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Faucheux

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[45] **July 15, 1975**

[54] **SET OF ELEMENTS FOR THE CONSTRUCTION OF BUILDINGS**

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June 25, 1973	Switzerland	9233/73

[52] **U.S. Cl.** **52/250;** 52/283; 52/439
[51] **Int. Cl.** **E04b 1/00;** E04c 1/04
[58] **Field of Search** 52/261, 283, 289, 702, 52/460, 227–229, 90, 167, 250, 251, 259, 300, 301

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Assistant Examiner—James L. Ridgill, Jr.
Attorney, Agent, or Firm—Emory L. Groff, Jr.

[57] **ABSTRACT**

Posts, beams and panels forming the framework of a building are mounted on a base plate embedded in a concrete layer, the base plate having tubular protuberances on which the posts are fixed in predetermined positions. The posts and beams, made of in extruded metal or synthetic resin, are preferably hollow and form a non-recuperable cofferwork in which concrete is poured after placing reinforcing cores. Concrete and similar walls or panels of the building can be reinforced with an embossed sheet of resin having an array of alternating protuberances and recesses.

1 Claim, 21 Drawing Figures

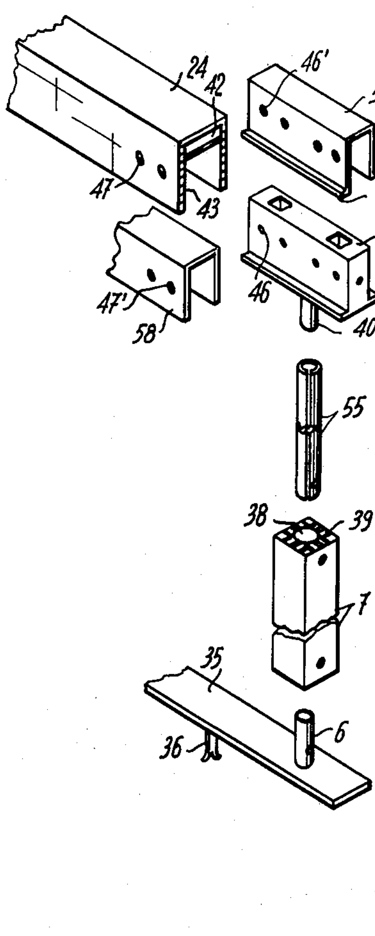


FIG. 3

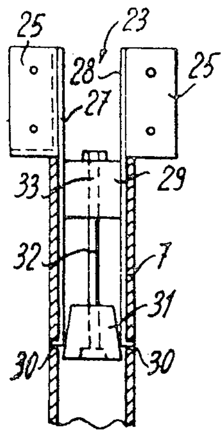


FIG. 5

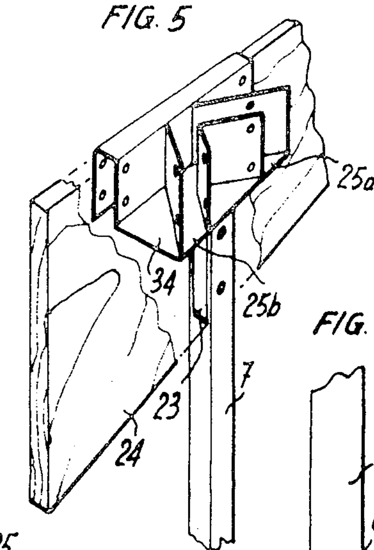


FIG. 1

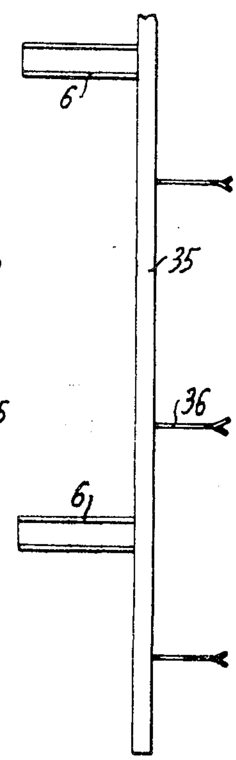


FIG. 4

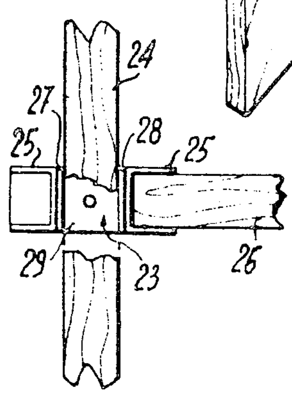
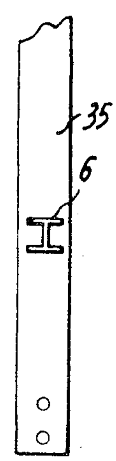


