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(54) **Metal truss for building constructions and construction system using said truss**

(57) Metal trestle (10) for building constructions, consisting of a first stringer (11, 211), a second stringer (12, 212) and at least a central connection element (16)

between the stringers. Each of the stringers (11, 211; 12, 212) consists of a metal profiled element which has at least a plane surface, and the plane surfaces of the two stringers are co-planar.

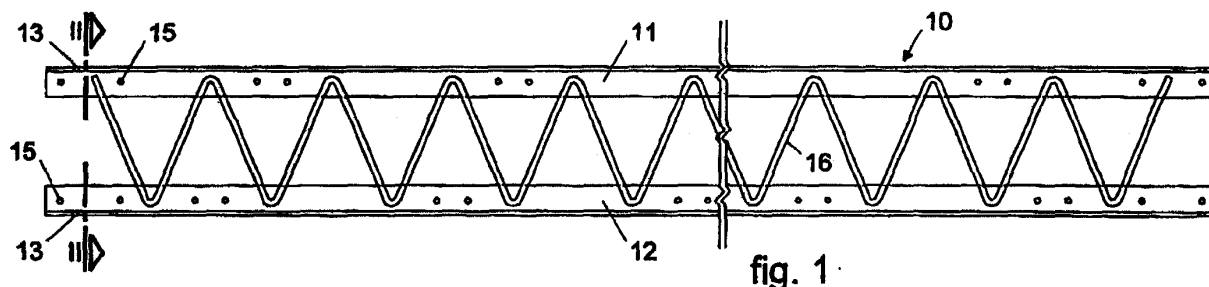


fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns a substantially plane metal trestle for building constructions and a construction system using a plurality of said metal trestles. The latter consist of metal profiles, such as L bars or plates, easily found on the market and can be arranged and connected one to the other so as to form beams and/or pillars, by means of conventional clamping elements, such as for example bolts, nails or other. The size of the trestles according to the present invention can be standardized, making them more economical.

BACKGROUND OF THE INVENTION

[0002] In the field of building constructions different types of metal elements are known by means of which the main bearing structures of buildings are achieved. Such structures, mainly consisting of beams and pillars, can be achieved with profiles of different cross sections: HE, IPE, UPN, L-shaped, T-shaped; they can be used individually, or joined together by means of bolting, or welding, according to their size and the loads they have to support.

[0003] The metal elements have the disadvantage, however, that they cannot easily be integrated with the concrete structures cast on site, generally used to achieve the secondary structures of the buildings (floors), since the solid cores of the profiles prevent the passage both of the concrete and also of the relative reinforcements.

[0004] It is also known to achieve beams using metal elements arranged in parallel stringers, connected by one or more elements configured in a lattice and positioned between a lower stringer and an upper stringer. The lower stringer is formed by a base sheet, perpendicular to the lattice, and/or by at least two metal round pieces, while the upper stringer is formed by at least two metal round pieces. The upper and lower stringers are welded at opposite ends to the metal connection elements.

[0005] These conventional metal beams, which are only suitable for mixed structures of steel and concrete, also have the following disadvantages and the following limitations:

- they are not suitable for achieving both the elements of the structural frames (pillars and beams) since their use is limited only to the beams;
- they pose serious executive problems in achieving the nodes between pillars with a traditional reinforcement and beams with prefabricated reinforcement; these problems are connected with the restoration of the continuity of the upper stringers which, necessarily performed through superimposition, causes excessive bulk and, in the outer nodes,

problems with anchorage;

- their self bearing capacity is limited by the fact that the upper stringers, subject to instability due to the combined bending and compressive load, are not mutually connected by elements able to contrast their listing on the horizontal plane.

[0006] A purpose of the present invention is to achieve a metal trestle which consists of simple elements, easily found on the market, and can constitute a modular element able to be coupled with at least another modular element of the same or similar type, in order to achieve structures both completely metal and also of the mixed steel-concrete type.

[0007] The present Applicant has devised and embodied the metal trestle according to the present invention in order to overcome the shortcomings of the state of the art and to obtain these and other purposes.

SUMMARY OF THE INVENTION

[0008] The present invention is set forth and characterized in the main claims, while the dependent claims describe other innovative characteristics of the invention.

[0009] In accordance with the above purpose, the metal trestle for building constructions according to the present invention comprises a first stringer, a second stringer and a central connection element between the two stringers. Each of the two stringers consists of a metal profile having at least a plane surface on which the above central connection element is attached. Moreover, the plane surfaces of the two stringers are co-planar. In this way, each metal trestle is substantially plane, or lying on a plane.

[0010] Advantageously the metal profiled elements that make up the stringers are plates or L bars, while the central connection element is a metal round piece or other profile of a different section other than circular, having a substantially zigzag development and welded to the plane surfaces of the metal profiled elements in correspondence with its variations in direction.

[0011] If the metal profiled elements consist of L bars, the metal round piece can be welded inside the angle formed by the two wings of the angular element, or outside it.

[0012] The trestles according to the present invention can be applied both to make reinforced concrete structures and also to make metal trestled structures. To be more exact, in the construction of reinforced concrete structures the traditional metal reinforcement of the beams, and possibly that of the pillars, is totally or partly replaced with one or more trestles according to the present invention, which are combined or arranged so as to form a box-like element. Each trestle can advantageously be made in a workshop or production plant, preferably by means of automated machines. The connection of the central element to the upper and lower

bar is performed by welding, for example electro-welding. The metal profiles, angular or flat, are provided with through holes by means of which, with bolts, threaded bars or nails, they can be joined to other similar metal profiles.

[0013] For beams in reinforced concrete, using the trestles according to the present invention, partial pre-fabrication is also provided with a cast of concrete into the lower part of the section.

[0014] The trestles according to the present invention allow to implement a new construction system to make frames or structures both totally metal and also in reinforced concrete. The new construction system advantageously differs from conventional systems:

- in the original way in which the beams are made, by assembling the plane metal trestles;
- in the way in which the beams thus achieved are constrained to the vertical supports during the construction step;
- because the partly pre-fabricated beams, suitable for the direct support of the floors, can be self-bearing for loads during the construction step;
- in the simplicity of construction;
- in its executive precision;
- in its technological reliability.

[0015] When the trestles according to the present invention are used to make reinforced concrete structures, the connection bolts, or alternatively the threaded bars with double nut, not only make the trestles solid with each other but also perform, if properly proportioned, the function of connectors between the metal elements and the concrete, in order to improve adherence.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] These and other characteristics of the present invention will become apparent from the following description of some preferential forms of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a front view of a metal trestle for building constructions according to the present invention;
- fig. 2 is a section from II to II of fig. 1;
- fig. 3 is a front view of a first variant of the trestle in fig. 1;
- fig. 4 is a section from IV to IV of fig. 3;
- fig. 5 is a front view of a second variant of the trestle in fig. 1;
- fig. 6 is a section from VI to VI of fig. 5;
- fig. 7 is a cross section of a first coupled structure, made using two trestles as in fig. 1;
- fig. 8 is a cross section of a second coupled structure, made using two trestles as in fig. 1;
- fig. 9 is a cross section of a third structure, made

using two trestles as in fig. 1 and one trestle as in fig. 5;

