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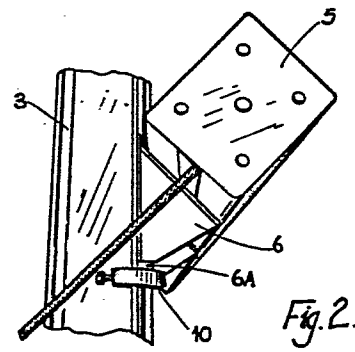
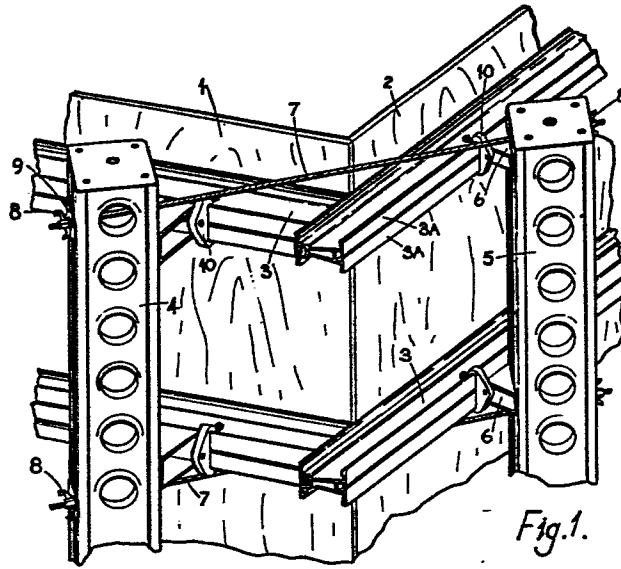
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(54) Formwork support system.

(57) A force restraint system includes a transversely flanged beam (3), a restraint device (10) for mounting on the beam by embracing a flange (3A) of the beam transversely thereof and locking at a desired location thereon. An element (6A) engages the restraint device (10) at a predetermined location thereon such that the application of force via said element to the device at that location causes tilting and jamming of the device on the beam, thereby increasing the reactive effect of the device to movement longitudinally of the beam.

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FORCE RESTRAINT SYSTEM.

This invention relates to a force restraint system which includes a restraint device mounted on a support to provide an abutment for forces applied generally
5 longitudinally of the support. The restraint system of the invention is primarily, although not exclusively, for use in formwork support systems for the casting of concrete structures, such as soffits and walls.

There is an increasing tendency in modern formwork
10 support systems to use transversely flanged beams, usually of generally 'T' or 'I' section and often in the form of aluminium extrusions, for supporting horizontal and vertical formwork panels. It is frequently necessary, when such beams are used, for
15 example, as horizontal walings for vertical formwork panels, to provide abutments thereon against which to react forces arising during a casting operation, such forces being principally the bursting forces on the formwork generated by the poured concrete. The
20 provision of reliable abutments on beams of the aforesaid kind is difficult often representing a complicated and time consuming part of assembling the system and an object of the invention is to provide an improved force restraint system which simplifies such
25 assembly operations whilst providing a very effective means of locking an abutment on a flanged beam.

According to the present invention, a force restraint system comprises a transversely flanged beam, a
30 restraint device for mounting on the beam, said device being such as to embrace a flange of the beam transversely thereof, means for locking the device at a desired position on the beam, and means engagable with the device at a predetermined location thereon such that

the application of force via said means to the device at such location, in use, increases the reactive effect thereof to movement longitudinally of the beam.

Typically, the restraint device is a clamp adapted to
5 be clamped on the flange embraced thereby, said location being spaced from the flange whereby application of force to the clamp at said location causes tilting and consequent jamming of the clamp thereby to increase said reactive effect to its
10 movement longitudinally of the beam.

The bursting forces generated by poured concrete can be very significant, particularly when the cast structure is of considerable height and thickness. At corner locations, it is necessary to retain mutually angled
15 formwork elements firmly in abutment with each other in order to define the required configuration of structure to be cast and problems can arise due to the formwork elements being forced apart, to a greater or lesser extent, by the concrete pressure and causing unsightly
20 fins on the cast concrete surface. In certain exposed locations in modern buildings, this can be unacceptable, and the force restraint system of the invention can be employed in a formwork support system in a manner which alleviates the aforesaid problem.

25 In one convenient arrangement, a plurality of said beams are arranged to support a plurality of uprights which support abutting formwork elements in mutually angled relationship disposed in a formwork support system to define an external surface of a corner
30 structure to be cast, said system including force transmission means interconnecting a pair of said uprights associated respectively with said formwork elements, the restraint devices being arranged to provide a reaction against forces transmitted between

said uprights through the force transmission means in such a manner that the application of said forces to the devices increases the reactive effect provided thereby to movement along the beams.