FIG. 2



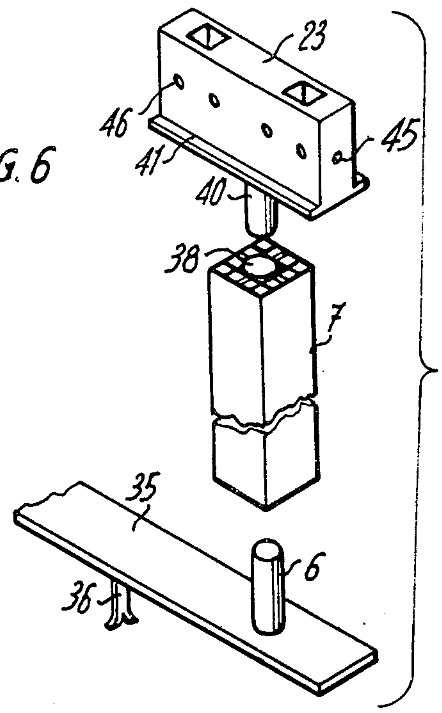


FIG. 6

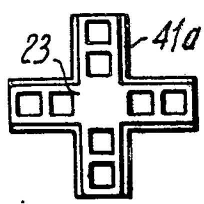


FIG. 7

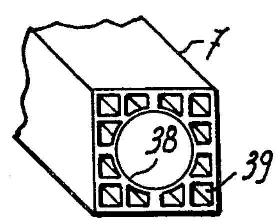


FIG. 8

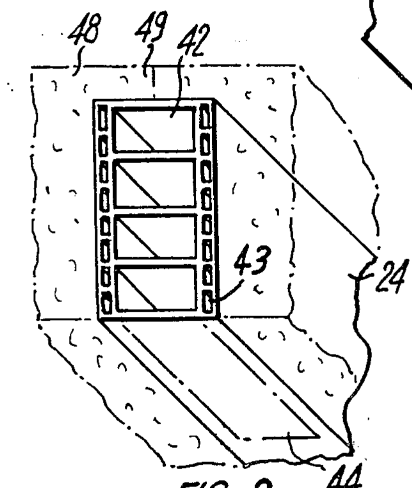


FIG. 9

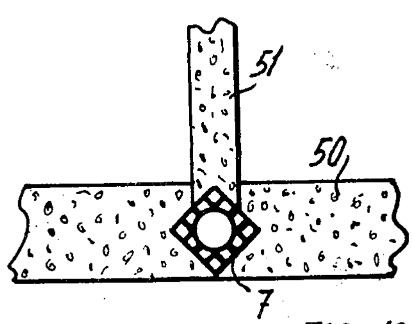


FIG. 10

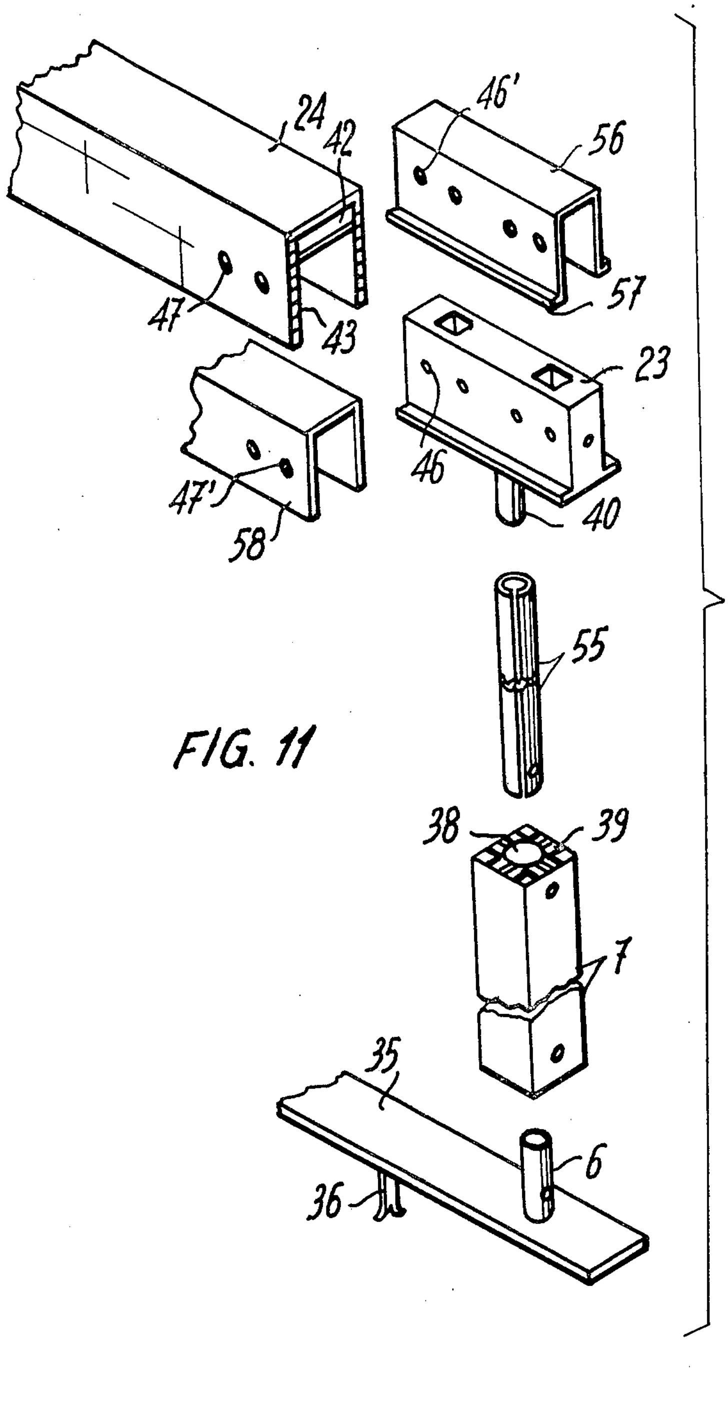


FIG. 11

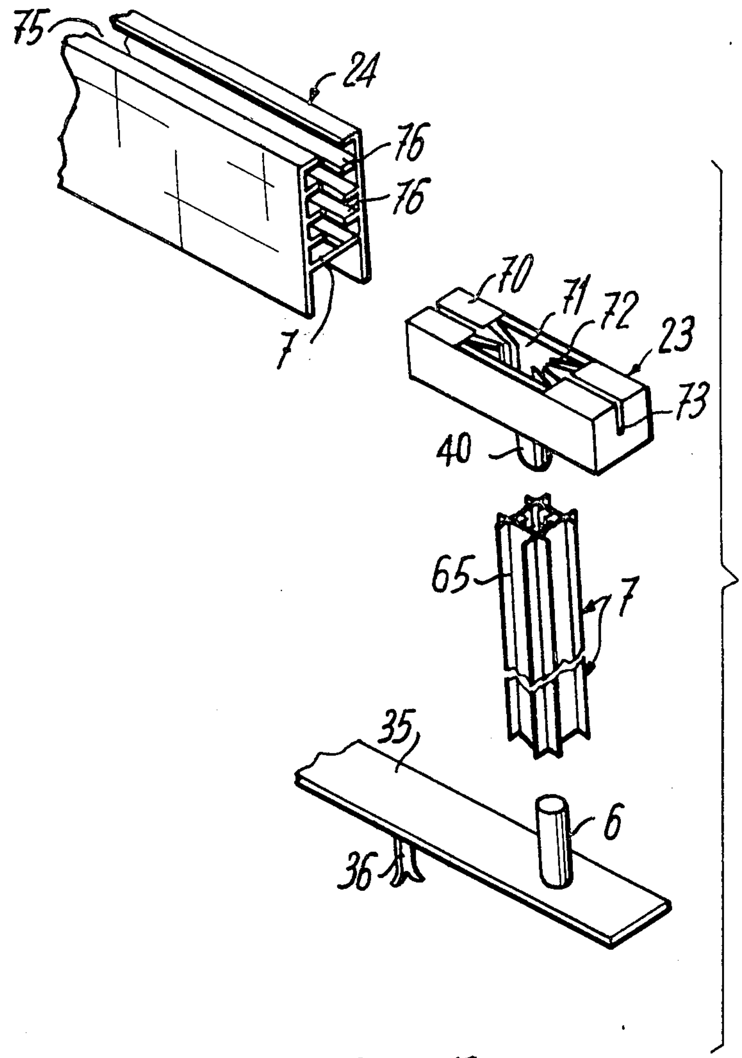


FIG. 12

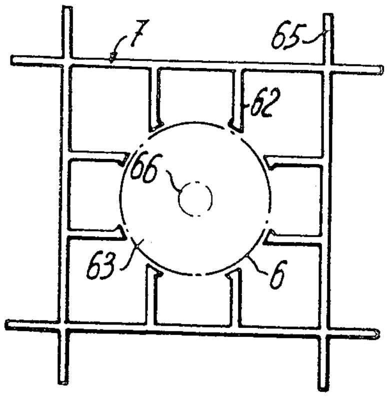


FIG. 13

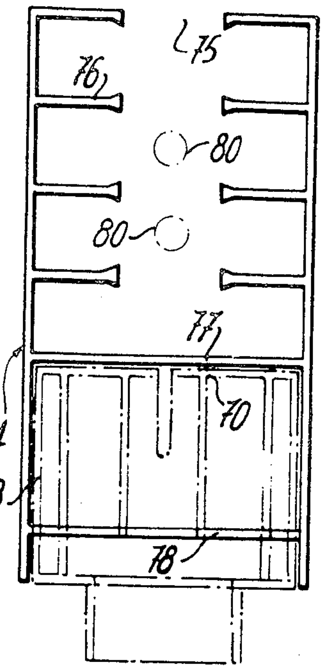
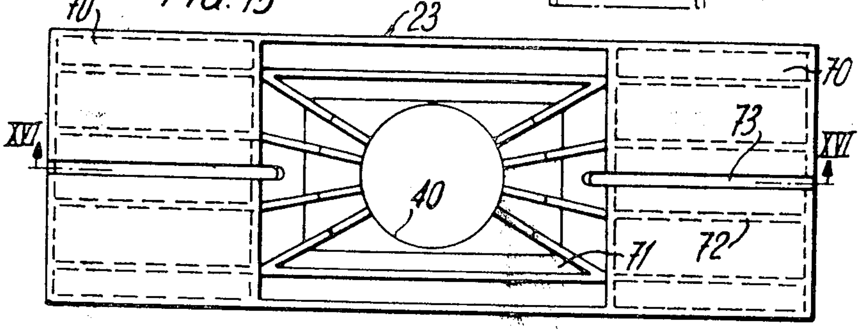


FIG. 14

FIG. 15