- fig. 10 is a cross section of a fourth structure, of the box-like type, made using four trestles as in fig. 1;
- fig. 11 is a cross section of a fifth structure, of the box-like type, made using four trestles as in fig. 1;
- fig. 12 is a cross section of a sixth structure, of the box-like type, made using four trestles as in fig. 1;
- fig. 13 is a cross section of a seventh structure, of the box-like type, made using three trestles as in fig. 1 and one trestle as in fig. 5;
- fig. 14 is a cross section of an eighth structure, of the multi-cell type, made using six trestles as in fig. 1 and one trestle as in fig. 5;
- fig. 15 is a cross section of a box beam made partially inside the floor using four trestles according to the present invention;
- fig. 16 is a plane view of the beam in fig. 15, mounted on two vertical supporting elements; to be more exact, for better understanding, in the left part of the drawing only the basic reinforcement is shown, while on the right part of the drawing only the additional reinforcement is shown;
- fig. 17 is a longitudinal section from XVII to XVII of fig. 16;
- fig. 18 is a cross section of a perimeter box beam made partially inside the floor using a structure in fig. 13;
- fig. 19 is a cross section of a box beam made totally inside the floor using a structure similar to that in fig. 11;
- fig. 20 is a cross section of a variant of the box beam made totally inside the floor in fig. 19;
- fig. 21 is a front view of two consecutive pillars, during the assembly step, made using trestles according to the present invention;
- fig. 22 is a front view of the two consecutive pillars in fig. 21 after assembly;
- fig. 23 is a cross section from XXIII to XXIII of fig. 21;
- fig. 24 is a plane view of a structure comprising: a pillar in fig. 21 and a beam in fig. 16; to be more exact, for a better understanding, in the left part of the drawing only the basic reinforcement is shown, while in the right part of the drawing only the additional reinforcement is shown;
- fig. 25 is a section from XXV to XXV of fig. 24;
- fig. 26 is a front view of a coupled beam, during attachment to external constraints, made using two trestles according to the present invention and having the wall rods phased;
- fig. 27 is a front view of the coupled beam in fig. 26, attached to the external constraints;
- fig. 28 is a cross section from XXVIII to XXVIII of fig. 27;
- fig. 29 is a view from above of the coupled beam in fig. 27;
- fig. 30 is a front view of a coupled beam, made using the trestles according to the present invention, and

having the wall rods counterphased;

- fig. 31 is a cross view of the coupled beam in fig. 30;
- fig. 32 is a front view of a beam with cross stiffening brackets, made using two trestles according to the present invention;
- fig. 33 is a transverse view of the beam with cross stiffening brackets in fig. 32;
- fig. 34 is a view from above of the beam with cross stiffening brackets in fig. 32.

DETAILED DESCRIPTION OF SOME PREFERENTIAL FORMS OF EMBODIMENT

[0017] With reference to figs. 1 and 2, a trestle 10, substantially plane, according to the present invention comprises an upper stringer 11 and a lower stringer 12, parallel to each other and made with two angular metal profiles provided with through holes 13 and 15. The two stringers 11 and 12, which have plane and co-planar surfaces, are mutually connected by means of wall rods 16, consisting of a zigzag shaped metal round piece. The latter, in correspondence with its variations in direction, is welded to the plane and co-planar surfaces of the stringers 11 and 12, so as to be arranged inside the right angle formed by the wings of the angular elements.

[0018] According to a first variant, shown in figs. 3 and 4, in a trestle 110 according to the present invention the wall rods 16 are welded outside the right angle formed by the angular stringers 11 and 12, instead of inside the wings of said angle.

[0019] According to a second variant, shown in figs. 5 and 6, in a trestle 210 according to the present invention the parallel stringers 211 and 212 are made with flat metal profiles and the wall rods 16 are welded onto one of their plane surfaces.

[0020] Both the angular profiles and the flat profiles are of the type easily found on the market.

[0021] Each metal trestle 10, 110, 210 can advantageously be made at a specialized work shop.

[0022] According to a characteristic of the present invention, by joining together two or more metal trestles 10, 110, 210 it is possible to achieve an extremely various plurality of structures, some examples of which are shown in figs. 7 to 17.

[0023] As can be seen, the metal trestles 10, 110, 210 are easily joined together using connection bolts 20 and threaded bars 21, or nails (not shown in the drawings), possibly with the aid of conventional elements that are easily found on the market, such as intermediate plates or spacers 22, flat wall rods 23, bayonet joints 25, supporting cross-pieces 26, diagonal flat bracing rods 27 and cross stiffening brackets 29.

[0024] To be more exact, fig. 7 shows a first structure 30 consisting of two coupled trestles 10, coupled together and with intermediate plates 22 interposed.

[0025] Fig. 8 shows a second structure 31 consisting of two bracketed coupled trestles 10, that is, coupled

with cross stiffening brackets 29 interposed.

[0026] Fig. 9 shows a third structure 32 consisting of two trestles 10, arranged laterally, and a trestle 210 arranged centrally and parallel to the lateral trestles 10.

The trestles 10 and 210 are coupled together by means of bolts 20 and threaded bars 21, with cross stiffening brackets 29 and intermediate plates 22 interposed.

[0027] Fig. 10 shows a fourth structure 33, of the box-like type and with a substantially square cross section, which consists of four trestles 10 arranged in a quadrilateral, with the angular elements 11 and 12 directly coupled by means of bolts 20, without any cross stiffening brackets 29 and/or intermediate plates 22 interposed.

[0028] Fig. 11 shows a fifth structure 34, of the box-like type and with a substantially square cross section, which consists of four trestles 10 arranged in a quadrilateral, but with the different angular elements 11 and 12 coupled by means of bolts 20, with intermediate plates 22 interposed.

[0029] Fig. 12 shows a sixth structure 35, similar to the fifth structure 34, but where the lower trestle 10 is arranged in a turned over position compared with structure 34.

[0030] Fig. 13 shows a seventh structure 36, similar to the fifth structure 34, but where a trestle 210 with flat metal profiles 211 and 212 is used instead of a trestle 10 with angular elements.

[0031] Fig. 14 shows an eighth structure 37 similar to the third structure 32, but where two pairs of horizontal trestles 10 are used instead of the cross stiffening brackets 29 and where the intermediate plates 22 are arranged between the vertical and horizontal trestles.

[0032] If we examine the structures from 30 to 37 as shown above, it can easily be seen that the design engineers of building constructions can use the trestles 10, 110, 210 to make structural sections of different shapes and sizes, obtaining a numerous series of solutions suitable for the various requirements which occur in structural design.

[0033] Moreover, with the trestles 10, 110, 210, that is, by means of the structures 30 to 37 described above, it is possible to achieve different types of beams, some of which, to give an example, are shown in figs. 15 to 20. We shall now give some examples of said beams.

Example No. 1 - Box beam made partially inside the floor

[0034] With reference to fig. 15, we shall describe a box beam 40, made partially inside the floor using three trestles 10 and a trestle 110, joined together so as to form a structure similar, but not equal to the fifth structure 35 as described above.

[0035] The partial prefabrication of the beam 40 can advantageously occur in the prefabrication workshop by performing the following operations:

- two trestles 10, indicated by 10a and 10b, and a trestle 110, are assembled to form the two flanks

and the lower side of the beam;

- a possible additional metal reinforcement is introduced, consisting of brackets 41, longitudinal bars 42, possibly shaped bars 43 and possibly diagonal flat bracing rods 27;
- the fourth trestle 10d is assembled, which constitutes the upper side, attaching it to the upper stringers 11 by means of bolts 20;
- the flat wall rods 23 (fig. 16) and the bayonet joints 25 are assembled at the ends of the beam 40;
- the lower joints are mutually connected by means of the supporting cross-piece 26;
- the concrete cast 45 is made, to achieve the lower part of the beam 40, taking care that in the end segments hollows 46 must be left in the thickness of the cast 45 in order to allow the installation of the lower connection reinforcements 47, provided to make the structural nodes.

[0036] Once pre-fabricated, the beam 40 is installed on site, by means of the following steps, described with reference to figs. 16 and 17, in which two vertical supporting elements 50 and 51 are shown, made for example with any traditional system:

- the partly pre-fabricated beam 40 is positioned on the vertical supports 50 and 51, after levelling the supporting zones;
- the ends of the beam 40 are attached to the vertical supports by means of vertical blocks 52 passing through the holes made in the supporting cross-pieces 26;
- the segments of reinforcement 47 are inserted in correspondence with the nodes;
- the floors 55 (fig. 15) and the relative reinforcements are positioned;
- the concrete is cast to complete the whole.

Example No. 2 - Perimeter box beam made partially inside the floor

[0037] With reference to fig. 18, we shall describe a perimeter box beam 62, made partially inside the floor, which consists of three trestles 10, respectively 10b, 10c, 10d, and a trestle 210 which makes possible to not go beyond the outer edges 63 of the vertical supports 50 and 51. The four trestles 10b, 10c, 10d and 210, joined together, form a structure equal to the seventh structure 36 described above.

Example No. 3 - Box beam made totally inside the floor

[0038] With reference to fig. 19, we shall describe a box beam made totally inside the floor 65, which consists of four trestles, respectively 10a, 10b, 10c, 10d. The assembly of the four metal trestles is performed in the same way as indicated in example 1. The thickness of the concrete 66, cast in the pre-fabrication site, in this

case is limited to the height of the lower stringers 12 of the trestles 10a and 10b. The assembly on site and the completion on site differ from what was indicated in example n° 1 in that for the provisional support of the floors 55 the wings 12a of the external angular elements of the lower stringers 12 are used, which for this purpose can be chosen on uneven wings, with the wings 12a wider than the others.

