel.

FIGS. 62–64 illustrate various versions of parts for attaching a wall to main composite joists in the corners of the composite structure according to the invention.

FIG. 65 shows one of the possible constructions based on joists and assemblies according to the invention.

FIG. 65*a* is a distorted and exploded view, in perspective, of a parallel squaring connection between a main joist and a secondary joist.

FIG. 66 is a plan view of an assembly between three main joists according to the "squaring" version.

FIG. 67 id a plan view of a "squaring" assembly between four main joists.

FIG. 68 is a combination of a single wall with a double wall.

FIG. 69 illustrates the non-continuity along one and the same main joist.

FIGS. 70 and 71 are plan views of assemblies of the "perpendicular" versions.

FIG. 72 shows all the profiled sections and accessories indispensable to the construction of the composite structures according to the invention, for the standardized applications.

FIG. 73 is an orthogonal connecting piece between a first complete main joist and a second orthogonal main joist (one half).

FIG. 74 is a cross section through an alternative version of an internal strue between two external sheaths of a main joit.

FIG. 75 is a view of an angular cap of a cap structure with a ribbed return.

FIG. 76 is a view, in perspective, showing the interconnection of two orthogonal main joists, by the combination of two castellated profiled sections, taken from each of the two joists respectively and placed orthogonally at least against a part of the web of each.

FIGS. 77–80 are constructional variants of bridges strutting two external sheaths of a main joist.

FIG. 81 is a cross section of a mixed "panel-and-joist" assembly.

FIG. 82 is a cross section through a variant of the main joist, in which the two external sheaths are situated at different levels.

FIG. 83 is a view, in perspective, and distorted, of a quadrangular main composite joist, consisting of the connection of four identical C-channels, the web of each being turned over at 90° towards the outside, along its longitudinal axis of symmetry, which said joist defines, along each of its four faces, a housing set off from a regular longitudinal space, the four spaces being situated 90° apart from one another.

According to the invention, a homogeneous lightweight structure is formed of profiled joists and is composite from the web to the external sheaths, from one end cross section to the other. This structure is mainly of metal but may perhaps include one or more parts of plastic; the structure is also a bearing, fastening, squaring and binding structure, since arms, clips and even similar profiled joists may be fixed inside the said structure, these connections being totally invisible and provided without screws or bolts, to form the desired fitting or article of furniture or joinery. All the squaring connections, intended, for example, for the production of a panel, to be combined longitudinally with another panel, will preserve, at all their corners, both internal and external, free access from the internal longitudinal housings of the main joist.

This composite structure thus consists of two essential elements complementary to each other: a main composite joist **1** and a secondary composite joist **2.** In FIG. **11,** in particular, a main joist is illustrated in the central part, forming an assembly and mixture of possible constructions, which are also defined one by one in other attached diagrams, while a main joist situated in the upper part of the structure shown in FIG. **11** constitutes the preferred version, which as such will be regarded as the typical main joist throughout the rest of the description and other relevant illustrations accompanying it, although this characteristic will not thereby be limitative.

The main joist, bearing and combinable in every direction, consists of two parallel external sheaths **3** and **4,** of C-shaped straight cross section, arranged face to face in such a manner that their flanges, **5** and **6** respectively, comprise or constitute longitudinal projecting retaining devices, directed towards one another. The web of each external sheath is either flat (extreme joist in FIG. **11**) or of broken and distorted shape (middle joist in FIG. **11**); thus, any curves included in the webs **7** of the sheaths **3** and **4** are either symmetrical in relation to the longitudinal plane of symmetry **18** between the said sheaths, or complementary at **8** and **9,** as shown in FIG. **11,** in order to enable the units to be fitted into one another if necessary.

The longitudinal retaining projections **5** and **6** may be produced in the form of flanges or ribs, the following thus being constructed:

- — a single flange **10** inclined at an angle of less than 90° in relation to the web **7**(FIG. **4**);
- — an intermediate flange **11** perpendicular to the web **7** and itself prolonged from an end flange **12** likewise perpendicular to the intermediate flange **11**(see FIG. **2**);
- — an intermediate flange **13** perpendicular to the web **7** and prolonged from an extreme return **14** inclined substantially at an angle of 45° in relation to the first intermediate flange **13**;
- — a single flange **15,** perpendicular to the web **7,** comprising near its end a longitudinal rib **16** and possibly bent over in itself at **17,** to form a reinforcement of the extreme edge, not cutting(see also FIG. **3**)

The purpose of all these internal projections is to make it possible, by clamping action, to retain two external sheaths **3** and **4** effectively around an internal longitudinal strut constructed in the form of bridges of constant or variable length, the said bridges being arranged modularly at certain distances apart, in the longitudinal direction. As already specified, the particular shape of the retaining projection **5** or **6** constructed from a first intermediate flange **11** and from a second orthogonal end flange **12** will be regarded as the preferred embodiment of the invention here described.

As may be seen from the rest of the description, the external sheaths, in addition to their functional purpose, enable very ornamental assemblies to be formed, having no deformation which would render them incompatible with the construction of a luxury fitting.

The internal longitudinal strut, constructed in the form of bridges, consists essentially of a central body **19,** of polygonal straight section and prolonged by four identical jaws **20,** and constituting two symmetrical lateral fixed gripping devices("pincers") interconnecting the two external sheaths **3** and **4** and keeping them apart from one another by a regular longitudinal space **21**(FIGS. **2** and **3**). The central body **19,** shown by the hatching in FIGS. **2** and **3,** defines at least two full lateral surfaces **22** and **23,** on the one hand, and two front supporting planes **24** and **25,** on the other hand, these being parallel to the median plane or plane of longitudinal symmetry **18** separating the two external sheaths **3** and **4.**

The front supporting planes **24** and **25** are thus each in contact with the median part of the intrados of the web of an external sheath **3** or **4.** Each side face **22** or **23** is prolonged, at the level of the front supporting plane, towards the exterior of the central body **19** of an intermediate flange **26** in contact with the marginal part of the intrados of the web of the sheath **3** or **4**; except in the particular case illustrated in FIG. **4** and in the general diagram of FIG. **11** for the main joist illustrated in the central part (single flange **10** arranged with only "slender squaring" in relation to the web **7** in

the lower part, to the right of the joist), the intermediate flange **26** is always prolonged by a second end flange **27**, arranged at right angles to the first flange **26** and in contact with the internal surface of at least the initial part of the retaining projection **5** or **6** of the external sheath. Consequently, the flanges **26** and **27** of each jaw **20** of a lateral "gripper" are accurately embraced by the external sheaths and form useful marginal reinforcing devices.

The presence of two external sheaths **3** and **4** enables the beginning of a wall, or a "double-face wall," to be produced. These external sheaths may be continuous or non-continuous, as indicated for the sheath **3** in FIG. **5**. In the first place, for aesthetic and ornamental purposes, an external sheath may be produced from a number of portions made of different materials or in different colours. Subsequently and in many cases, for reasons of economy, particularly when one of the two external sheaths is invisible, there will be a tendency to use this latter in its noncontinuous form. Finally, when rapid access is required to the internal connection means situated below the sheaths **3** and **4**, subdivided C-shaped external sheaths will be used as an exception, as well as single U-channels, if necessary, for the visible connection, for purely aesthetic purposes, between the portions of the C-shaped sheaths; the fact is that the installation and removal of a U-channel are effected easily and rapidly, unlike those of a C-channel **3** or **4**, which can only be installed or dismantled after the longitudinal displacement of the said C-channel in relation to the internal joist.

Two constructional versions are possible where the central body **19** is concerned: the front supporting surfaces **24** and **25** are solid (full), i.e., consist solely of the two extreme supporting edges of the lateral surfaces **22** and **23**.

In FIGS. **5–13**, solid front surfaces have been shown. For example, the central body **19** is made up of two open hollow profiles fitting in elastically to define a generally prismatic enclosure, closed longitudinally; these two open hollow profiles have either plane lateral faces (U profiles **28** and **29** of FIGS. **5, 10** and **11**) or castellated lateral faces (profiles with Ω side flanges **30** and **31** in FIG. **6**). Needless to say, it is just as conceivable for this quadrangular enclosure to be full (solid), as shown at **32** in FIG. **12**, or defined in the interior by one single longitudinal profiled section, with a completely straight or square or rectangular cross section. In all the cases just described, the lateral grippers each defined by the two jaws **20** are each formed by a profiled unit of a generally C-shaped cross section, as defined by the profile **33** of FIGS. **5** and **12**, the said C-profile being capable of having a plane of Ω web, as shown at **34** in FIG. **6**. Finally, the web of the profile **33** is full or has at least one line of rectangular perforations **35** constituting a "rack," whether or not in the centre, and positioned opposite the longitudinal housing **36**, fully accessible from the outside of the main composite joist **1**, the said housing being defined between the bridge providing the internal strut and the marginal extremities of the projections **5** and **6** of the external sheaths **3** and **4**. The main joist **1**, thanks to its four lateral jaws **20**, is "binding"; the perforations **35** likewise render the said joist "fastening", as they can accommodate the locking teeth provided on the accessories to be affixed at the side. In most cases the line or line of perforationo **35** is substantially central. In order not to impede the introduction of the locking teeth, an internal relief **183** of the perforations is provided, either by the use of an enclosure **30–31** of a length less than the centre-to-centre distance of the perforations, or by the adoption of the special inverted-U (Ω) shape for the lateral flanges of the profiles **30** and **31** (FIG. **6**).