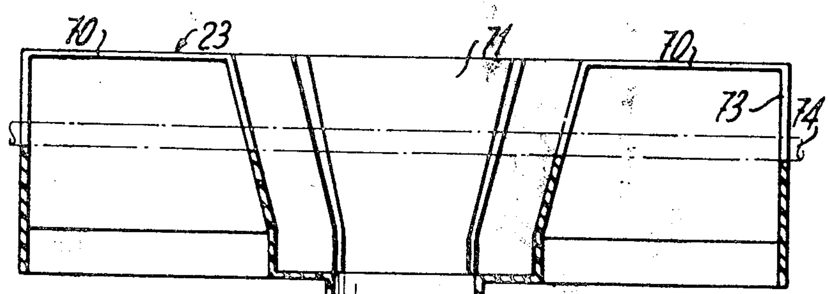


FIG. 16

FIG. 17

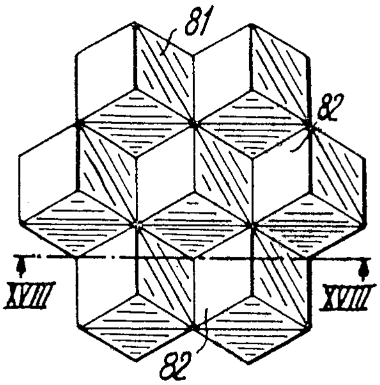
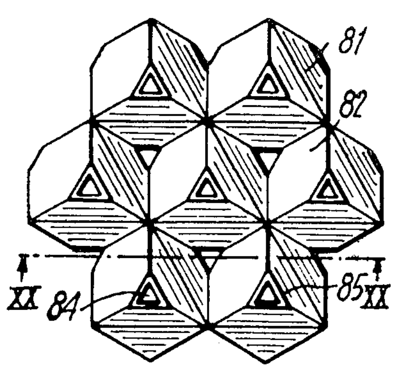


FIG. 19



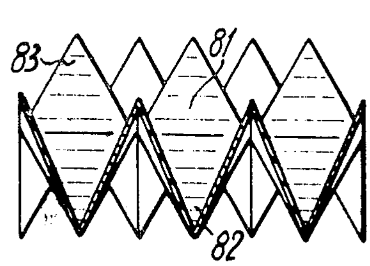


FIG. 18

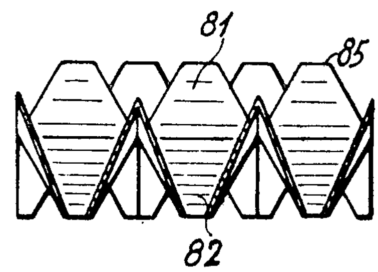


FIG. 20

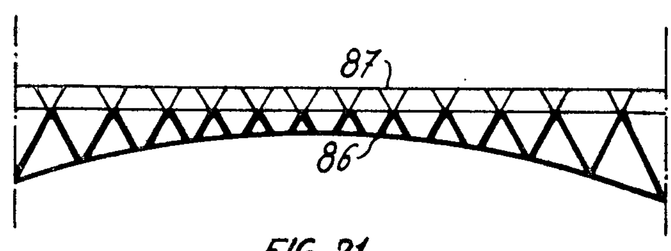


FIG. 21

SET OF ELEMENTS FOR THE CONSTRUCTION OF BUILDINGS

The invention relates to the construction of buildings.

In traditional methods of constructing buildings, it is observed that architect's plans are often only approximately followed by the builders. This gives rise to difficulties in fitting various elements together, notably when prefabricated elements must be mounted on a base of masonry set at the site.

The invention aims to remedy this lack of precision of traditional building methods.

According to the invention, there is provided a set of elements for the construction of buildings, comprising prefabricated framework elements, elements determining the position of at least a part of the framework elements, and reinforcing elements.