[0039] According to a variant, shown in fig. 20, a box beam made totally inside the floor 68, similar to the beam 65, differs from the latter in the arrangement of the lower trestle 10c, which is turned over by 180° with respect to that of the beam 65 in order to allow to achieve a greater thickness of the ironcover of the lower metal reinforcements and hence a greater protection of the reinforcements themselves. This variant, obviously, can be adopted in all applications.

[0040] We shall now illustrate another application of the trestles according to the present invention, which can also be used to make the base reinforcement of supporting pillars.

Example No. 4 - Frame where the pillar reinforcement consists of box trestles

[0041] With reference to figs. 21 to 25, a base reinforcement of a pillar 70 consists for example of a box-like structure similar to the fifth structure 34 (fig. 11), which can possibly be integrated with longitudinal bars and brackets, not shown in the drawings.

[0042] The construction of the pillars 70 of a general plane or floor occurs by means of the following steps:

- the trestles 10 of the box-like structures that make up the base reinforcement of the pillars 70 of the general plane are connected with the similar reinforcement of the pillars 70 below, by using flat rods 23, bayonet joints 25 and bolts 20. Figs. 21 and 22 show the connection of the box trestles of the pillars 70 of the general plane. The joint must be made in a zone outside the nodes. For pillars which protrude from the foundations it is necessary to prepare in the foundations the connecting elements for the trestles of the pillars 70 above;
- the formworks of the pillars are made;
- the concrete is cast to make the pillars as far as elevation 90 (fig. 22) where the beams above are disposed.

[0043] The construction of the horizontal beams above the pillars 70 of the general plane occurs by means of the following steps:

- the partly prefabricated beams 40 that make up the truss are installed, after supporting elements 91 (semi-joints) have been inserted into the lower stringers 12 of each beam of the truss (figs. 24 and 25);

- the additional reinforcements 47 of the beams 40 are installed in correspondence with the nodes of the frame;
- the upper stringers 11 of the consecutive beams located on the same truss are connected by means of the bayonet joints 25;
- the floor elements are installed;
- the concrete is cast to complete the whole.

Another use of the trestles 10, 110, 210 according to the present invention is to make metal structures. This allows to obtain a very versatile new construction system, which allows the construction of trestled structures of various shapes and sizes, by assembling two or more trestles 10, 110 and/or 210 by means of the connection elements described above.

In the following examples some possible applications are indicated, given as an indication only: from them it is clear that the design engineers and constructors who use the present invention can achieve a numerous series of structural solutions suitable for various requirements that arise in the construction industry.

Example No. 5 - Coupled beam

[0044] With reference to figs. 26 to 31, as in the first structure 30 (fig. 7), by using two trestles 10 only we obtain a coupled beam 80. To be more exact, figs. 26, 27, 28 and 29 show a coupled beam 80, with the wall rods 16 phased, in the front view (fig. 27), transverse (fig. 28) and from above (fig. 29). Fig. 26 shows the same beam 80 during its attachment to external constraints 81.

[0045] Figs. 30 and 31 show a coupled beam 82 with the wall rods 16 counterphased. This solution offers the advantage that, for the frequent case of normal loads to the axis of the beam 82, any cross section of the beam intersects a wall rod 16; this circumstance contributes to improve the local stability of equilibrium. For this case the holes, needed to couple the trestles 10, must be staggered by about 90° with respect to the position shown for cases previously seen.

Example No. 6 - Coupled beam with cross stiffening bracket

[0046] With reference to figs. 32, 33 and 34, by using two trestles 10 and cross stiffening brackets 29 we obtain the coupled beam 85.

[0047] In addition to the uses set forth above, with the trestles 10, 110, 210 according to the present invention and using for example box trestle elements like those described above, it is possible to construct frames with many bays and floors, operating in a similar way to that indicated in example 4 concerning reinforced concrete frames. For this type of use (steel trestled frames) substantially the same methods of execution are used as

indicated in example 4, with the variant that the lower stringers 12 too of consecutive beams can be connected with bayonet joints since the connection zones are free because, obviously, no concrete casts are provided.

[0048] We shall now give, purely as an example, some performance characteristics of some structural sections obtained using the trestles 10, 110, 210 according to the present invention.

Reinforced concrete beam, partly pre-fabricated

[0049] With reference to fig. 15, the static behavior is analyzed of a horizontal beam deriving from a beam 40 defined by the following data;

Geometric parameters

[0050]

B = 70 cm;
b = 60 cm;
H = 30 cm;
h = 25 cm;
a = 10 cm;
i = 48 cm;
stringers 11 and 12: 50 mm x 50 mm x 5 mm;
wall rods 16: d = 12 mm - pitch 20 cm;
additional longitudinal reinforcement 47: d = 24 mm;
additional brackets 41: d = 8 mm - pitch 20 cm;
shaped transverse reinforcement: d = 8 mm - pitch 20 cm;
bolts 20: M10.

Materials

[0051]

Hot rolled steel, for base reinforcement, type Fe 510;
Steel for additional reinforcement type FeB 44K
Welding with corner beads - II class;
Bolts class 8.8.

Concrete class Rck 35

Performance characteristics of the partly pre-fabricated section

[0052]

- Bending moment resistant to last limit state: $M = 135.5 \text{ KNm}$;
- Shearing stress resistant to the last limit state: $T = 50.3 \text{ KN}$

Performance characteristics of the complete installed section

[0053]

- Bending moment resistant to last limit state: $M = 211.8 \text{ KNm}$;
- Shearing stress resistant to the last limit state: $T = 253.7 \text{ KN}$;

Coupled beam

[0054] With reference to figs. 27, 28 and 29, the static behavior is analyzed of a horizontal beam deriving from a coupled beam 80 defined by the following data:

Geometric parameters

[0055]

$B = 17 \text{ cm}$;
 $H = 25 \text{ cm}$;
 stringers 11 and 12: $50 \text{ mm} \times 75 \text{ mm} \times 6 \text{ mm}$;
 wall rods 16: $d = 12 \text{ mm}$ - pitch 20 cm .

Materials

[0056]

Hot rolled steel for base reinforcement, type Fe 510;
 Welding with corner beads - II class;
 Bolts class 8.8.

Performance characteristics of the section

[0057]

- Bending moment resistant to last limit state: $M = 105.5 \text{ KNm}$;
- Shearing stress resistant to the last limit state: $T = 50.3 \text{ KN}$.

[0058] It is clear that modifications and/or additions of parts may be made to the metal trestles 10, 110, 210 as described heretofore, without departing from the field and scope of the present invention.

[0059] It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of metal trestles for building constructions, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Metal trestle for building constructions, consisting

of a first stringer (11, 211), a second stringer (12, 212) and at least a central connection element (16) disposed between said stringers, **characterized in that** each of said stringers (11, 211; 12, 212) substantially consists of a metal profiled element which has at least a plane surface, and **in that** the plane surfaces of said two stringers are co-planar.

2. Metal trestle as in claim 1, **characterized in that** said metal profiled elements are angular (11, 12) or flat (211, 212).

3. Metal trestle as in claim 1 or 2, **characterized in that** said connection element (16) comprises a metal round piece having a substantially zigzag development and welded to the plane and co-planar surfaces of said metal profiled elements (11, 211; 12, 212) in correspondence with its variations in direction.

4. Metal trestle as in any claim hereinbefore, **characterized in that** said metal profiled elements (11, 211; 12, 212) are provided with through holes (13, 15).

5. Metal structure for building constructions, **characterized in that** it comprises at least two trestles (10, 110, 210) according to any one of the preceding claims, joined together by means of attachment means (20, 21), possibly of the removable type.

6. Metal structure as in claim 5, **characterized in that** two of said trestles (10, 11, 210) are disposed parallel to each other and coupled so as to form a coupled beam (30).

7. Metal structure as in claim 5, **characterized in that** two of said trestles (10, 11, 210) are disposed parallel to each other and coupled so as to form a first coupled beam with cross stiffening brackets (31).