As may be seen from FIGS. **7** and **8**, the non-continuous bridges serving as struts between the two external sheaths **3** and **4** are made from four profiles **37,38,39,40**, themselves constituting a tubular composite profiled unit, of rectangular or square cross section. The four U-profiles are arranged perpendicularly, two by two, and spot-welded together or interconnected with adhesive. On the one hand they are covered respectively by the two C-shaped external sheaths **3** and **4**, while on the other hand their intradoses are partly in contact with the flanges **41** of the two internal profiled units **37** and **38**, which are perpendicular to them, the flanges of the said internal profiled units being oppositely orientated in respect of one another. The non-continuity of the internal strut constructed in the form of a bridge is clearly seen from FIG. **8**, which is a profile view of the main composite structure shown in perspective in FIG. **7**. This non-continuity of the bridges, arranged modularly at intervals apart in the longitudinal direction, is clearly seen from FIGS. **10***a* and **10***b* attached, but whatever the constructional form adopted, each bridge remains entirely independent, both of the sheaths and of the other bridges.

Another variant is defined in FIG. **9**: two external U profiles **42** and **43**, covered by the external sheaths **3** and **4**, each comprise, in the whole of their central cavity, a Ω profile **44**, of which the flanges rest on the marginal parts of the web of the U profiles **42** and **43**, and of which the central flat surface of the web extends a considerable way beyond the level of the plane formed by the two extreme flanges **12** of one and the same external sheath **3** or **4**. The interconnection of the two Ω profiles is effected, for example, by means of the bridge **45**.

Needless to say, this method of constructing the central body **19**, in which the front supporting surfaces **24** and **25** are full (solid), is also conceivable in a number of modified versions, of which only two supplementary versions will be briefly described: each C profile **33** constituting the gripper (pincer) defined on the basis of the two jaws **20** comprises in the central part of its web a joist **46** likewise functioning as a stiffening device, the said joist being covered with a U-shaped embellisher **47**, continuous or non-continuous, or a number of such embellishment devices fitted one inside the other in such a way that the side flanges **48** of the internal "U" are gripped elastically by the lateral flanges of the external "U" (FIG. **13**); finally, to replace the four U profiles arranged perpendicularly in pairs and constituting the internal strut of FIG. **7**, it is easy to conceive of a profiled unit of the same cross section but in this case made in one piece and produced, for example, by extrusion of a metal suitable for such an operation or of a plastic material; in this case the single-piece profiled unit will have the following straight section:the two parallel external U profiles **39** and **40** of which the flanges are turned towards each other are strutted by two parallel walls, perpendicular to the respective webs of the two external U profiles **39** and **40**.

To revert to the second possible constructional version where the central body **19** is concerned, one preferred embodiment of this latter is defined as follows: the front supporting surfaces **24** and **25** consist solely of the extreme edges of the lateral walls **22** and **23.** For this purpose, FIG. **14** shows a strut, naturally non-continuous, made up of two identical castellated profiled units **49,** of a Ω straight section, placed back to back by their central part **50,** the extremities of each Ω comprising a return at 90°, **27,** so as to reproduce the jaws of the gripper according to the present invention. The said profiles **49** are then interconnected by welding, or the use of an adhesive, even if the metal is prelacquered, for example, or by any other traditional mechanical connection method. In the illustration in FIG. **14,** the central part of the Ω profile is of a "U" rectangular section.

The castellated profiles of the internal strut shown in FIG. **15** are Ω profiles similar to those shown in FIG. **14,** the sole difference being at the level of the central zone, which in this case is trapezoidal instead of rectangular. These latter profiles **51** are adopted as the preferred example throughbut the description; they are interconnected, by the aforementioned technique, by the major base **52** of the trapezium, in order to provide hairpin bends **53** of which the utilization will be described in due course. In this version, shown in FIG. **15,** the central body **19** of the internal strut comprises four lateral surfaces.

The units between the various struts described reside in the following points:

— two symmetrical lateral grippers each defined by two equal jaws **20;**

— height of strut exceeds the sum of the thicknesses of the external sheaths **3** and **4,** in order to produce, between the said sheaths, a regular longitudinal space **21** fully accessible from the exterior of the composite profiled unit, the width of the said space being not more than the thickness of the metal or material forming the longitudinal edge used in the parallel squaring connecting element formed by the second composite joist **2;**

— support of each jaw **20** of each lateral gripper, on the one hand, by its flange **26,** on the marginal part of the intrados of the web **7** of an external sheath, and on the other hand, if necessary, by its flange **27** on at least the initial part of the internal face of longitudinal retaining projection **12, 14** or **15** of the external sheath **3** or **4.**

The castellated profiles **51** consistuting the internal strut, instead of being interconnected by their central part **52,** may be interconnected by a quadruple-hook part **55** (FIG. **16**) or by two double-hook parts **56,** themselves placed back to back (FIG. **17**).

In this case, the two central parts or platforms **52** are positioned in the alignment of the marginal extremity of the longitudinal retaining projections of the external sheaths **3** and **4,** i.e., the gap between two platforms **52** is equal to the width of the longitudinal space **21.**

The function of the castellated internal profiles **51** is essential, as it is on the basis of these latter that all of the orthogonal connections in relation to the main composite joist can be produced. In particular, use will be made, for this purpose, of the gap between the two platforms **52,** to give passage, replacing the hooked connecting pieces **55** and **56,** to the branch of an angle of which the other branch is itself included in the interior of another composite main joist perpendicular to the first. In most cases the branches of these angles will comprise rectangular perforations **57,** as shown for the angle of FIG. **18,** and thus, opposite the said perforations, the platforms **52** comprise protuberances **58,** congruent with the perforations **57** and of a height equal to half the thickness of the material or materials of which the branches of the angle are made.

The main property of the composite structure to which the invention relates is its lightness in weight. This is why it has been considered appropriate to interconnected the two external sheaths by means of a non-continuous internal strut. The combinable bridges must thus be in accordancx with the following criteria: they must be made of a light material and at the same time completely rigid, and create a regular and functionally satisfactory space **21** between the two external sheaths, accurately fit the internal contours of the said sheaths, slide easily inside these latter in order to retain their independence of movement, and possibly provide locking or tight mounting systems by means of studs or perforations respectively, for example, and reinforce the external sheaths **3** and **4,** and finally constitute bases for all devices enabling orthogonal connections to be provided to the main composite joist to which the said bridges belong. Some of these required properties conflict, this being the reason why two varieties of bridges will be provided, to strut two external sheaths **3** and **4.** For this purpose, it will be of use to refer to FIGS. **10***a* and **10***b*. Each of the elements constituting the internal strue illustrated in FIGS. **5** and **6** is easily produced from a piece of sheet metal of four tenths of an mm in thickness, while the internal strut shown in FIG. **15** is produced from one of 1 mm in thickness. Consequently, the strut in FIG. **5,** which cannot easily be used for orthogonal connections, is mainly used for all or part of the central structure of the main composite joist, while that shown in FIG. **15,** having a considerable stiffening effect and indispensable for the said orthogonal connections, is always positioned at the ends of each main composite joist and also possible at each of their levels intended to provide a basis for a perpendicular connection. There is a second reason why in most cases there will be a tendency to use, as far as possible, the light internal strut of FIG. **15,** in the central structure of the joists. The fact is that the end part, of thicker sheet metal, are comparatively difficult parts to produce, if accurate calibration and husing are desired, where the regularity of thickness if concerned, and if they are to be economical, providing a fitting-system of "joinery standard." This independent bridging parts can with advantage be reserved for perpendicular and lateral connections, a certain mountings of single or double walls, ends of joists which combine with the squaring connections in general. Furthermore, this form of internal independent strut has the advantage of possible leaving free a whole portion of the ends of the external sheaths.

In the case of the prefered use of internal castellated profiles **51,** the following values can be mentioned, by way of example, for their configuration:

The returns **53** are positioned at an angle of 135° in relation to the major base **52** of the trapezium of the central part, and the intermediate flanges **26** are likewise arranged at an angle of 135° in relation to these returns **53,** in such a way that they are situated in the prolongation of the minor base of the said trapezium. The hooks **59** of the union pieces **55** and **56** likewise

form an angle of 135° with the web of the said pieces, in such a way as to form a slide for the castellated profiles **49** and **51**. If the profiles **51**, owing to their contours, congruent with those of the union pieces, lock themselves transversally in the slides, the profiles **49**, of which the central zone includes a rectangular section, must, on the contrary, comprise retaining slides **60**, set back from the minor sides of the rectangular central portion, so that the extremities of the hooks **59** come to rest and are locked elastically along the said slides **28** (FIG. **19**).

If use is made of two double-hook union pieces **56**, these latter are themselves placed back to back, as were the two castellated profiles **49** or **51**, i.e., by welding, an adhesive or purely mechanical means.

A final variant of a union piece is shown in FIG. **17**: each of the returns **59**, at 135° in respect of the web, is itself prolonged by a second return at 135°, **61**, constituting an additional reinforcement flange, the said flange fitting the internal contours of the castellated profile **51** and coming to rest against the internal part of the end flange **27** of the said castellated profile **49** or **51**.

In the illustration of the main joist **1** in FIG. **4**, the two external sheats **3** and **4** are interconnected, for example, by means of two Ω profiles **62**, with a trapezoidal web, their flanges **26** having no second return **27**, the said profiles **62** being themselves combined by means of a quadruple-hook union piece **55**, as shown in FIG. **16** of the present application.