An embodiment of the invention, and variations of this embodiment, will now be described, by way of example, with reference to the accompanying schematic drawings, in which:

FIG. **1** is a partial side elevational view of an element for determining the position of adjacent posts;

FIG. **2** is a partial plan view of the element shown in FIG. **1**;

FIG. **3** is a partial view in longitudinal cross-section of a post provided with a member for supporting beams and panes of a framework;

FIG. **4** is a top plan view of the support member shown in FIG. 3;

FIG. **5** is a perspective view of part of a varied form of the support member shown in FIGS. **3** and **4**;

FIG. **6** is an overall exploded perspective view of a varied form of the elements of FIGS. **1, 3** and **4,** namely a part of an element fixing the position of a post, the post, a member for supporting beams of the framework, and a beam;

FIG. **7** is a plan view of another varied form of the support member shown in FIG. **6**;

FIG. **8** is an enlarged scale perspective view of an end part of the post shown in FIG. **6**;

FIG. **9** is an enlarged-scale perspective view of an end part of the beam shown in FIG. **6**;

FIG. **10** is a horizontal cross-section through a wall of a building cast about a post such as that shown in FIG. **6**;

FIG. **11** is an overall view similar to FIG. **6** of a second varied form of a set of elements;

FIG. **12** is an overall view similar to FIG. **6** showing a third type of set of elements;

FIG. **13** is an enlarged scale end view of the post shown in FIG. **12**;

FIG. **14** is an enlarged scale end view of the beam shown in FIG. **12**;

FIG. **15** is an enlarged scale top plan view of the beam-supporting element shown in FIG. **12.**

FIG. **16** is a cross-section taken along line XVI—XVI of FIG. **15**;

FIG. **17** is a plan view of part of a reinforcing or bracing element;

FIG. **18** is a cross-section taken along line XVIII—XVIII of FIG. **17**;

FIG. **19** is a view similar to FIG. **17** of part of a varied form of reinforcing or bracing element;

FIG. **20** is a cross-section taken along line XX—XX of FIG. **19**; and

FIG. **21** is a schematic cross-section through another varied form of a reinforcing or bracing element.

FIG. **1** shows an element for determining the position of adjacent posts **7**, comprising a base plate **35** having on its lower faces protuberances **36** adapted to be anchored in a concrete slab and, protruding perpendicularly from its upper face, tubular protuberances **6.** A post **7** is adapted to be mounted in each protuberance **6.** The base plate **35** can then be embedded in a coating layer of the concrete slab.

Of course, when the nature of the ground permits, the base plate **35** may be disposed on the ground and a concrete slab or layer can be provided by pouring in concrete on either side of the base plate **35** to form a finished ground surface.

The posts **7**, preferably tubular and of round or square cross-section, are provided at their upper ends with a U-shaped piece **23** adapted to carry beams **24** of the framework of a building. Stirrup pieces or yokes **25** for supporting framework panels **26** are welded on the outer faces of the arms of U-shaped pieces **23.**

As shown in FIGS. **3** and **4,** the piece **23** for supporting beams **24** is formed by the upper end of two flat irons **27, 28** connected together by a metal block **29.** The lower ends of the irons **27, 28** are adapted to engage in the upper end of a post **7.** The post **7** has transverse grooves **30** in which out-turned lower ends of the irons **27, 28** can engage and be locked by a trapezoidal or truncoconical lock nut **31** connected to the block **29** by a threaded locking rod **32** passing through an axial bore **33** of block **29.**

Alternatively, as shown in FIG. **5,** the pieces **23** for supporting beams **24** could each be formed by a recess in an upper end of a post **7**, and stirrup-pieces **25*a*** and **25*b*** for supporting panels **26** could be welded to a bracket **34** adapted to be suspended from a beam **24.**

According to a particularly advantageous alternative form shown in FIG. **6**, the posts **7** can include one or several tubular pieces **38**, preferably cylindrical, held together end-to-end in a sleeve-like piece including a peripheral network of cavities **39** (FIG. **8**) made in one piece by extruding a synthetic resin. Such a post **7** can be mounted on a protuberance **6** which is preferably cylindrical and with an outer diameter corresponding to the inner diameter of the pieces **38** of post **7.** The protuberance **6** is fixed on the upper face of a base plate **35** of metal or a synthetic resin provided on its lower face with protuberances **36** for anchoring it in a concrete slab.

Multi-directional support members **23** for beams and panels of a framework can be formed by partially hollow pieces moulded in a synthetic resin and each including a stud **40** for securing it to the upper end of a post **7.** The stud **40** is preferably cylindrical with a diameter corresponding to the inner diameter of pieces **38** of the post **7** on which it is adapted to be mounted.

The support members **23** preferably include flanges **41** protruding from along their lower longitudinal edges.