8. Metal structure as in claim 5, **characterized in that** three of said trestles (10, 11, 210) are disposed parallel to each other and coupled so as to form a second beam with cross stiffening brackets (32).

9. Metal structure as in claim 5, **characterized in that** four of said trestles (10, 110, 210) are disposed in a quadrilateral and coupled so as to form a beam or a pillar of the box-like type with a substantially rectangular cross section (32, 33, 34, 35, 70).

10. Metal structure as in claim 5, **characterized in that** seven of said trestles (10, 110, 210) are disposed so as to form a multi-cell beam, with an H-type cross section (37).

11. Method to achieve building constructions, **charac-**

terized in that it includes the use of at least one of the trestles according to any claim from 1 to 4.

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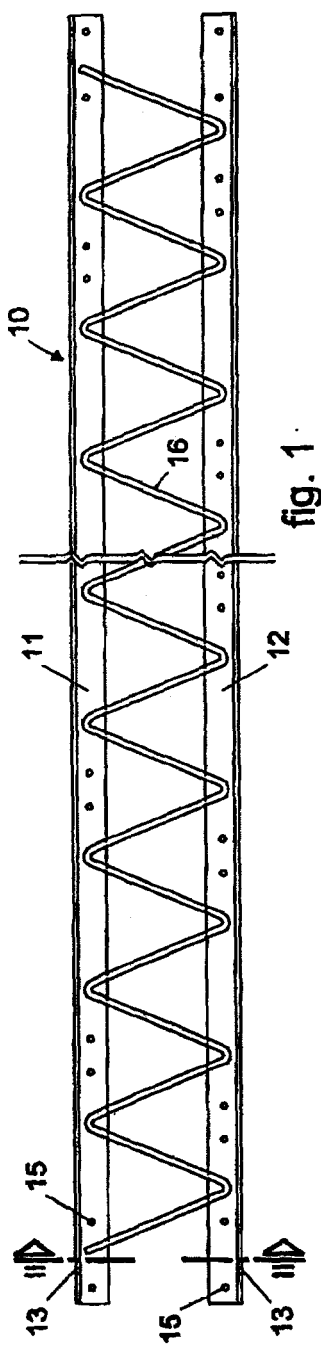