The main composite joist **1** thus constructed posseses a noncontinuous internal longitudinal strut, in the form of bridges, its main characteristic being the fact that it supplies the following in combination:

— a regular longitudinal space **21**, fully accesible from the exterior of the joist, the double function of this space begin as follows: aesthetic and decorative but at the same time functional, since its width is at most equal to the thickness of the sheet metal of the profiled material used at the level of the longitudinal edge of the secondary composite joist **2**. This latter thickness varies according to whether the composite structures according to the invention are used for industrial purposes (appr. 30–50/10 mm) or for furniture (10–25/10 mm). In the preferred version of the secondary joist **2**, this thickness at the lever of the longitudinal edge is equal to twice the thickness of the sheet metal forming the external profiles added to the thickness of the web of the bridge used as a strut;

— a longitudinal housing **36** defined on the one hand between bridge forming the internal strut and on the other hand the extreme marginal portion **63** of the flange **10,12** or **14** of the rib **16**, the said housing enabling additional hook devices to be introduced which form part of the secondary joist **2**, in order to combine the composite joists **1** and **2** constructed in the form of a parallel "squaring connection."

The secondary composite joist, marked **2** as a whole, is illustrated by way of an example in FIG. **20**. This joist is naturally symmetrical in respect of the plane **18** alreade defined, but is likewise symmetrical with respect to a plane **64** perpendicular to the plane **18**, so that by functioning as an intermediate joist it enables two main joists **1** to be combined so that these latter form the commencement of a wall, or else iit enables a main joist **1** to be combined with a wall having a housing of a configuration identical with that of the housing **36**, thus still allowing of the combination defined as one of the main characteristics of the present invention.

The secondary joist **2** of FIGS. **2** and **20** is made up of two Ω profiles **65** and **66**, arranged face to face, interconnected by an internal strut in the form of second bridges **67** likewise independent, on which the two lateral flanges **68** of each of the Ω profiles **65** and **66** come to rest. The bridges **67** are variable in length and arranged modularly at a certain distance apart in the longitudinal direction. They comprise a central web **69**, constructed, for example, in the form of a rectangular flat plate of a width slightly above that of the Ω profile **65** or **66**, the said web being provided, over at least part of its height, on each of its two longitudinal edges **70**, with two symmetrical returns **71**. These returns, which form, for example, an angle of 135° with the web **69**, surround the edges **72** of the flanges **68** of the two Ω **65** and **66** with an elastic locking action; furthermore, at least one of the bridges **67**, the lower bridge in the case of FIG. **20**, is provided, over part of its height, with devices capable of fitting into the regular space **21** existing between the external sheaths **3** and **4** of the main joist, these devices being constructed, for example, in the form of a rectangular flat plate **73** which, after being fitted in, will be locked inside an main composite joist orthogonal to the secondary joist, by a technique to be described later (FIG. **21**).

To provide a parallel "squaring" assembly between a main joist **1** and a secondary joist **2**, or a secondary joist **2** and a large-area wall having at its extremity a configuration identical to that of the main joist **1**, the two returns **71** constituting one of the longitudinal edges of the structures joist of FIG. **20** are introduced longitudinally into the housing **36** defined between the two lateral jaws **20** and the two retaining projections **5** and **6** of the external sheaths **3** and **4** of the main joist. The inclination of the returns **71** in relation to the web **69** and also the length of the said returns are selected so as to ensure, sinumtaneously, that:

— the extremity **74** of each return will rest on the extreme flange **27** of each jaw **20**, constituting each lateral gripping of the joist **1**;

— the extremity **63** of each internal retaining projection **5** or **6** comes to rest against the internal face of the return **71** situated opposite (upper joist in FIG. **1**).

The finished parallel "squaring" connection is as illustrated in the right hand portion of FIG. **21**.

The returns **71**, to adapt themselves to all contours of the main joist, at the level of its housing **36**, are advantageously provided with a certain flexibility, so that the angle which they form with the web **69** will be subject to variations of the order of about 10°, i.e., range between 130° and 140° in the example shown.

At the extremities of the structure or wall produced as illustrated in FIGS. **11** and **21**, by the juxtaposition of main and secondary joists, the said structure or wall can be simply covered with a profiled cap **75**, of C-shaped straight section, which for reasons of homogeneity will preferably be of the type constituting lateral pincers for the internal strut, the profile **33**, for example. In most cases, this time owing to the absence of an internal plate of the same type as that formed by the extreme flange **27**, there will be a slight clearance left between the intermediate flange **76** of the C-section cap **75** and the extreme edge **74** of the return **71** (lower portion of FIG. **11**). The operation of mounting the caps **75** is thus rendered far easier, and the blocking of

each one of them in relation to the resulting composite structure only takes place after the wall or article of furniture has been constructed, e.g. by covering the free transversal ends of the structure and of its end caps by one single U-bonnet **133** of which the width, separating the two lateral flanges, is equal to the over-all width separating the two intermediate flanges **76** of the cap **75**, this width being also equivalent to the over-all width of the structure, i.e., that separating two webs **7** of two external sheaths face to face, for example(FIGS. **45***a* and **45***b*).

The introduction of the returns **71** into the housings **36** of the main joist is advantageously facilitated by the presence of rounded parts as shown by way of an example at **54** in FIG. **20.**

Needless to say, the bridge **67** forming a strut between the two Ω profiles **65** and **66** could easily be produced either from two profiled parts **77** with two symmetrical lateral returns, the profiled parts **77** being placed back to back (upper secondary joist of FIG. **11**), or from one single profiled part **78**, of which the web itself comprises four symmetrical returns **71** in pairs, these returns being, for example, welded to the web of the profile **78** (secondary joist forming the base in FIG. **11**).

As already mentioned, the secondary joists juxtaposed laterally to a main joist or a wall slide longitudinally in the housing **36** and are locked in position by the returns **71** with which they are provided, this longitudinal displacement being shown schematically in FIG. **22** by the arrow **79.** The main and secondary joints once blocked, to constitute a plane structure, as illustrated by the completed systems shown in FIGS. **11** and **22**, it is possible to cover the web **80** of each of the two external Ω profiles **65** and **66** by the embellishers **81** of straight U-shaped section; if the web **80** of the Ω profiles is full(solid), the U-profile **82** itself has a full web and functions mainly as a decorative device, whereas if the web **80** of the Ω profile will comprise a central line of rectangular perforations **82** constituting a rack for various assemblies orthogonal to the composite structure, and the embellisher **81** will likewise comprise a central line of rectangular perforations congruent to the perforations **82**, in such a way as to reinforce the said rack. In both cases, the embellishers **81** are blocked by elastic gripping action along the Ω profiles **65** and **66**; they are introduced as shown schematically by the arrow **83** in FIG. **22.**

The second bridges **67** advantageously form struts for the two external profiles **65** and **66**, at a constant preselected distance apart, in such a way that the distance separating the external faces of the marginal flanges **68**, opposite each other, are at least equal to the space **21** separating the retaining projections **5** and **7** of the external sheaths **3** and **4.** For example, the space **21** of a main joist being 22/10 mm and the Ω profiles **65** and **66** each being made of a material of 6/10 mm in thickness; thus, care will be taken to use webs **69** of a material of 10/10 mm, to form a bridge having a total thickness of 22/10 mm, of which the result will be to provide exactly the space desired between the two external sheaths **3** and **4.** The secondary joist then fits, by each of its longitudinal edges, between the external faces of the flanges **68** of the Ω profiles and the retaining projections. In addition to the hooking action obtained by means of the returns **71**, a gripping action is also exerted on the longitudinal edges of the secondary joist, between the rigid external sheaths of the main joist.

The composite structure obtained by the assembly, by juxtaposition, of at least one main joist and its complementary secondary joist is a bearing and binding structure, as a result of the internal struts provided in the form of the first and second non-continuous bridges, which likewise improve the rigidity of the joists. The fact is that it is the noncontinuous internal strut, provided in the form of the first bridges, that binds and rigidifies the two external sheaths **3** and **4**, face to face, of the main joist, and it is likewise a non-continuous internal joist, taking the form of the second bridges, which connects, face to face, the two external Ω profiles **65** and **66** of the secondary joist, which said second bridges make it possible, on an intermediate basis, to connect longitudinally a main joist either with another similar joist or with a C-shaped end cap **75** of the structure, or with a C-shaped profile **33** similar to those forming the main joist and belonging to a large-dimension wall. The distance separating two main parallel joists connected laterally by means of the second bridges **67** of a secondary joist is exclusively defined by the width of the web **80** of the Ω profiles **65** and **66.** In certain cases, therefore, it will be necessary to present two parallel main joists interconnected and separated by as small a gap as possibe; the Ω to be used for this purpose are illustrated, by way of an example, in FIGS. **23** and **24.** In these two variants ot external profiles, the central seb **80** of the omega is simply reduced to double the thickness of the plate constituting the said profile, the result being that it is practically possible for two main joists to be juxtaposed edge to edge, one forming a prolongation of the other. The central web **84** of the profile **85** of FIG. **24** is full(solid), whereas the central web **86** of the Ω profile **87** of FIG. **23** comprises rectangular or trapezoidal perforations **88** constituting a continuous and regular "rack" along the said central web. The racks obtained from the perforations **82** and **88** render the secondary joist "fastening," since the said perforations can accommodate "fastening" bolts or hooks.

According to another main characteristic of the present invention, the main and secondary composite joists defined in the foregoing enable orthogonal connections in all directions to be produced with other main joists to which are attached other secondary joists as accessories. These advantageously consist of independent, movable, "combinable" and "binding" bridges, which give the external joists of the composite structure the multi-purpose character of a structure based on external sheaths which may or may not be manufactured by the continuous process but of which the lengths are variable.