The beams **24** of the framework may include one or several superimposed tubular parts **42** whose lateral walls are by a network of cavities **43.** The lower wall or edge of these beams **24** has a recess **44** at its two ends so as to allow each end of the beam **24** to rest on the upper face of a support member **23** and on its flanges **41.** The recesses **44,** shown in dotted lines in FIG. **9,** can be provided not only in the lower wall of the lower tubular part **42**, but also in the lower wall of one or several of the tubular parts (see FIG. **6**), so as to enable the walls of the beam in which the network of cavities **43** is provided to be supported on the flanges **41** of the corresponding support member **23**.

Bores **45**, disposed in the support members **23** along their longitudinal axial direction, enable the assembled framework to be placed under tension, for example by means of cables, and transverse bores **46, 47** provided respectively through non-hollow parts of the support member **23** and in the side walls of the ends of beams **24** enable the beams **24** to be fixed to support members **23** by means of pins, for exemple.

Of course, panels can be provided in the same manner as the beams **24** shown in FIG. **9.** When the posts **7** must simultaneously support beams **24** and panels, they are provided with a support member **23** having four cruciform arms **41***a*, as shown in FIG. **7.** Numerous other variations of these support members can be envisaged for a corner beam or angle joist assembly or even for the construction of inclined, spherical and conical frameworks and so on.

In the event where the set of elements is to be used for making ceilings, agglomerated elements **48** are inserted between the beams **24**, as shown in dotted-dashed lines in FIG. **9**, and the panels can be dispensed with. These elements **48** have along each of their longitudinal edges a projection **49** bearing against a half of beam **24** and preferably filling all of the space between two adjacent beams **24**, which makes the ceiling assembly rigid and protects the flanks of the beams **24** in the case of fire, for example.

The posts **7** are generally embedded in the masonry **50**, for example a wall, of a building after placing possible inner partitions **51.** As shown in the example of FIG. **10**, when the posts **7** are of square outer cross-section, they are advantageously disposed with a diagonal of their section parallel to the surface of the masonry wall in which they are embedded.

Numerous other variations of the above-described set of pieces can also be envisaged.

The posts **7** and beams **24** could notably be made in single pieces by extruding a light metal such as an aluminum alloy, for example. The same applies to the support members **23** which could be moulded in a light alloy.

According to another variation shown in FIG. **11**, the posts **7** are reinforced by inserting in the tubular piece **38** a longitudinally split metal tube **55** which notably increases the resistance of the posts to compression. This split tube **55** can for example be provided in a rolled, nonjoined steel sheet 2 mm thick. Each support member **23** is also provided with a metal cover **56** of inverted U-shape in transverse cross-section. The ends of the arms of the U of cover **56** are outwardly directed and form flanges **57** on which the lower edges of the end of a beam **24** rest. Similarly, a metal reinforcing piece **58** of inverted U-shape in transverse cross-section is disposed in each of the recesses at the ends of the beams **24**, for which they form inner linings.

Thus, the set of elements of the framework shown in FIG. **11** is reinforced by a set of metal parts **55, 56, 58** which can be provided in sheet steel by rolling or stamping respectively. These metal reinforcing pieces enable framework elements **7, 23** and **24** in synthetic resin to have a resistance to compression and flexion comparable to that of steel framework elements the weight, bulk and cost price of which are several times greater.

As shown in FIG. **11**, the reinforcing pieces **56** and **58** have bores **46′** and **47′** corresponding to the transverse bores **46, 47** respectively in the non-hollow parts of the support members **23** and in the lateral walls of the ends of beams **24.** Preferably, the other elements of the framework and their reinforcing pieces have similar transverse bores.

Numerous varied embodiments of the described reinforcing pieces can be envisaged.

Thus, pieces for reinforcing the ends of a beam **24** could, for example, be provided in a synthetic resin. Such a piece of U-shaped transverse cross-section would be mounted in extension of the beam and would have, at its end facing the end of the beam **24**, reinforcing protuberances which would engage in the network of cavities **43** in the lateral walls of beam **24.**

The base plate **35** carrying protuberances **6** could be thicker than that shown, possibly alveolate, to enable adjustment of the thickness of a layer intended to cover the concrete slab on which the base plate **35** is fixed. The protuberances **6** of this base plate **35** could pass through the base plate and simultaneously perform the function of the anchoring protuberances **36.**

The protuberances **6** could be dispensed with and replaced by sockets intended to be embedded in the concrete slab. Such sockets fixed to the lower face of the base plate **35** would open at their upper ends into the upper surface of the plate **35.** A mandrel introduced into a socket could thus serve as a liason piece between the concrete slab and a post **7.**

Instead of having two arms (FIG. **6**) or four arms (FIG. **7**) in one plane, the moulded support member **23** could have a greater number of arms in different planes (i.e. orientations) for the provision of arches or domes for example. The lower surface of support member **23** instead of being disposed perpendicular to the axis of stud **40**, could be inclined thereto.