fig. 1

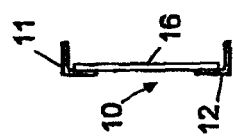


fig. 2

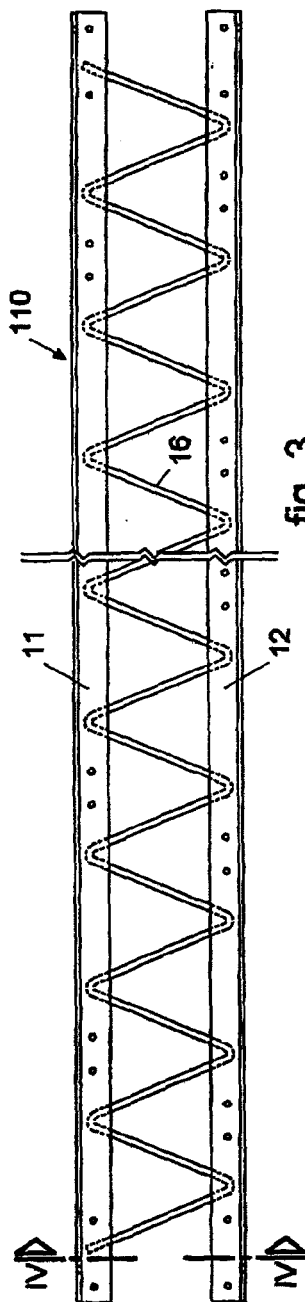


fig. 3

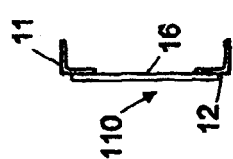


fig. 4

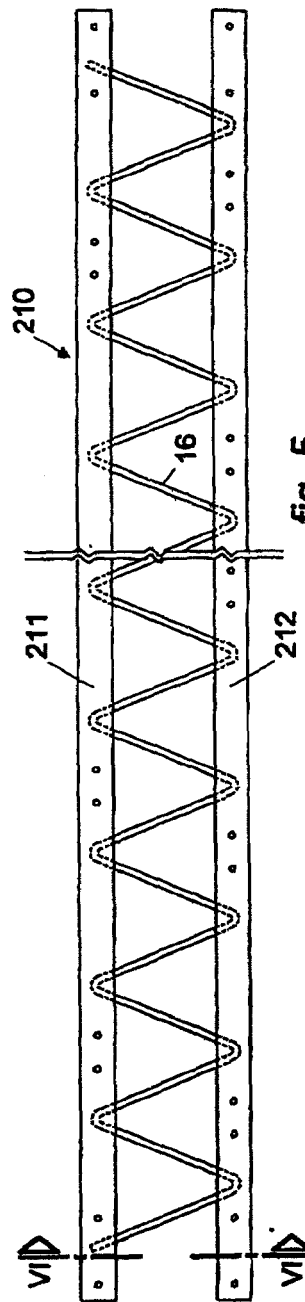


fig. 5

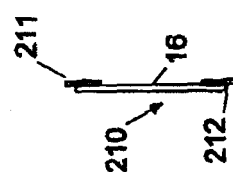


fig. 6

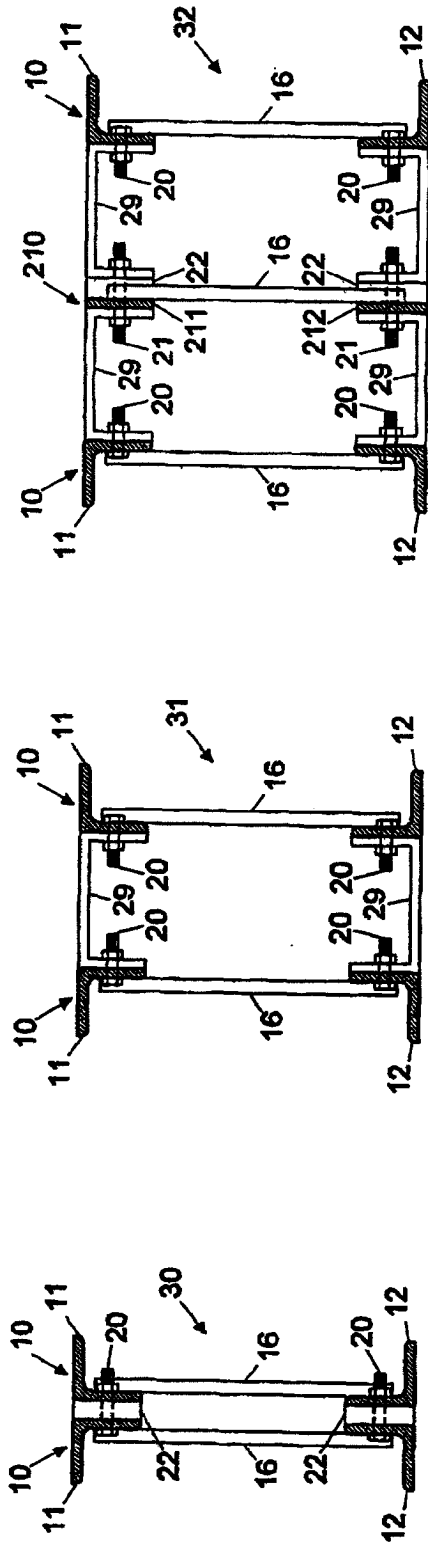


fig. 7

fig. 8

fig. 9

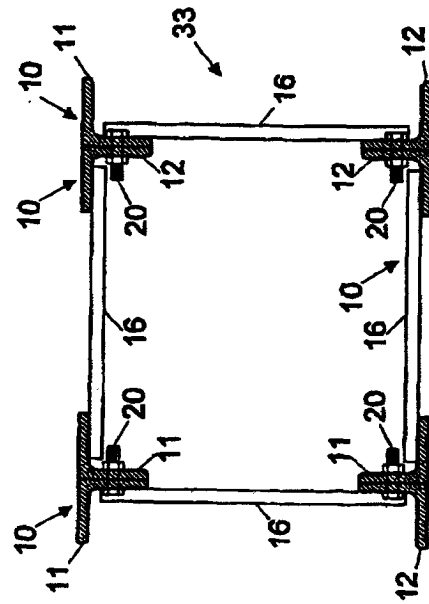


fig. 10