Various types of connection are shown on the attached drawings. For a clearer comprehension of these drawings, all the connections illustrated are at 90°, i.e. only orthogonal connections are described, but it is obvious that this angle of inclination is not limitative and that without departing from the principles defined in the foregoing it is possible to conceive of all kinds of connections between two joists with any angles of inclination, the devices providing the said connection having the desired and suitable shape for this purpose.

Throughout the rest of the description, the following terms will be used:

— "squaring connection" for the type of assembly in which two main joists are interconnected in one and the same plane according to two orthogonal directions in such a way as to provide continuity between the regular longitudinal spaces **21** of the said profiled units(-FIGS. **18,21,32** . . .)

— "perpendicular connection" for the type of assembly in which two main joists are also interconnected in one and the same plane, in two orthogonal directions, this time in such a manner that the continuity in the assembly is produced in relation to the extradoses of the webs **7** of the external sheaths **3** and **4**(FIG. **25**, bottom part, and FIG. **36**, bottom part).

— "lateral connection" for the type of assembly in which two main joists are interconnected in such a way that the web **7** of an external sheath of the first comes to rest on the intermediate flange **11** of an external sheath of the second(FIGS. **37–41**).

These orthogonal connections may be either horizontal or vertical; furthermore, in certain corners of the structures, it possible to provide mixed connections, e.g. "squaring" between the joists marked **89** and **90**, and "perpendicular" for the main joists marked **89** and **91** of the diagram of general assembly in FIG. **25**.

According to the particular internal strut selected and also according to the method of orthogonal connection to be produced, the part providing the connection proper, between two composite joists, can be constructed on various principles:

1. The internal strut of the main joist, taking the form of bridges, consists solely of two castellated profiled parts **49** or **51**, directly interconnected back to back-(FIGS. **14** and **15**), in which case each of these profiles defines at least the first branch of an angle of which the second branch can also be directly engaged in an external sheath perpendicular to the first branch (FIG. **26** and upper half of FIG. **27**).

2. The castellated profiles **49** or **51** are interconnected by a piece **55** or two pieces **56**, and it is these latter connecting pieces that define at least one of the two branches of an angle, this branch being in this case engaged under two castellated profiles themselves engaged under two external sheaths **3** and **4** (FIG. **28**).

3. The connecting piece of FIGS. **27, 29,30** and **31** is a mixture illustrating the two preceding paragraphs. This piece comprises a first angle branch **92** consisting of two crenellated profiled units, or rectangular units **49** or trapezoidal units **51**, while the second orthogonal branch **93** is formed two pieces **56** with a double book **59**, placed back to back. The branch **92** is covered solely by two external sheaths **3** and **4**, continuous or non-continuous, while the branch **93** is first of all covered with castellated profiled parts **49** or **51**, forming bridges, and then by external sheaths **3** and **4**, continuous or non-continuous.

The second branches **93** of the angles of FIGS. **27, 29, 30** and **31** are exactly identical: in FIGS. **30** and **31** the branches **93** are shown in their entirety, by means of two pieces **56** placed back to back, while in FIG. **29** it is only the rear piece **56** that has been shown. The illustration for the angle branches **93** of FIGS. **27** and **29** is identical, with the sole difference that the piece **56** in FIG. **27** comprises beyond each hook **59** a return **61** and is covered with its castellated profiled unit **51**.

The angle of FIG. **26** is equipped, by way of information, with an high external sheath **3**, covering the profiled part **49**, and with a low sheath **4**, covering the profiled part **51**.

As a last variant the connecting piece of FIG. **29**, of which piece only one half is shown, comprises two branches, such as defined in FIG. **30**, the sole special feature being provided at the level of the central section of the castellated profiled part, which in this case is trapezoidal, with a rectangle at **94**.

As already mentioned, it is also possible to use the gap separating the two platforms **52** of two castellated profiles **49** or **51** to give passage, instead of the connecting pieces with hooks **55** and **56**, to the branch of an angle **95** of which the other branch is itself included between two platforms **52** of castellated profiles **49** or **51**, constituting the bridges functioning as struts between two external sheaths of a second main joist orthogonal to the first (FIGS. **18** and **32**). In this latter case the external surface of the platform **52** is exactly in the plane of the external face of the extreme flange **12**.The platform **52** is also provided with protuberances **58** of which the height corresonds to half the thickness of the material of which the angle **95** is made, so that when the combination of two orthogonal main joists **1** is completed the protuberances **58** of the castellated profiled units opposite to each other are in contact and the width of the space **21** is equal to the thickness of the material of which the angle **95** is made.

As a variant likewise considered, the "squaring" connection between two main composite joists **1** is produced from an angle **96** (FIG.**28**) of which each of the two branches is defined from a piece **55** with four hooks **59** or two pieces **56** back to back,each comprising at least two hooks **59**.

The arrangements in FIGS.**18,21** and **26–32** show "squaring" connections or means to obtain such connections, while the arrangements shown in FIGS.**33–36** show "perpendicular" connections, of the T type in FIG.**33** and of the X type in FIG. **34** and of the L type in FIGS.**35** and **36**. The "perpendicular" connections of FIGS.**33** and **34** are produced,as mentioned in the second paragraph, by means of angle(squaring)connection pieces of which each branch consists of two connection pieces **56** with double hook **59**. In FIG.**34** one of the connection pieces **56** is shown covered first with a castellated profiled unit **51** and an outer sheath **3**; it clearly illustrates the original functional dna aesthetic features accessible from the main composite joist **1** according to the present invention. The web of the connection pieces **56** of the "perpendicular" connection pieces comprises reinforcement angles **97**.

Another method of "perpendicular connection"is shown in FIG.**35**, and this method can only be applied to the main joists of which the external sheaths are interconnected by an in ernal strut made up of castellated profiled parts **49** or **51**, since this time it becomes necessary to use the cavity **98** available between the central part of the intrados of the web **7** of an external sheath and the base **50** or **52** of the central part of a castellated profiled unit **49** or **51**. The illustration in FIG. **35** relates solely to a castellated profiled unit **51** with a trapezoidal central part. For this purpose, each branch of the T-type connection piece marked **99** as a whole is made up of two identical arms **100**, parallel and forming a pincer (gripper) and defined as follows: the web **101**, of which the width corresponds to the minimum gap separating the hairpin bends **53** of a profile **51**, is prolonged along each of its longitudinal edges

by a first intermediate flange **102** inclined at an angle of 45° and a second extreme flange **103** turned over by 130° in respect to the flange **102**, in such a way that it is parallel to the web **101**. Each arm **100**, having geometrical contours congruent with those of the cavity **98**, is capable of sliding longitudinally in this latter and of thus constituting a connecting piece **99** but also a reinforcement piece. This time the "perpendicular connection" invisible between two main joists is due not to the internal strut or to an element inside the latter but, on the contrary, to an element totally external thereto, although remaining perfectly concealed.

Needless to say, two arms **100** placed face to face can form a unidirectional connection for two distinct main joists or else can form a prolongation for a composite main joist which is too short.

The connecting piece **104** in FIG. **36** likewise enables L or T connections to be produced, in the same way as the piece **99**. The web **105** of the profile to which the two arms **100** are welded or attached by adhesive is prolonged along each of its two longitudinal edges by a first intermediate flange **106**, turned by 135° in respect of the web **105** and by a second flange **107** likewise turned by 135° in respect of the web **105**, the two flanges **107**, opposite each other, being turned in opposite directions to each other. The profile on which the two arms **100** are thus affixed has an identical configuration to that of the castellated profiles **51** and of the parts with a double hook **56**. This piece **104** can thus be hooked to one single arm **100** introduced into the cavity **98** of a first main joist, or can be hooked, in the same way as a piece **56**, to a castellated profile **51**; in both cases, the piece **104** for "perpendicular connection " is the base on which a second main joist is affixed (FIG. **36**).

According to another characteristic, perforations **108** can usefully be provided on approximately the central part of the second extreme flange **27** of the jaw of the internal strut, and these perforations interact with analogous protuberances on the intermediate flanges **11** of the external sheaths **3** and **4**. It is thus possible to provide a short of longitudinal locking system by engaging struts in their sheath. In exactly the same way, the cap **110** shown in FIG. **36** comprises protuberances of the same time as **109**. The protuberances of the cap **110** are standard, while those provided on the flange **11** of the external sheaths **3** and **4** can be added before or after the assembly operation.

The function of this cap **110** becomes clear when, in a "perpendicular connection," the wall of one of the two joists exceeds, by at least the thickness of the said wall, the other orthogonal joist, whether for aesthetic or for functional reasons. In this case it is indispensable to disguise the projecting part of the internal joist by means of two "masks" of characteristic geometrical contours identical to those of the external sheaths **3** and **4**. For this purpose, the caps **110** shown consist of profiled parts of C-shaped section comprising a web **111** prolonged along each of its two longitudinal edges by a first intermediate flange **112** and a second extreme flange **113**, the said web comprising a return **114** along it external transversal edge **115**, the length of this return being equal to the width of the intermediate flange **112** and its prime function being to make all the inner parts of the composite structure absolutely invisible. Each cap **110** can be rapidly positioned or removed, so that all the internal connection, locking or extension devices for the composite joists are very easily accessible. If this cap **110** is applied to a very wide joist or two combined joists **1**, the free transversal edge of the web of the cap bears a ribbed return **176** (FIG. **75**). The function of these caps is all the more important since the modular independent struts are mass-produced units, and are made, for example, of galvanized steel, so that they require a "mask" in the form of an embellisher which ensures the aesthetic homogeneity of the entire assembly.