The variation shown in FIGS. **12** to **16** enables the use of sheaths or casings of the posts and beams, preferably in a synthetic resin, as non-recoverable cofferwork for the erection of a concrete framework of a building. There is thus provided an increase, by reinforced concrete, of the resistance to compression of the post casings and of the resistance to flexion of the beam casings.

These beam and post casings improve the final appearance of the framework, while defining its position in a precise way.

FIG. **12** shows a set of elements similar to those of FIG. **6**, comprising a base plate **35** having anchoring projections **36** on its lower face and protuberances **6** on its upper face. Each protuberance **6** is adapted to support a tubular post **7** carrying at its upper end a member **23** for supporting beams **24**, only one of which is shown partially in the drawing.

The hollow post **7** is of generally square transverse cross-section, as can be seen from the end elevational view of FIG. **13**, and can be made by extruding a synthetic resin. It has inner longitudinal ribs **62** whose inner edges define a cylindrical housing **63** for receiving a cylindrical, preferably tubular protuberance **6** to hold the post **7** upright.

The hollow post **7** also preferably has, as shown, external protuberances in the form of flanges **65** protruding in extension of its four faces, from its longitudinal edges. These flanges **65** are intended to serve as a frame former for the uprights of windows or panels disposed between adjacent posts.

The hollow post **7** serves as a non-recuperable cofferwork for a mass of concrete that can be poured therein after having introduced an armature or reinforcement such as an iron bar **66** extending along its length. This iron bar **66**, for example, enables the base protuberance **6** to be connected to the stud **40** of a member **23** received in the upper end of post **7** (see FIG. **12**).

This particular form of the support member **23** is shown in detail in FIGS. **15** and **16**. It can, for example, be provided in cast aluminium and includes two supporting wings or surfaces **70** on either side of a hopper **71** placed over the hollow cylindrical stud **40** adapted to fit into the upper end of the cylindrical housing **63** of post **7**.

As shown in FIG. **15**, the supporting wings **70** are made rigid by ribs **72** and have a longitudinal median slot **73** for passage of an anti-seismic cable **74** (FIG. **16**).

The hollow beams **24** whose ends are adapted to rest on the supporting wings **70** of two adjacent support members **23** may, as the posts **7**, be provided by extruding a synthetic resin. The casing of beams **24**, which is of rectangular transverse section, as can be seen in the end elevational view of FIG. **14**, has a longitudinal slot **75** in its upper face and longitudinal inner ribs **76** in parallel spaced apart relation to the remaining edges of the upper face so as to define therebetween a central passage whose width is substantially the same as that of slot **75**. A transverse web **77** parallel to the upper face of the beam **24** serves to rest the two ends of the beam **24** on supporting wings **70** of two adjacent support members **23**, as shown in FIG. **14**. For this purpose, the lower face or wall **78** of beam **24** is cut away at each end over a length corresponding to a third or half of the length of the upper face of the support members **23**, i.e. to about the length of wings **70**.

It is thus possible to erect the framework of a building in the following manner:

On a low wall defining a sanitary space or airgap, a concrete slab is poured. A base plate **35** carrying tubular upper protuberance **6** is fixed in this slab by embedding it under its surface. On each of the protuberances **6** is mounted a hollow post **7** with a iron bar **66** disposed along its axis. A support member **23** is then placed on the upper end of each post **7** by fitting its hollow stud **40** into the corresponding cylindrical housing **63**.

Sections of anti-seismic cable **74** are then introduced into the hollow beams **24** which are then disposed on the support members **23** on posts **7**. The various sections of cable **74** are then connected together in the region of hoppers **71** of the support members **23** and the assembly of elements is tensioned by means of a turnbuckle **74a** for example, having right and left hand threads at opposite ends into which threaded bolts **74b** and **74c** secured to the ends of sections of cable **74** may be threaded.

The hollow posts **7** are then filled with concrete by the slots **75** of beams **24** and hoppers **71** of the support members **23**. The beams **24** are filled with concrete through their respective slot **75** after having disposed iron cores **80** at different levels therealong.

Numerous variations of the last described embodiment may be envisaged.

The support members **23** can, for example, be provided in reinforced or non-reinforced moulded synthetic resin.

Instead of having only two supporting wings **70**, certain support members **23** could for example have four or more. In every case, it is necessary to provide a common joining piece for the various sections of anti-seismic cable in the beams, which meet in the hopper **71** of such a multidirectional support member **23**. In angle or skirting support members **23**, it is also necessary to provide members for tensioning the anti-seismic cables.

Instead of being parallel to the upper face of the beam **24**, the ribs **76** could be inclined downwardly towards the lateral walls of beam **24** to improve filling of the spaces defined therebetween with concrete. Similarly, the internal ribs **62** of posts **7** could be inclined to their walls.