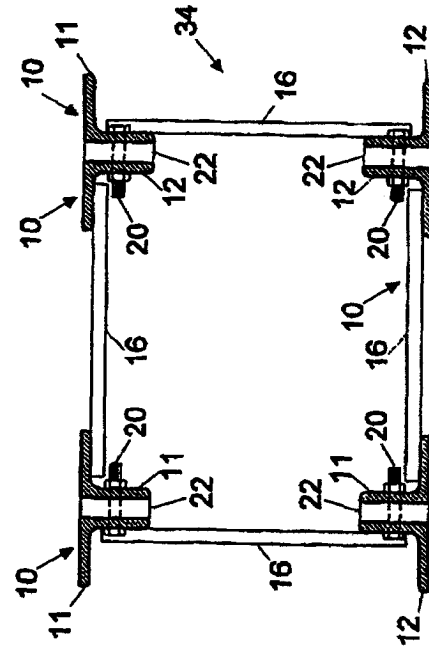


fig. 11

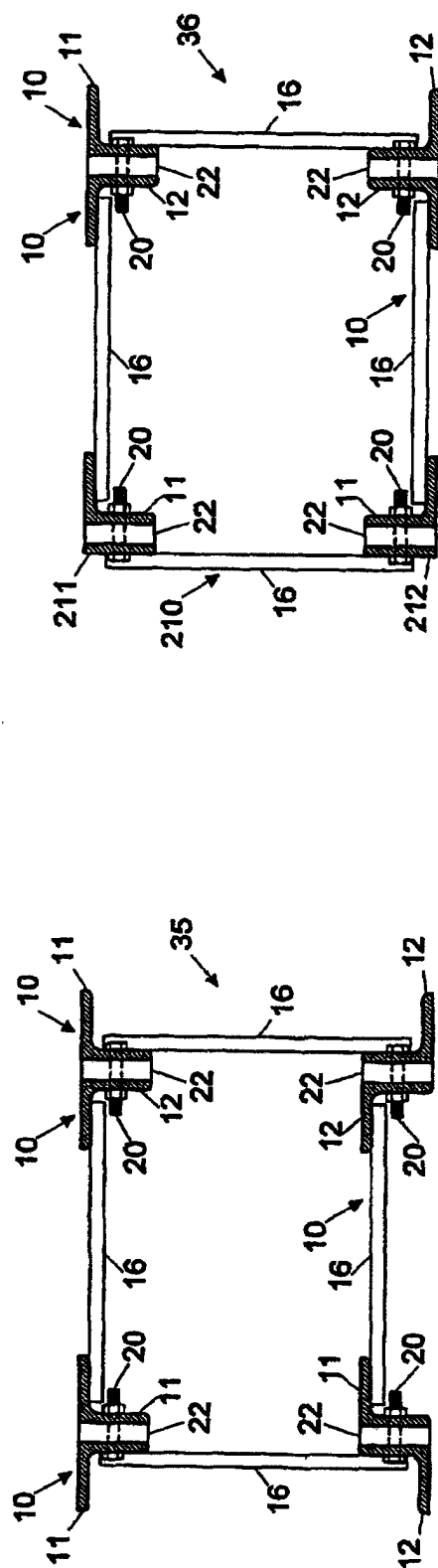


fig. 12

fig. 13

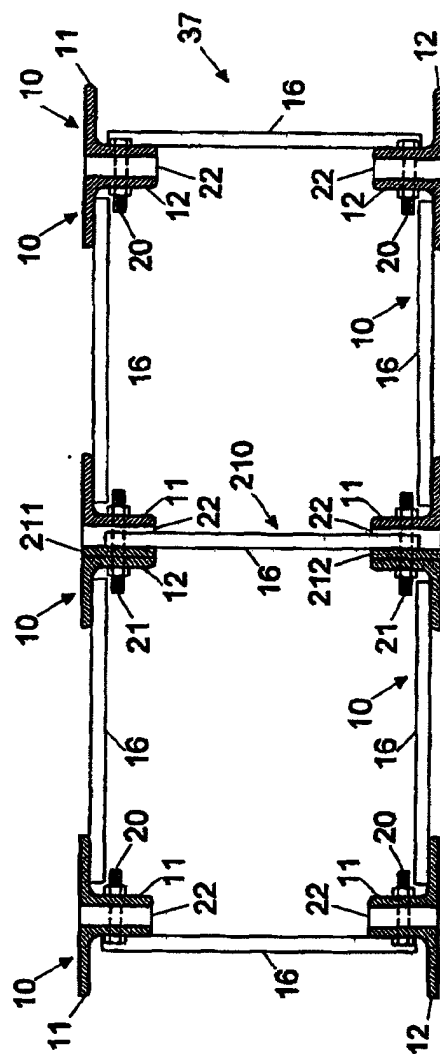


fig. 14

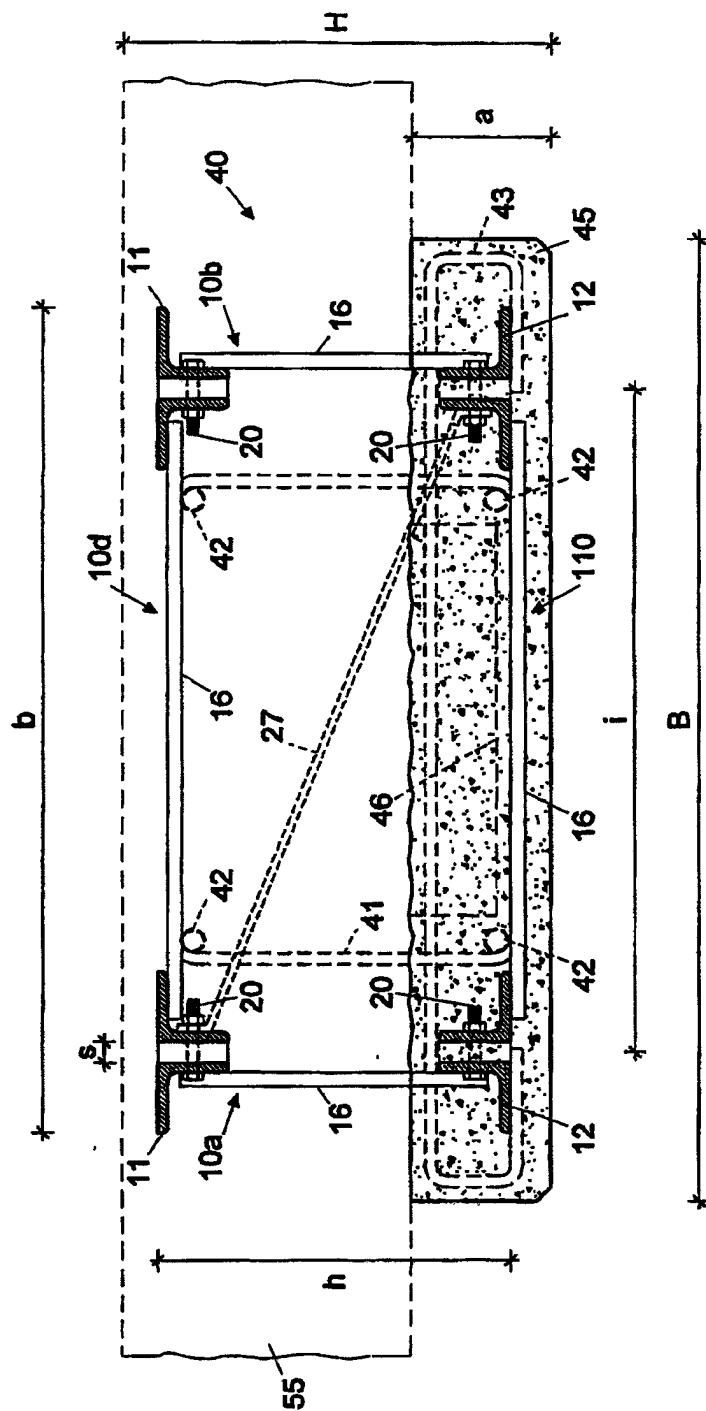


fig. 15

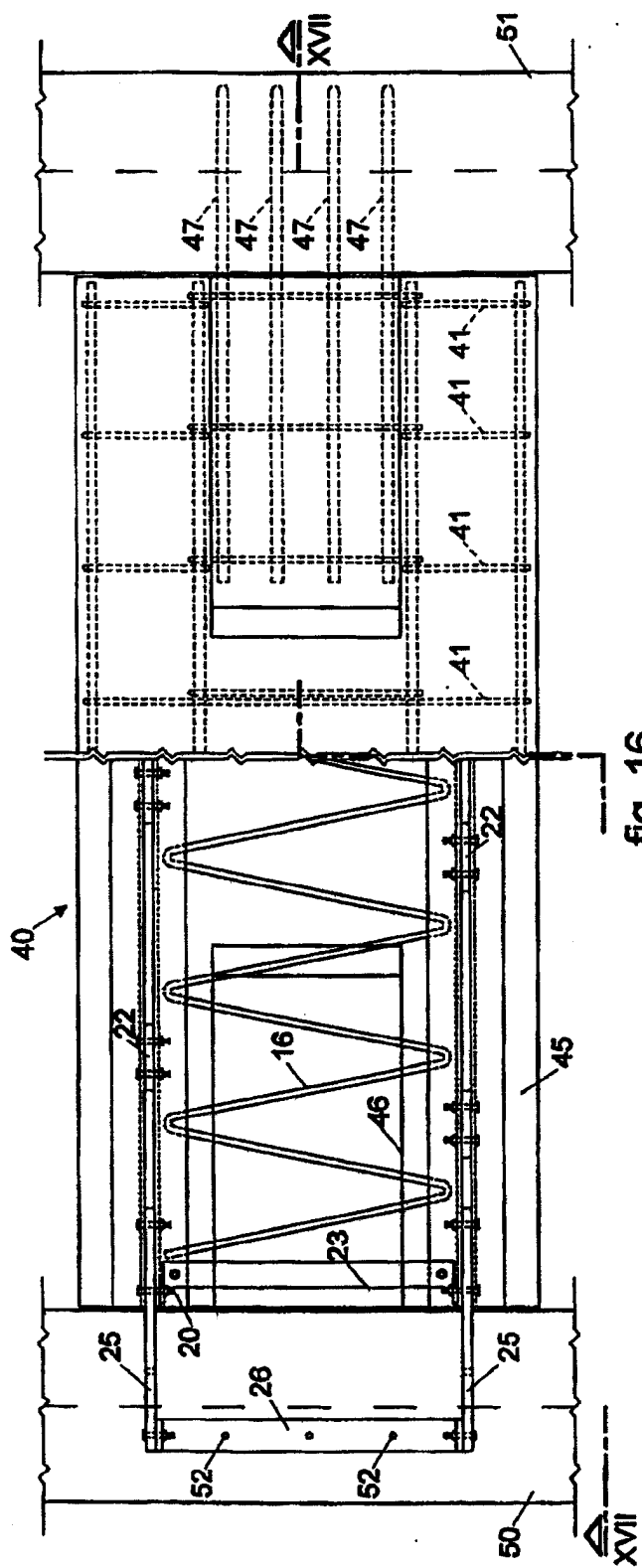


fig. 16

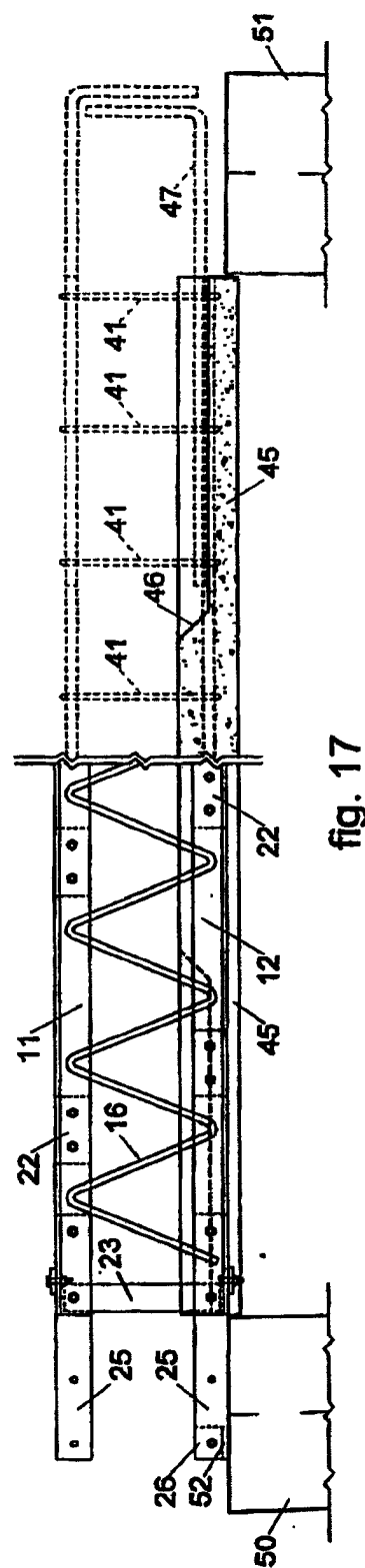


fig. 17

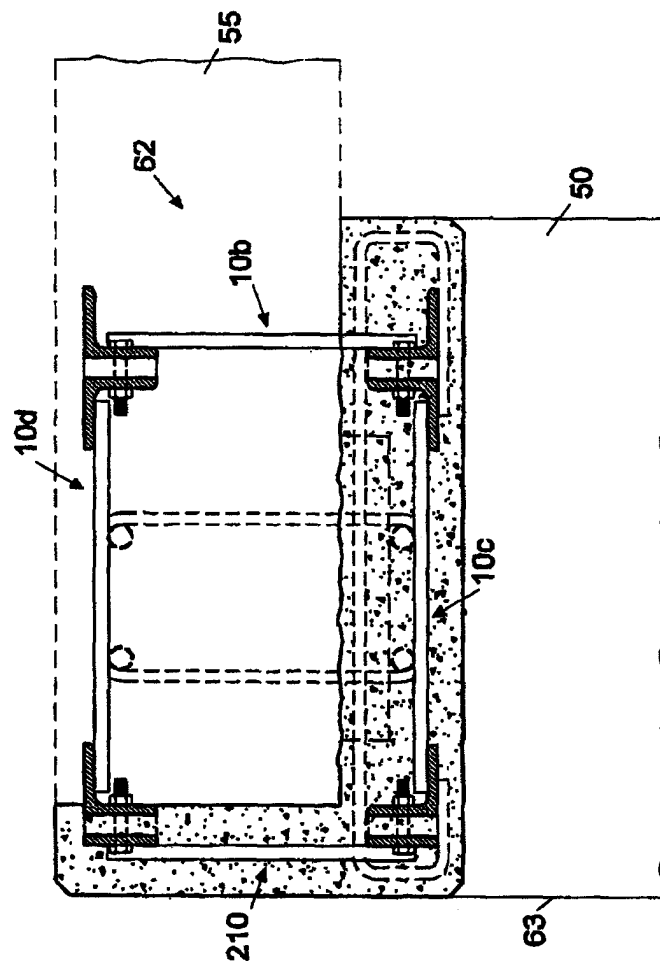


fig. 18

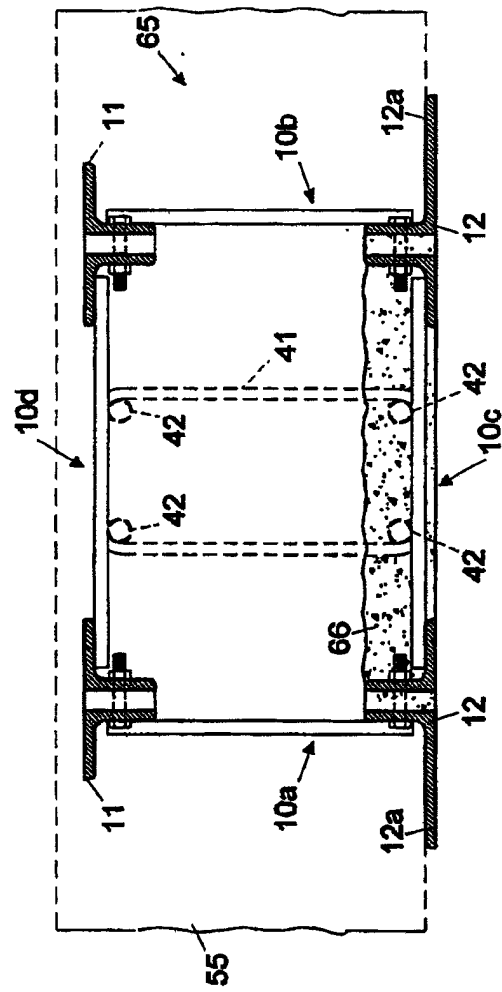