The lateral extremities of the connection pieces with hooks **55** or **56**, of the castellated profiles **49** or **51**, of the reinforcement or internal connection profiles **100**, and of the "squaring" connecting pieces **95** and **96** are advantageously equipped with teeth **116** designed to penetrate the perforations **117** synchronously arranged on the central part of the castellated profiles **49** or **51**, or on the central part of the hooked connecting pieces **55** or **56**, of the arms **100**, of the webs **105** of the pieces **104**, so that the transversal locking between two orthogonal main joists is completed. The caps **110** or the external U-shaped sheaths and arranged in the form of "masks" between two sheaths **3** or **4** (as indicated in lines **39–44** on p. **14**) are all easily movable and give access to the locking teeth **116** passing through the perforations **117**. After unlocking the constituent elements of the main joists recover their initial relative mobility and can then be displaced in order to form an article of furniture of different shape and volume. The outer corner of the teeth **116** is advantageously chamfered, to render the locking action effected by the said teeth progressive and gradual.

The orthogonal connection between two main joists of the "lateral connection" type is illustrated in FIGS. **37 – 41**. It is obtained by the use of an accessory **118** known as an angle and formed of one or more sheets of metal folded at 90°. The angle **118** is either a completely independent unit (FIG. **37**) or obtained by the use of two pieces **56** back to back, the webs of the said pieces being prolonged longitudinally, the two extension being then folded at 90° in one and the same direction, so that they are kept back to back (FIG. **38**). The first branch **119** of the angle **118** is affixed mechanically, or welded, or slid by friction, between the two trapezoidal platforms **52** of the castellated profiled, e.g. **51**. The external sheath **4** and the relevant castellated profile **51** ectend beyond the sheath **3** and its own profile, in the main joist into which the first branch **110** of the angle **118** is introduced, the said branch being of a length euql to the distance separating the webs **7** of the external sheaths of the second main joist into which is to be introduced the second branch **120** of the angle **118** (FIGS. **39** and **40**). The second branch **120** extends beyond the extremity of the external sheath **3** of the first joist by a length equal to the thickness of an external sheath of the second main joist, in such a way that the said branch **110** is arranged opposite the regular longitudinal space **21** of the latter. The branch **120** is flat and of a thickness equal to the regular gap between the two platforms **52** of the castellated profiles **51** which constitute a bridge forming a strut between the two external sheaths of the second main main joist **1**. The branch **120** is also cut on each of its two longitudinal sides **121** in such a way as to provide a notch **122** which is substantially ososceles and trapezoidal. This notch is cut at a level such as to correspond exactly to the level of the teeth **116** of the connection pieces **55**

or **56** with hooks or else of the "squaring branches" for a "squaring" orthogonal connection **95** or **96**, for example. Thus two angles **95** arranged opposite each other and substantially in the central part of one and the same main joist are able, thanks to a combined movement illustrated by the arrows **123**, affix the second branch **120** of the angle **118**, which will have been introduced in advance into the even longitudinal space **21**, in such a way that it engages more deeply, and accurately, between the platforms **52** of the profiles **51** of the same main joist (FIG. **39**); needless to say, the combined movement **123** of the angles **95** is conceivable both for the angles by themselves if they are merely slid between the profiles **51** and for the said profiles **51** likewise if these latter firmly hold the angles **95** by means of their protuberances **58** and the perforations **57**. The same principle can be applied to the firm and rigid fixing of an angle **118** by the combined displacement **124** of two connection pieces **55** provided with teeth **116** enabling them to engage, as has been shown in FIG. **40**.

The first main joist to which the angle **118** bent at 90° is affixed forms in itself a complementary "squaring" means, thanks to the particular arrangement of its two external sheaths **3** and **4** in relation to the second branch of the angle **120**. Thus, the extremity of the shorter joist, i.e., that of the external sheath **3**, slides along the marginal portion of the extrados of the web **7** of the external sheath **4** when the branch of the angle **120** is being inserted. To ensure that the second external sheath **4** of the first main joist will also ensuring a satisfactory "squaring" by resting on the intermediate flange **11** of the sheath **3** of the first main joist, it is of use to provide on the external face of the platform **52** of the profile **51**, secured in the sheath **4** of the first main joist, either a number of protuberances or else means for affixing a flat accessory piece **125**, of a width not exceeding that of the intermediate flange **11** of an external sheath. Needless to say, the protuberances or pieces **125** have a thickness corresponding exactly to the thickness of the first branch **119** of the angle **118**, in order to ensure satisfactory "squaring" (FIG. **41**).

This principle whereby the "squaring" is maintained between two main joists, by means of the relative arrangement of the extremites of the external sheaths, is as far as possible applied to all the orthogonal connections, whether "perpendicular," "squaring" or "lateral." In particular, an application of this method of supplementary "squaring" is found in the illustration in FIG. **36**, where the two main horizontal joists are attached according to a perpendicular connection, i.e., web to web. An arrangement of this kind also provides a fully aesthetic and decorative structural composition. As already explained, for the extremities of the structure, where it will be difficult to ensure satisfactory covering of the struts bridging two external sheaths, by means of the external sheaths proper, recourse is had to end caps **110**, still for the same aesthetic and ornamental purpose; furthermore, it is naturally conceivable that all the extremities of the main and secondary joists can be masked by means of square or rectangular embellishers which, by means of fastenings turned at an angle, are inserted in the cavities **98** or housings **36** of the joists, so that any internal visible part of these latter is concealed, thus ensuring a composite structure with an absolutely satisfactory finish.

By definition, the purpose of the internal strut of the main joist constructed in the form of non-continuous bridges is to interconnected and hold the two external sheaths **3** and **4** in such a way as to provide the even longitudinal space **21** and that of the housing **36**, which substantially takes the form of a C-shaped cavity arranged between the two jaws each forming a lateral gripper for the main joist. The external sheaths **3** and **4** can have webs **7** of variable width, and the main function of the central body **19**, of polygonal straight section, of the said internal strut is to maintain a constant distance between the two lateral grippers, on the one hand, the two external sheaths, on the other. For the comparatively narrow external sheaths, a strut simply consisting of two castellated profiled parts **49** or **51** is sufficient, but on the other hand, the greater the increase in the width of the sheaths, the greater will be the tendency to introduce internal reinforcing elements, such as pieces **55** and **56**. Any dimensional problem, as regards the width of the external sheaths, is thus solved; it may also prove useful to provide between the external sheaths, at the level of the struts forming bridges, central reinforcements of plastic or wood, enabling the two profiles **49** or **51** to be interconnected by an elastic locking action, or an adhesive, or the welding of these latter around the periphery of the said central reinforcements, which also enable good soundproofing and/or heat-insulating characteristics to be obtained for the composite structure.

FIG. **42** shows an assembly of compoisite joists in which one of the main joists **1** is equipped, at the level of its two lateral grippers, formed by C-shaped profiled units **33**, with two rings **126** capable of maintaining a certain constant distance opposite the space **21** existing between the external sheaths **3** and **4**. The fact is that for joists of small length the maintenance of the space between the said external sheaths at the two extremities of the joist ensures the evenness of the aesthetic and functional distance **21**, an essential characteristic of the present invention. However, as soon as recourse is had to comparatively long main joists, the regularity of this space **21** is more difficult to ensure, owing to the fact that the two projections **5** and **6** of the respective external sheaths **3** and **4** have a tendency to move apart; the introduction, substantially in the central part of the main joist **1**, of at least one ring **126** of C-shaped straight section, between the jaws **20** of a lateral gripper, in such a manner that the said ring exactly fits the contours of each C-shaped lateral gripper, for example the profile **33** in FIG. **42**, results in the prevention of this type of movement apart. The intermediate flanges **26** of each lateral gripper are then firmly pressed against the marginal portion of the intrados of the web **7** of each external sheath **3** or **4**, and the main joist according to the invention undergoes no deformation over any of its length.

Various accessories for reinforcement, connection or locking are naturally adapted to the specific shape of the composite joists according to the invention.

Thus, the accessory in FIG. **43** enables two composite main joists to be placed edge to edge and parallel, taking the form of a profiled unit or wall, in such a way that their spaces **21** are situated opposite to each other. For this purpose use is of the space **21** maintained between the two external sheaths and also the longitudinal housing **36** provided in the form of a C-Shaped cavity. The accessory **127** of FIG. **43** is defined as follows: two symmetrical units **128** back to back each comprise a first return at 45°, **129**, followed by a second return at

135°, **130**, the two returns being geometrically such that they can be introduced between the central body **19** and the lateral grip of an internal strut. Needless to say, the two pieces **128** can be manufactured from one single element equipped along its two edges with the two returns **129**, followed by the two returns **130**, aforementioned. The introduction of the piece or pieces **128** back to back is effected in the longitudinal direction in relation to an externally sheathed main joist, in a complete or partial manner. The projecting part of the piece or pieces **128**, in relation to the first main joist in which the returns **129** and **130** slide, is advantageously used for the interconnection of the two castellated profiled units **49** or **51** of the second main joist which is to be juxtaposed to the first, or else for fixing the connecting pieces such as **55** and **56**, or else for the locking of an accessory onto the profiled **49** or **51**; perforations **131** enable the various pieces to be mounted on one another without difficulty.