Of course, instead of being extruded in a synthetic resin, the hollow posts **7** and beams **24** could be made by folding and welding or sticking sheets of synthetic resin about an inner lining including the said inner ribs **62** and **76** respectively.

Instead of being filled with concrete, the hollow posts **7** and beams **24** could contain any other suitable binder including expanded plastics materials.

When a great rigidity of the framework is required, the lower metal protuberances **6** can be replaced by tubes of steel of an increased length on which the studs **40** of member **23** are directly supported.

The slab in which the base plates **35** are embedded, as well as the covering elements carried by the framework of the building, are preferably reinforced, as are the partitions, facade panels and other visible structures of the building.

A particularly advantageous reinforcing or bracing element is shown in FIGS. **17** and **18**. This element is in the form of a sheet having an array of trihedral protuberances **81** alternating with trihedral recesses **82** on its two faces. It is obtained by hot embossment of a sheet of steel, aluminium, or synthetic resin, or even pressing a moist layer of paper paste, in a plate press or between two pressure cylinders.

For this purpose, the plates of the press are provided with matrices having facing complementary trihedral protuberances and recesses. Similarly, cooperating press cylinders used for this purpose would have at their periphery complementary trihedral protuberances and hollows between which a sheet of metal or synthetic resin, or layer of paper paste, is continuously passed.

The embossments or corrugations thus obtained provide, after cooling or drying of the reinforcing elements obtained, a high multi-directional resistance to flexion and compression in particular, and enable a chosen construction material, in a pasty state, to be applied on either side thereof. This material can be concrete, notably so called cellular concrete ($d < 1$), or a lime mortar, or a binder with a base of a hardenable expanded or other synthetic resin, or even a fibro-cement possibly mixed with inert fillers.

Preferably, the embossing matrices or cylinders mentioned above have facing trihedral protuberances and recesses of such a shape that the apices **83** of the trihedral protuberances embossed in the sheet are truncated (see FIGS. **19** and **20**). This particular shape of the matrices or cylinders facilitates removal of the embossed sheets from the press. Moreover, such embossed reinforcing elements in which the bottoms **84** of the recesses are pierced enable a better adhesion on either side thereof of the hardenable material that they reinforce.

In the embodiment of the reinforcing element shown in FIGS. **19** and **20,** the edges **85** of the truncated points **83** of the trihedral protuberances **81** lie in two parallel planes.

In the variation shown schematically in FIG. **12,** the lower trihedral protuberances are truncated at different levels so that their truncated edges **85** define a concave curved network **86.** The upper trihedral protuberances are, to the contrary, all truncated at the same level, and their truncated edges **85** define a planar network **87.**

A semi-curved reinforcing element of this type can be provided by embossing a sheet of metal or a synthetic resin in a press having a plane matrix facing a convex curved matrix.

Numerous other variations of the described reinforcing elements can be envisaged. The protuberances **81** and recesses **82** could, for example, be tetrahedral or hexahedral.

The advantages of the above-described reinforcing elements, and in particular that shown in FIG. **21,** reside in the appreciable economy of material that can be achieved compared to usual types of reinforcing elements, and in the facility they offer for mass production. When they are provided in synthetic resin, their cost price is very much reduced compared to that of corresponding metal reinforcing elements.

The reinforcing elements according to the embodiments of FIGS. **17** and **19** can in particular be manufactured in standard dimensions and can be superimposed by nesting protuberances **81** of the lower face of one element in recesses **82** of the upper face of another element, with a view to storage and subsequent transport.

Assembly thereof at a work-site can be provided by nesting the protuberances **81** and recesses of the adjacent edges of two reinforcing elements which are placed side by side, in extension of one another in the same plane.

It can also be noted that the reinforcing element according to FIG. **19** can advantageously be used as a planar or curved surface for the manufacture of panels or sheets for example. In effect, films, sheets or blades of any kind may easily be stuck, on either side of the reinforcing element, onto the edges **85** of the truncated trihedral protuberances.

I claim:

1. A building structure framework comprising, a plurality of base plates including anchoring projections depending from the bottom surface thereof and tubular protuberances extending vertically from the upper surface thereof, said base plates embedded in concrete footings with the protuberances projecting through and above said footings, hollow posts fitted over said protuberances, beam supporting members, hollow studs depending from said supporting members and connected to the tops of said posts, said beam supporting members having a plurality of vertically disposed hopper-like openings, hollow beams mounted on said supporting members, said beams having a longitudinally extending slot in their upper wall, a reinforcing bar member fitted in each of said posts and extending into said hollow studs of said beam supporting members to connect said protuberances to said hollow studs, and upon pouring concrete through said slot in the upper surface of said beams, said concrete fills the hollow posts, the hollow studs and the vertically disposed openings in said beam supporting members and said beams providing an integrated structural framework.

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