fig. 19

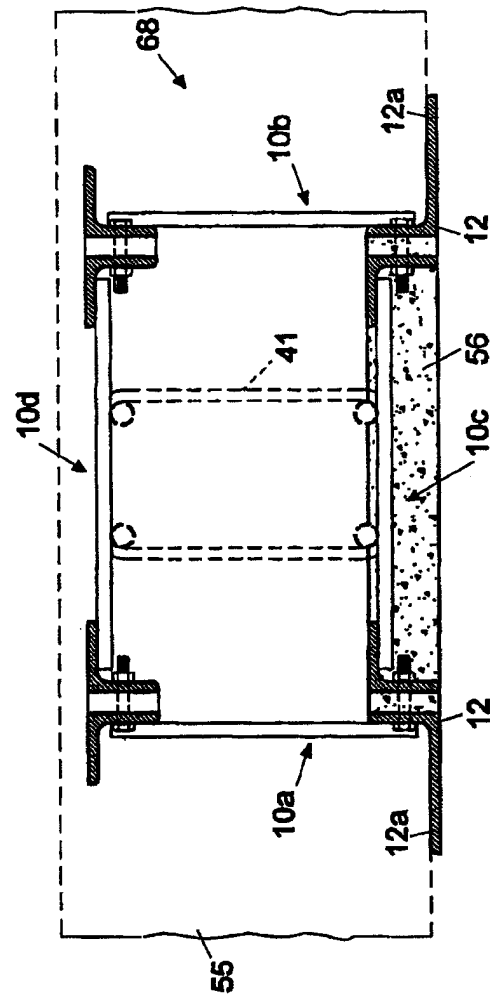
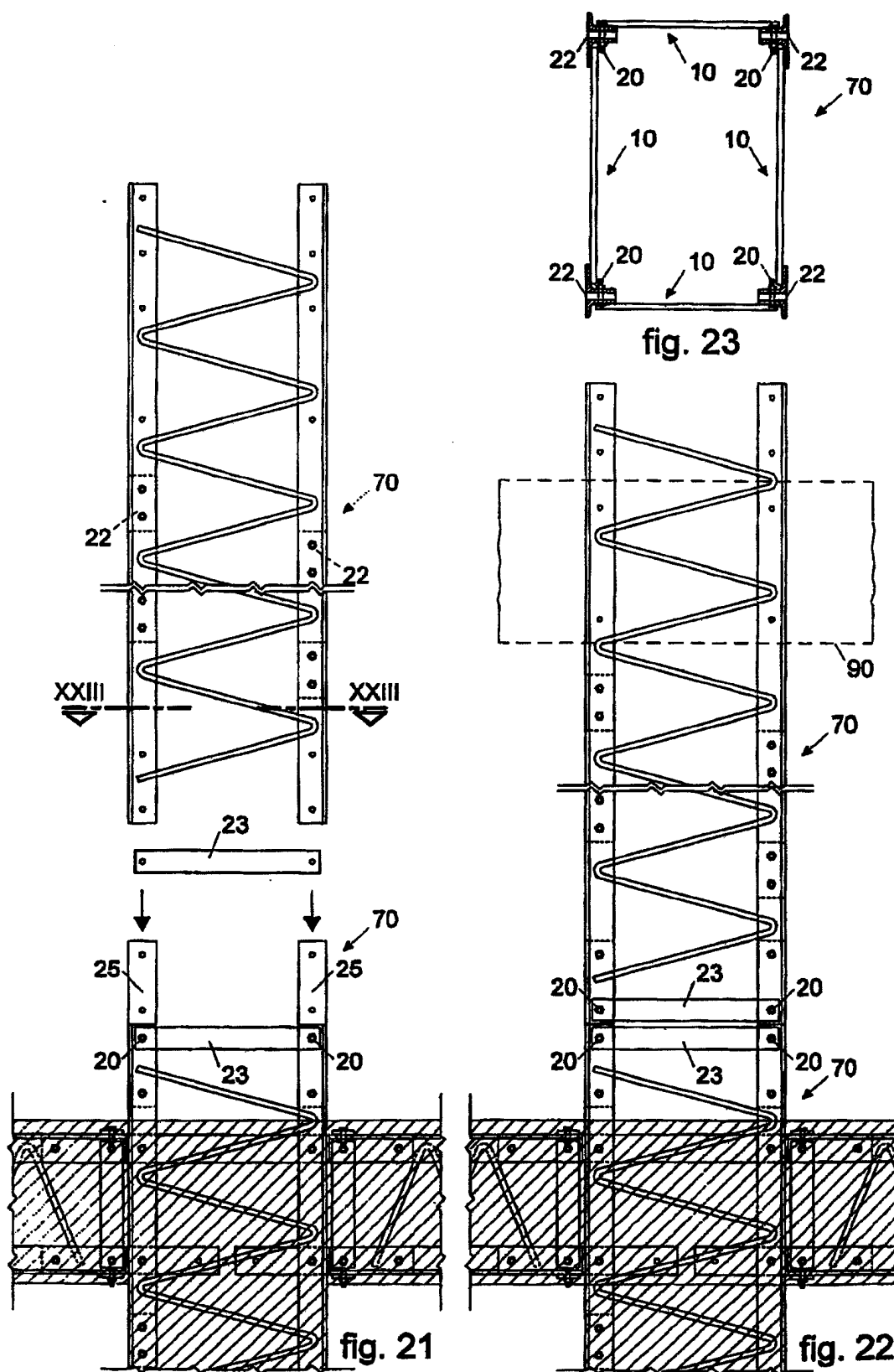
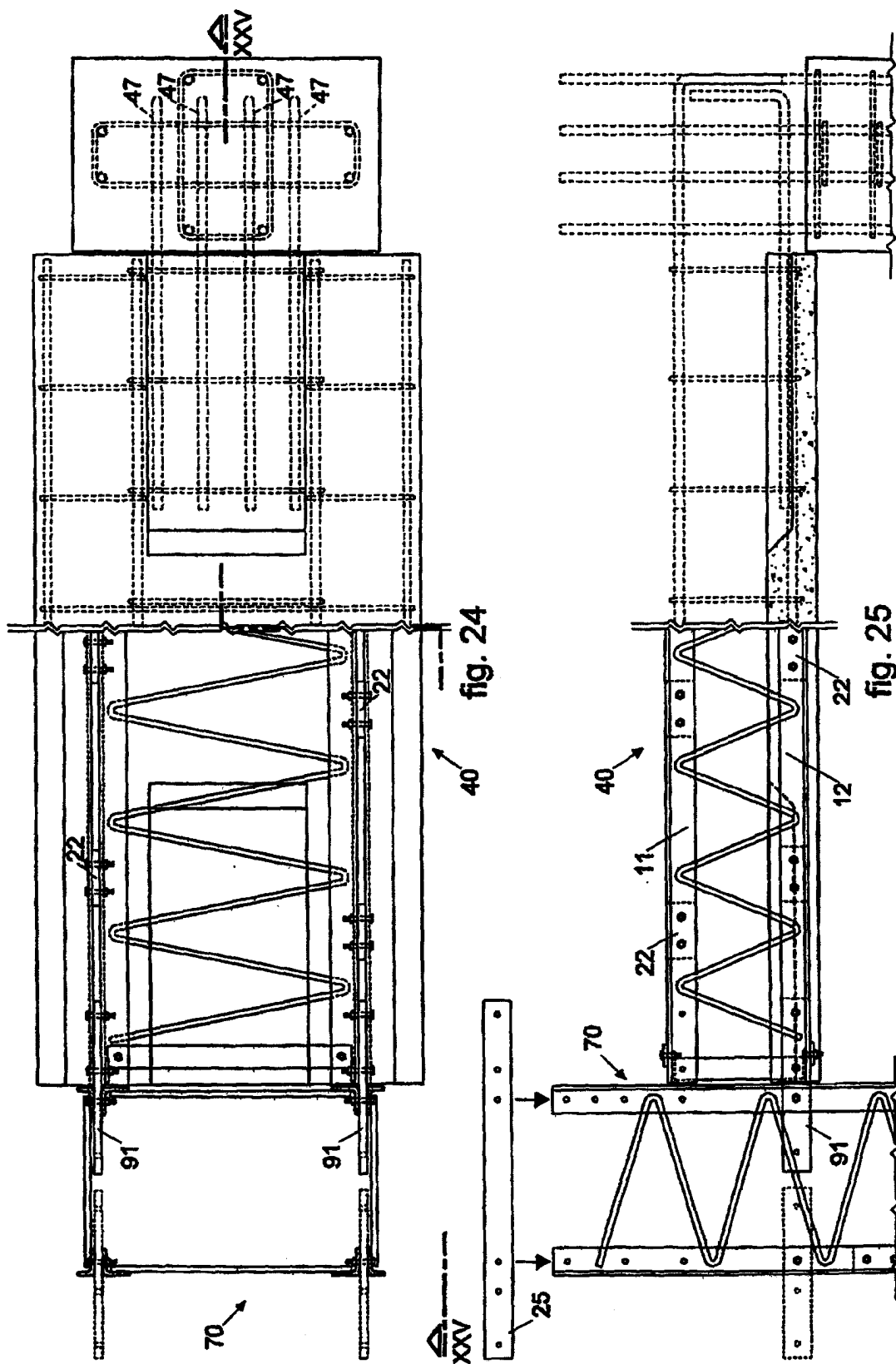
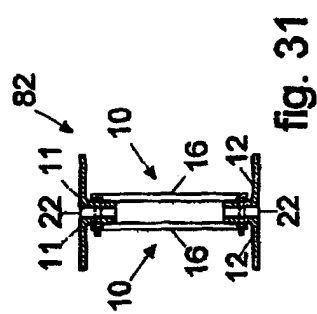
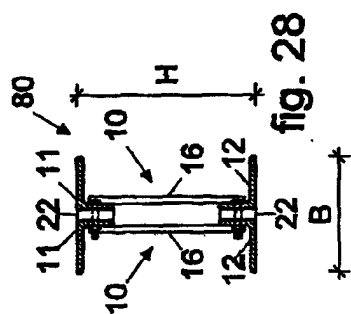
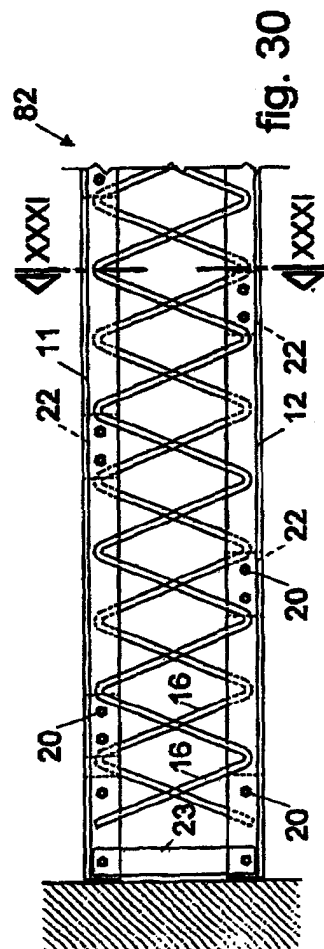
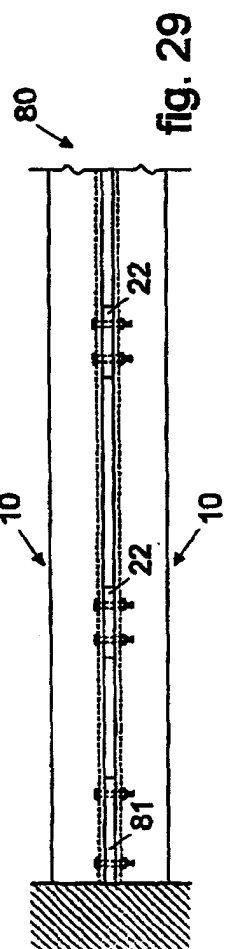
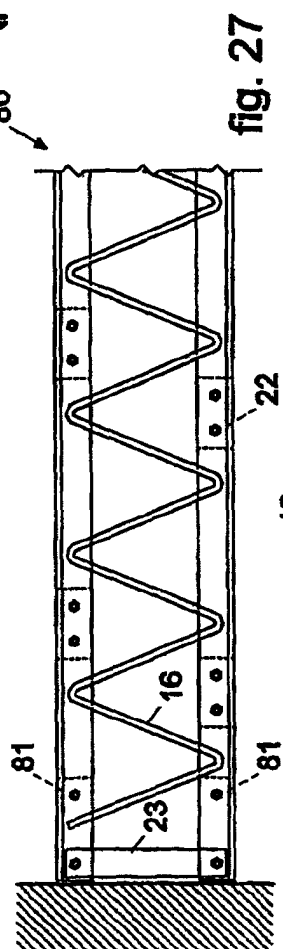
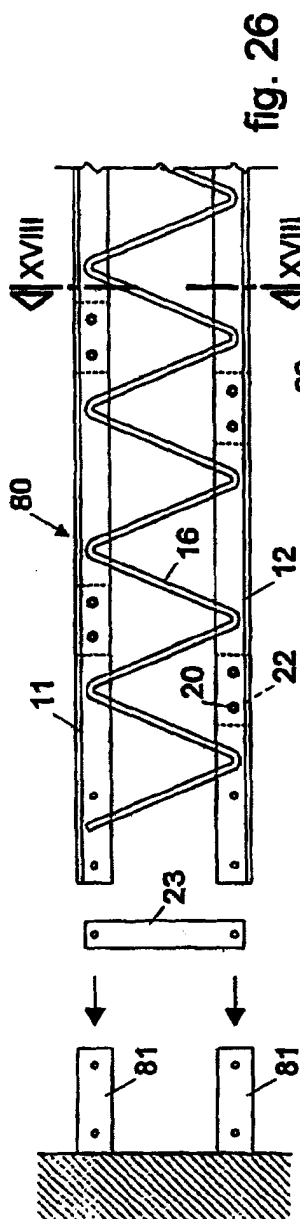