The piece shown in FIG. **44** serves as a locking means for a U-profiled bonnet **132** (FIG. **42**) or **133** (FIG. **45**); these bonnets, as already explained, enable a number of composite joists to be affixed to the juxtaposed non-bound parallel walls or to those bound parallel, according to the "squaring" method adopted, the said U-bonnets **132** and **133** resting by their webs on the transversal edges of the joists and gripping these latter by their lateral flanges **134**. The U-bonnet **133** of FIG. **45** totally covers the end section of the joist assembly, while the U-bonnet **132** of FIG. **42** only covers half the end section of the same assembly, and utilizes for this purpose the symmetrical manner in which the main and secondary joists are designed, particularly by fitting into the spaces **21**, between two castellated profiled **49** or **51** and two external profiles **65** and **66** of a secondary joist **2**. The mounting of the bonnet **132** is effected by means of the end platforms constituted by the flanges **12** of the external sheaths **3** or **4** of the main joists of the structure.

The body **135** of FIG. **44** is formed by a U-shaped profile **136** of which the web is prolonged at one of its transversal ends by a return **137** taking the direction of the flanges of the U and itself prolonged by a hairpin bend **138** along its external surface. The gap between the two returns **137** and **138** is equal to the thickness of the metal or plastic profiled material used for the construction of the U-shaped assembly bonnet **132** or **133**, so that the web of the said bonnet is capable of being kept elastically gripped between the returns **137** and **138** and of coming to rest against the edge **139**. The starting U-profile **136** can with advantage be replaced by the C-shaped profile **133** forming a lateral gripper on a composite extremity joist without thereby changing the method by which the bonnets **132** and **133** are engaged. As an example the piece **135** can also serve as the commencement of a U-shaped profiled unit for the commencement of a stand or shelf. For preference, all the profile **1 36** of the piece **135** is introduced into the internal strut of a main joist between a lateral gripper and the central body **19**, i.e., into the longitudinal housing **36**.

The piece **140** of FIG. **46** is a piece modularly distributed along a main joist and thus makes it possible, by its flat surface **141**, to form a right-angled lateral engagement with a certain preselected gap. In the example illustrated, the flat surface **141** is positioned at an angle in relation to the web **142** of a Ω profile with a trapezoidal central part, capable of sliding longitudinally along a castellated profiled unit **51** of the internal strut.

Finally, in FIG. **47**, two supplementary internal struts **143** are shown, each consisting oa a U-profilewith two successive returns at 135°, **144** and **145**, coming in contact with the two double-hook connecting pieces **56** and keeping these latter regularly spaced out. The distance between the two units **56** being increased, the same applies to the height of the central body **19** of the internal strut, so that the even longitudinal space **21** between two external sheaths **3** and **4** is increased, this providing a solution for all dimensional problems relating to the various possible ways of utilizing the said space **21** (Utilization for furniture or for industrial purposes).

After having studied the various types of orthogonal connection between two main joists **1**, the se connections being either "squaring," "perpendicular" or "lateral," and all produced from a piece intergral with a strut forming bridge and constructed in the form of castellated profiled units **49** or **51**, or even belonging to the said castellated profiled, a description will now be given of the method of orthogonal connection of the "squaring" type between a secondary joist and a main joist such as shown in FIG. **21**. The fact is that starting with the combination of two joists, a main one and a secondary one, parallel to each other, and constructed in the form, therefore, of a parallel "squaring" connection, it is possible to combine the composite assembly, thus obtained, with a second main joist orthogonal to the two preceding joists, by binding the second main joist either to the secondary joist, which is perpendicular to it, or to the first main joist, which is likewise perpendicular to it.

For the connection between the secondary joist and the second main joist use is made for this purpose of the end piece **73** which prolongs one of the struts forming a bridge between the two external profiles **65** and **66** of the secondary joist **2**. This piece **73** penetrates the even longitudinal space **21** of the second main joist and, for example: engages between the two platforms **52** of the two castellated profiled **51** forming a strut for the said second joist, or is equipped with a return such as the extreme flange **12** of an external sheath **3** of the second main joist or gripped between the piece **73** and the said return, or else comprises a perforation or two teeth **116** between which a locking clip **146** is introduced, of which one constructional version, to be preferred, has been shown in FIG. **36**. Finally, the piece **73**, designed to fit into the second main joist, can also be constructed at an angle, and it is substantially of the type of the piece **96** shown in FIG. **28**; in this latter case the second branch of the angle forms a piece **55** or two pieces **56** capable of assembling two castellated profiled **49** or **51**. The angle strip **96** of FIG. **28** is advantageously provided, on at least one of its two branches, with perforations **57**, designed to accommodate the protuberances **58** provided on the outside of the platforms **52**.

The assembly between the first and the second main joist of FIG. **21** can also be obtained or completed by means of an accessory **147** known as an "angle"; the lower part of this latter penetrating the housing **36** of the second main joist underneath the jaw **20** of a lateral gripper defined by the two external sheaths **3** and **4**. The method of fixing the angle **147** to the second joist is thus similar to one of those mentioned in connection with the method of fixing the piece **73** to the same joist. The angle **147** consists of two parallel side plates **148**

and 149, interconnected by a strut 150 of which the thickness is substantially equal to that of the Ω profiles 65; the side plate 149 is rectangular, its width corresponding substantially to that of the flange of Ω profile; on the other hand, the cheek 148 is substantially in the form of a right-angled isosceles triangel of which the base is slightly in excess of the over-all width of the Ω profile 65, in such a way as to cover over the internal faces of the two lateral flanges 68 of the said profile. The cheek 147 terminates in a first right-angled return 151 directed towards the cheek 149, and possibly a second righ-angled return 152 prolongs the return 151 in the vertical plane passing substantially through the side plate 149. A free space separates the first return 151 from the strut 150 in such a way as to give passage to the extreme retaining flange 12 of the external sheath. The use of the angle 147 is thus conceived of as follows: the first return 151, possibly the second return 152, are introduced into the housing 36 of the second main joist by the longitudinal displacement along the latter, in such a way that the internal strut 150, by its bottom end, comes to rest against the intermediate flange 11 of the external sheath. A profile Ω 65 or 66 is then slid between the two side lates 148 and 149 in such a way as to block the said profile longitudinally in relation to the second main joist. The angle 147 is completely utilized in the extremities of the construction of the wall orthogonal to a second main joist and enables the Ω profiles 65 or 66 to be blocked laterally in realtion to the second main joist, since these Ω profiles are gripped between the two side plates 147 and 148. By way of an example, the angles 147 will be the thin stainless steel side plates. The thickness of the material forming each angle 147 is equal to half the width of the even space 21 provided between two external sheath of a main joist, and thus two angles can be placed back to back.

It will also be noted that numerous accessories utilize, in common, the internal housing 36 of the longitudinal sides of a main joist; each of these accessories has a first end blade of which the thickness is equal to the width of the even space 21 provided between the extremities of the retaining projections of the external sheaths 3 and 4, and in general the blade or blades are prolonged by an end part which fits the geometrical contours of the castellated profiles 49 or 51 forming a non-continous bridging strut for the external sheaths 3 and 4 of a main joist. All the dimensions of each of these accessories constitute a relative system which facilitates their standardization and their various multiple uses but which, needless to say, could be different if necessary.

Each of the C-shaped external sheaths of the composite structure to which the invention relates has dimensions enabling it to be used as an external finish of a panel based on the said composite structure. Essentially, the composite main joists to which the invention relates can equally well take the form of walls; for this purpose, and by reference to FIGS. 48–61, the joists covered with the external sheaths 3 and 4 are arranged in one and the same plane, in such a manner that the extradoses of the webs 7 of these external sheaths are aligned. Consequently, two longitudinal spaces 21 between two successive joists are face to face, and it is permissible to introduce lon itudnally a connecting device between the two joists, which said connection device is naturally a secondary joist 2, as particularly defined in FIGS. 52 to 56. The distance separating the webs of the external profiles 65 and 66 is slightly less than that separating the external sheaths, 3 and 4, in order not to extend beyond the two parallel front planes defined by the external sheaths of the main joists. The width of the space 21 being not more than twice the thickness of the sheet metal of which the profiles 65 or 66 consist, plus once the thickness of the web of the strut 67, the secondary joist is gripped in the said space. The flexible returns 77 come to rest advantageously against the extreme flanges 27 of the jaws 20. The secondary additional joist of the main joist is advantageously covered on its two visible edges with two symmetrical U-shaped embellishers 81. contacting the planes of the extradoses of the webs 7 of the sheaths 3 and 4. In many cases the external profiles 65 and 66 will comprise projections 153 substantially on a level with their strut, these projections coming to rest against the intermediate flanges 11 of the external sheaths and the embellishers 81 coming to rest against the latter. The projection thus extends beyond the lateral faces 154 of the external profiles by a height equal to the thickness of the sheet metal constituting the embellisher 8, e.g. 8/10 mm in thickness.

As an illustration of the assembly operation, in succession:

— FIG. 57 shows a false ceiling, or a ceiling;

— FIGS. 54 and 59 show a single-surface shelf;

— FIG. 60 shows a number of commencements of showcases or showroom furniture or show windows;

—FIG. 61 illustrates an independent panel, capable of being mounted immediately on the customer's premises by the attachment (clamping) system already described.

A construction of this kind is difficult to produce, at any rate at such low cost, at the works, and on a mass basis, in contradistinction to that offered by the present invention.

The pieces in FIGS. 62–64 enable composite joists or walls to be assembled in the various corners of the composite structure to be produced. By way of an example, and without any limitative effect, the assembly of a vertical composite joist with a vertical wall in the following manner (FIG. 36): a profiled piece 155 forms a tight connection between two or four panels consisting of elementary U-shaped profiles.