fig. 20







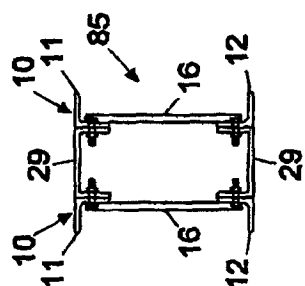


fig. 33

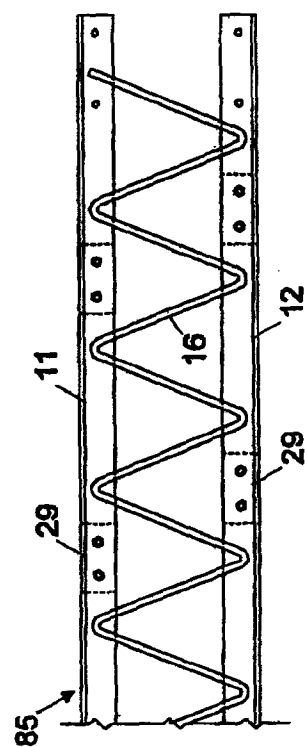


fig. 32

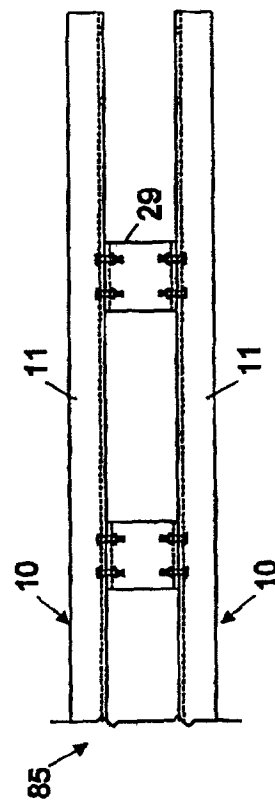


fig. 34



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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 June 2005	Examiner Hendrickx, X
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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