This piece 155 with a Ω profile comprises along the longitudinal axis of symmetry of the extrados of the web 156 of the said Ω profile, an orthogonal return 157 terminating in two wings 158, substantially forming a T with the return 157, the geometry of the segments 157 and 158 being such as to allow of their introduction into the housing 36 of the main joists. For preference the piece 151 will be of a plastic material, so that it can comprise reinforcements 159 along its two internal dihedrons (FIG. 62). Referring to FIG. 36, it is conceivable that a vertical wall will come to be fixed between the vertical main joist on the one hand, and the lateral flange 160 of the piece 155 and the intermediate flange 11 of the external sheath 3 of the horizontal main hoist going away towards the left-hand side of FIG. 36. This results in absolute hermeticity between the two main joists used and the vertical wall.

Possibly a second piece 155 can be arranged dymmetrically in relation to the first. By the blocking of the said second piece in a second main joist it is possible to assemble from one to four walls in a corner of the structure.

The pieces **161** and **162** respectively of FIGS. **63** and **74** follow naturally from the construction of the piece **155.** In particular, the piece **161** can receive a number of parallel thin plates or else be used as a base for a sliding door, moving in horizontal or vertical planes.

From the main and secondary joists defined according to the present invention, therefore, it is conceivable that it would be possible, with a parallel use of the accessories designed in accordance with the said joists, to produce all the fittings or articles of furniture required. An illustration given by way of an example is provided for this purpose in FIG. **65.** Any composite structure uses at the base at least one main joist **1** and its complementary secondary joist **2** bound to the main joist parallel in accordance with the "squaring" method, this method of binding being illustrated in perspective, as an exploded and distorted view, in FIG. **65***a*. From the assembly in FIG. **65***a* or another single main joist, the orthogonal connections are then conceivable with at least one other main joist, to which may be bound another complementary secondary joist. Cut plan views of such orthogonal connections, of the "squaring," "perpendicular" and "lateral" type are thus illustrated in the following diagrams:

FIG. **66**: three main joists are interconnected by means of two angle pieces, **95** for instance, ensuring "squaring" connections. The lower joist extends slightly towards the left beyond the plane of the intermediate flanges **11** of the two external sheaths constituting the main joist connecting them.

FIG. **67**: four main joists are inter connected by means of four angle pieces **95,** as defined in FIG. **66,** while the rigidity is improved by two joists in particularly, arranged parallel.

FIG. **68**: combination of a single wall with a double wall.

FIG. **69**: parallel illustration of the non-continuity which may occur in the external sheaths **3** and **4** of a main joist **1.**

FIGS. **70** and **71**: illustration of perpendicular connections.

FIG. **72** shows all the profiled units and accessories indispensable for the construction of the composite structure according to the invention and also for standardized applications.

It will be noticed that the number of profiled units is five and that there are eleven accessories. The piece **170,** in particular, not yet described, enables an orthogonal original connection to be provided, as shown in FIG. **73.** The piece **170,** assimilated to a castellated connection **56,** comprises on one of the transversal edges of its web an operating pusher **171** and on the other transversal edge a hook **172** of which the second return penetrated the even longitudinal space **21** of a main joist. The connection shown in FIG. **73** is that of a vertical main joist and of a horizontal main half-joist. Two pieces **170** are arranged on the castellated profiled unit **51** of the horizontal half-joist in such a way as to enclose the vertical joist. In the combined displacement **173** of the two pieces **170,** the two joists are firmly fixed together:

— firstly, by the gripping of one of the two external sheaths of the vertical joist between the extremity of the return **172,** on the one hand, and the platform **52** of the castellated profiled unit **51** of the horizontal half-joist, on the other;

— secondly, using the teeth **174** with which the piece **170** can be provided. These teeth penetrate the rack **35** with which the lateral gripper of a main joist is advantageously provided. This rack is defined, for example, on the web of a C-shaped profiled unit **33** (FIG. **52**); it is constructed in the form of at least one line of rectangular perforations identical for example to those provided on the central web of the external profiled **65** and **66** of the secondary joist **2.**

Needless to say, the invention is not confined the method of application or to the method of construction mentioned. Various alternatives would be conceivable, without departing from the scope of the present invention:

— At the level, for example, of the non-continuous struts of the main joists, struts constructed in the form of bridges, one of the original features of which may appear at the level of systems of ribs **175** thus enabling the trapezoidal shape of the profile **49** or **51** (FIG. **74**) to be replaced.

— At the level, likewise, of the caps **110,** which may comprise a ribbed return **176,** ensuring better cohesion (FIG. **75**). All of these caps **110** will preferably be made of a plastic material in such a way as to provide, in the composite structures when assembled, a protection for the users against corners.

— At the level of the internal struts of the main joists, which preferably, as shown in FIGS. **10***a* and **10***b*, are of two kinds, but which may just as easily be defined in the form of a single model of non-continuous bridge (FIG. **76**), in which single model the castellated profiled units **49** or **51** constitute the base, since it is only these types of profile that enable orthogonal connections to be obtained.

— Finally, at the level of the independent compact bridging struts capable of holding the external sheaths of the main joists firmly face to face, with a regular and functional gap **21,** and according to the width of this selected gap. These bridges are tightened or gripped by the walls of the external sheaths **3, 4** of the main joists, or else these bridges grip one another, thanks to retaining flanges with which they are equipped on the external sheaths, or the internal elements of the said main joists. The bridge **177** in FIG. **77** directly holds the two external sheaths **3, 4** by means of its four jaws **20,** defining the two lateral connecting grippers for the external sheaths. Two opposite jaws provided separately on each of the two grippers elastically grip a castellated profile **178** of which the central web and possibly the two marginal flanges are equipped with a rack constructed in the form of a line of rectangular perforations **179.** The bridge in FIG. **79** grips the two lateral flanges es **180** of a U-profile **181,** while, on the other hand, the lateral grippers of the bridge of FIG. **80** are gripped by means of a Ω profile **182.**

The spaces **21** between two external sheaths, face to face, of a main joist are indispensable for the production of the connections, and the extension of these gaps to the general composite structure obtained is an aesthetic and functional factor. Thus the space between two external sheaths can enable two different types of utilization to the distinguished:

a. for the fittings of living rooms, kitchens, stores, offices, etc., the aesthetic considerations are more important than mechanical strength factors, and the satisfactory threshold for this type of utilization is a gap of the order of 10-25/10 mm, for example:

b. for handling, industrial fittings, mechanical strength is more important than aesthetic considerations, and spaces may range from 3 to about 25 mm. Owing to this considerable space, elements such as walls, panels, racks, half-hoops, embellishers, sliding rails for doors etc. (FIG. **81**) can be introduced between two sheaths face to face. This provides a mixed assembly known as a "panel-joist," in which the function of the end flanges **12** of the external sheaths **3** and **4** is to enable the walls incorporated between the two sheaths to be satisfactorily aligned and rendered rigid in the lateral direction.

All the original characteristics of the present invention can be adapted to various dimensions or thicknesses of joists or walls to be constructed, provided each of the constituent elements of the composite joist proper is appropriately adapted. However, as far as possible, for reasons of economy, and above all for aesthetic reasons, when the problem is to provide internal fittings for dwellings or stores, the space **21** between two external sheaths will be limited to about 10 - 25/10 mm. These values, as already explained, will be greatly exceeded when the problem is to provide industrial fittings or those intended for handling purposes, in which fittings the mechanical strength is by far the most important factor.

As an alternative, FIG. **82** shows a main joist which still has an axis of symmetry but in which the external sheaths are at two different levels. This arrangement is a solution to the problem of opposite angles and still maintains the essential chracteristics of the main joist, i.e., the accessibility of its spaces **21,** of its housing **36** and cavities, and the possibility of introducing hooking devices into the said cavities, at all the corners of the structure. The particular arrangement of FIG. **82** provides a complementary solution to all the fundamental problems of level or "squaring," by the offsetting of the extremities and the externsl sheaths of the joist itself.

The main composite joist of FIG. **83** is very important insofar as it comprises, in the directio s parallel to its axis of longitudinal symmetry, four spaces **21** situated at 90° from one another. This quadrangular joist **200** thus consists of the combination of four identical C-profile see e.g. **201, 202,** etc., the web of each being bent at 90° towards the outside, along its median longitudinal axis. Whatever the arrangement of the first internal independent bridges, the joist **200** still defines, along each of its four faces, a housing **36** set back from an even longitudinal space **21.** In the formula shown in FIG. **83,** first bridges situated in perpendicular planes have been shown at the two ends of the joist, each bridge being essentially made up of two castellated profiled parts **51.**

Another original arrangement would be the combination, in a main joist **1,** of two external sheaths **3** and **4,** by two castellated profiled parts **49** or **51,** of which the webs would be in contact with the intrados of the web **7** of the sheath. This latter arrangement, for the interconnection of the two castellated profiles, necessitates the introduction of a piece of regular straight section, defined by two isosceles trapeziums, adjacent by their minor bases, the major bases of the trapeziums being parallel and in contact with the webs of the catelled profiled units, and the inclined sides of the trapeziums being in contact with the returns **53** of the profiles **51.**

The arrangement of the two main joists in FIG. **76** also shows a particular method of assembly, since the two orthogonal main joists are associated by their castellated profiles **51,** functioning as first bridges; the fact is that two castellated profiles provided respectively on the two main joists are placed back to back, by their protuberances **58** and congruent perforations **57,** orthogonally over at least part of their webs **57.** In this case, as in all the connections constituting the corners of the structure, the base of each angle maintains free access to the spaces **21** and to the housings **36.**

The movable modular homogeneous structural assembly in which the first bridging struts formed by two castellated profiled units placed back to back over at least part of their web, whether the said profiled units are parallel or cross over (FIG. **76**), makes it possible to use all the accessible parts of this assembly (cavities, housings) for all or part of the hooking and locking means slid into their sheaths. It is thanks to the individual form taken by these external sheaths (projecting retaining devices), their special method of combintion, the over-all rigidity of their materials, and the protuberances and perforations with which they may be equipped, that it is possible to introduce, and secure efficiently in the said structure, main and complementary connecting means as well as functional and ornamental caps, of which the shapes, protuberances and perforations are reciprocally adaptable to those of the castellated profiled units constituting the first bridges of the main joists. Thus these profiles can also serve as supports for the possible final mounting, which is easy to carry out owing to the interaction between the external materials, preferably of light weight, and decorative materials used, particularly necessary owing to the presence of independent bridges forming struts, whether these bridges are of the "squaring" type or not, their strong material, generally corrosion-proof, being of an unaesthetic nature, all the more so since the profile of these bridges is generally irregular; it is thus of particular advantage to render all bridges totally invisible by means of the cladding proposed by the invention.

What is claimed is:

1. A lightweight composite structure, comprising at least one main composite joist consisting of two external parallel disposed sheaths, each sheath comprising a central web and two flanges constituting projecting retaining devices, and arranged face to face in such a manner that their retaining devices are directed towards one another, a plurality of first stiffening bridge means comprising means disposed internally of the sheaths interconnecting the sheaths and functioning as symmetrical struts for the sheaths and spacing them so the sheaths define between each pair of mutually opposite retaining devices a longitudinal slot of constant width, the plurality of first bridge means being spaced from one another in the longitudinal direction of the joist and frictionally engaging the sheaths for selective positioning thereof in spaced positions in said longitudinal direction, said bridge means defining two longitudinal housings between the external sheaths, one housing being positioned to the rear of each slot, in such a way that each housing is freely accessible through the slot from outside the said main joist, each first bridge means constituting means for providing a squaring-connection between two main joists.

2. A structure in accordance with claim **1,** comprising in combination with at least one main joist, a secondary composite joist, parallel and complementary to

the main joist, the secondary joist consisting of two parallel disposed external profiled sections, arranged face to face and each having a substantially flat central web substantially co-planar with the plane of the web of an external sheath of the main joist and two marginal retaining flanges defining a gap there between opposite said profiled sections being at least equal to the width of the slot, a plurality of second bridge means, spaced from one another in the longitudinal direction of the secondary joist and functioning as symmetrical struts for the said profiled sections, said second bridge means each comprising a central web having two flexible symmetrical longitudinal returns which grip extremities of the marginal retaining flanges of the two external profiled sections, the webs of the second bridge means extending longitudinally into one of the two housings of the main joist, the flanges of the external profiled sections being gripped between two mutually opposed retaining devices of the main joist, and each second bridge means also constituting means for forming a squaring connection between the joists.

3. A structure according to claim **2**, wherein at least one of the first bridge means of the main joist consists of two lateral grippers constructed in the form of longitudinal C-shaped cross section profiled units each comprising an uninterrupted or perforated web with a flange at each end, the said grippers, on the one hand, being aranged in such a manner that the flanges on one web extend in a direction opposite to the flanges on the other web, while on the other hand the webs are joined by a quadrangular, solid or tubular enclosure, the said one first bridge means thus defining, inside of its two lateral grippers, a C-shaped cross section longitudinal housing.

4. A structure in accordance with claim **3**, wherein said web comprises intrados and in which at least one of the first bridge means of a main joist comprises two symmetrical longitudinal castellated cross-section profiled units, each comprising a central web parallel to the webs of the external sheaths and two marginal flanges bearing against the intrados of the web of one of the two external sheaths, the said marginal flanges being each prolonged by a return bearing against one projecting retaining device of the external sheath, the width of the central web of each castellated profiled unit being at least equal to the gap between the two marginal flanges of said castellated profiled unit, the said two castellated profiled units also being joined to each other in such a manner that at least parts of their respective webs are situated opposite to each other and that they define longitudinal C-shaped cross-section housings.

5. A structure in accordance with claim **4**, wherein the two castellated profiled units connecting the two external sheaths of a main joist are joined by a connection piece of which the central web bears against at least part of the web of each castellated profiled unit and is prolonged by at least four longitudinal returns, enabling two castellated profiled units to be joined to each other, the external surface of the web of each castellated profiled unit associated with an external sheath being situated in the plane passing through that point of the projecting retaining device of the said external sheath which is nearest to the longitudinal plane of symmetry of the main joist, in such a manner that the thickness of the said connection piece is equal to the width of the said slot.

6. A structure in accordance with claim **5**, wherein the external surface of the web of each castellated profiled unit has at least one protuberance facing a corresponding protuberance on the other web, the sum of the heights of the two opposed protuberances being equal to the width of the said slot.

7. A structure in accordance with claim **6**, wherein at least one of its corners comprises two orthogonal disposed main joists connected together by a "square" or angle piece, each of the two branches of the latter being locked between and in contact with the webs of the two castellated profiled units respectively of the first and of the second main joist, while that part of the second orthogonal branch of the said "square" or angle piece which passes through the said slot provided between the projecting retaining devices of the external sheaths of the second orthogonal main joist is of a thickness equal to the said slot, in such a manner as to provide between the said main joists a connection of the "squaring or lateral" type as hereinbefore defined.

8. A structure according to claim **7**, wherein one of the two branches of the "square" or angle piece has perforations congruent with the protuberances on the castellated profiled units connecting the external sheaths of the main joists.

9. A structure in accordance with claim **8**, wherein at least one of the transversal or longitudinal sides of the "square" or angle piece comprises means, which are constructed, for example, in the form of hooked teeth for securing the said "square" or angle piece in each of the main joists which it connects orthogonally, the said teeth interacting with and passing through perforations in the central web of the castellated profiled units and in the web of the connecting pieces, and locking means, which are constructed, for example, in the form of clips positioned opposite the internal surface of the central web of the castellated profiled units, thus locking the said teeth and preventing them from working loose and leaving the castellated profiled unit within which they are enclosed.

10. A structure in accordance with claim **9**, wherein at least one of its corners comprises two orthogonal main joists connected together by the "perpendicular" system hereinbefore defined, i.e., a first main joist in which the bridge means used for the "squaring" connection is formed by two castellated profiled units fixed back to back, and a second main joist, from the end of which at least one tooth extends, prolonging the branch of an angle piece locked between the webs of the two castellated profiled units of the said second main joist, while that castellated profiled unit of the first main joist which is remote from the second main joist extends beyond the end of the said first main joist by a length equal to the distance separating the webs of the two external sheaths of the second main joist, in such a manner that the web of the said castellated profiled unit extending beyond it is traversed by the said tooth, and means for locking the said tooth being provided opposite the internal face of the central web of the extending castellated profiled unit.

11. A structure in accordance with claim **10**, wherein at least one of its corners comprises two orthogonal main joists, interconnected by the "squaring" system as hereinbefore defined, the central gap between the webs of the two castellated profiled units of the first main joist being accurately calibrated in such a manner that the second branch of the angle piece locked in the sec-

ond main joist is slid into position between the said castellated profiled units of the first main joist in such a way that at the same time the intermediate flanges of the external sheaths of the second main joist are in close contact with the end cross section of the two castellated profiled units of the said first joist, in order to prevent the angle piece from bending at its most fragile part.

12. A structure in accordance with claim **11,** wherein at least one joist comprises an L-shaped, T-shaped or X-shaped gripper, of which each branch consists of two arms of U-shaped cross section profile, which are face to face and symmetrical, each of the said arms having a configuration identical with that of the longitudinal cavity defined between the central part of the castellated profiled unit and the intrados of the central part of the web of the external sheath associated with the said castellated profiled unit, each arm of each branch of the said gripper being introduced into one of the said cavities, in such a way as to provide, between at least two main joists, an orthogonal connection of the "perpendicular" type or else a unidirectional prolongation.

13. A structure in accordance with claim **12,** wherein the central web of at least one of the second bridge means of a secondary joist, associated with and complementary to a first main joist, is provided over at least a part of its length with locking means capable of passing through the longitudinal space provided between two mutually opposite projecting retaining devices of a further second main joist orthogonal to the main and secondary joists already mentioned, while the external sheaths of the further second main joist are situated in the plane of the sheaths and of the external profiled units respectively of the said first main joist and of the secondary joist, while at least one of the two external sheaths or at least one of the first bridge means of the second main joist also comprises devices for locking the said means.

14. A structure in accordance with claim **13,** wherein at least one main joist is provided, on at least one of the ends of at least one of the two external sheaths of the said joist, with a finishing cap, for functional and aesthetic purposes, and made of metal or plastic, and covering the four non-sheathed surfaces of the extremity of the said main joist, the said cap consisting of a profiled part with a straight section identical to that of an external sheath of the said main joist and comprising, in particular, longitudinal retaining flanges and similar to the projections of the said main joist, in such a way that the removal of the said cap allows access to locking means in the said main joist, to enable accessories or a second main joist to be attached thereto.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,757,485 Dated September 11, 1973

Inventor(s) Rene VINCENS

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Heading of the patent, please insert as Item [30] the following:

--Foreign Application Priority Data

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Signed and sealed this 9th day of July 1974.

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McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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