5 The invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is an elevation of part of one form of a formwork support system incorporating the force restraint system of the invention and being for use in
10 forming an outer corner of a concrete structure;

Figure 2 is a detail in plan view of the system of Figure 1;

Figure 3 shows an alternative formwork support system for use in casting an inner corner of a concrete
15 structure;

Figure 4 is another alternative form of formwork support system for use in defining an end of a straight wall to be cast;

Figure 5 is a perspective view of a clamp forming part
20 of the force restraint system of the invention.

Figure 6 is an elevation of part of a further alternative form of formwork support system;

Figure 7 illustrates the force restraint system of the invention in the form of a lifting device, and

25 Figure 8 illustrates the section of a typical form of beam of the restraint system of the invention.

Referring to Figures 1 and 2 of the drawings, the formwork support system therein depicted is arranged to support a pair of abutting formwork elements 1 and 2 disposed in perpendicular relationship to form an outer corner of a concrete structure, such as a wall, to be cast. The formwork elements are supported by horizontal walings shown as transversely flanged beams 3, which may conveniently be of the kind illustrated in Figure 8.

As will be seen from Figure 8, the beam 3 has a channel-shaped first formation 30 having side walls 30a and 30b and a base 30c, each of the side walls being provided along their upper edges with outwardly extending flanges 31. The outer extreme portion 32 of each flange 31 extends out of the plane of its associated flange and is provided with upper and lower mutually parallel oblique faces 31a, 31b. each 31b interconnecting portions 31c and 31d of the undersurface of each flange 31 which are parallel to the upper surfaces 31e of the flanges. The interior of the channel formation is fitted with a joist 32 of timber or the like which would normally extend along substantially the whole length of the beam and provide an additional supporting surface for formwork.

The beam 3 also includes a second formation 33 which has a pair of spaced parallel walls 33a having a pair of opposed inwardly extending flanges 34 of which the free edges are mutually spaced, the formation 33 thereby forming effectively a T-slot which receives between the walls 33a the head of a bolt (not shown) of which the shank extends through the slot formed by the flanges 34 for fixing to a support. The formation 33 also has a pair of outwardly extending flanges 36, the

upwardly facing surfaces of which have oblique and planar surfaces, designated respectively 36b and 36c, corresponding to the surfaces 31b and 31c of the flanges 31 and lying respectively opposite to these latter.

The formations 30 and 33 are interconnected by a pair of webs 40 which extend from the upper extremities of the walls 33a to spaced points on the base 41 of the channel formation 30, the webs 40 converging in a direction towards the formation 30. It will be seen that the webs, together with that portion of the base 41 between the webs 40 and the upper wall 42 of the formation 33 constitute a closed box-like structure and it has been found that by inclining the webs in the manner described, a substantial increase in the rigidity of the beam is obtained, as compared with some conventional beams. Thus, the beam is found to have a considerably enhanced lateral stability and the load carrying capacity of the beam through the webs is also increased.

The waling beams 3 are held in position by vertical soldiers disposed at intervals along the length of each formwork element and the two soldiers nearest to the junction of the formwork elements are illustrated respectively at 4 and 5. Each soldier abuts the adjacent walings by way of respective abutment members 6, each of which is in the form of a right-angled triangle of which one side is secured to the soldier and another side to the adjacent waling, as by bolts for example. Tie members 7 extend between the adjacent soldiers 4 and 5 and are provided with nuts 8 which can be used to apply a tension force to the tie rod by reacting against plates 9 on the soldiers.

It will be seen that a component of the tie rod force acts at right-angles to the adjacent formwork element to resist outward pressure imposed upon the element by concrete poured thereagainst, whilst the other

5 component of the tie rod force acts in a direction along the waling beams 3 and must be firmly reacted in order to maintain the soldiers in their upright positions. For this purpose, the walings are provided with restraint devices or clamping abutment 10 in the

10 form of releasable clamps which may be engaged around oppositely directed flanges 3A of the waling beams and clamped firmly to the beams at positions in which they are in abutment with the abutment members 6. The clamps will be described in greater detail hereinafter.

15 As will be seen more clearly from Figure 2, each abutment member 6 is provided with a projection 6A extending into abutment with the adjacent clamping abutment 10 and this is the only part of the member 6 which actually abuts the clamping abutment. The

20 projection 6A is spaced outwardly of the flanges 3A so that forces applied therethrough to the clamping abutment 10 are offset from the clamping location, the effect of which is to apply a tilting couple to the clamping abutment 10, causing the latter to jam in

25 position on the waling beam 3. The greater the force applied to the ties 7 from the poured concrete, the greater will be the jamming force resisting movement of the abutment 10 along the waling beam 3. It has been found that very considerable

30 restraint forces can be applied in this manner by the ties 7 to the formwork elements 1 and 2, such that the tendency of the formwork elements to part at the junction therebetween is minimised or avoided entirely for normal casting pressures.

Figure 3 illustrates an alternative formwork support system incorporating the force restraint system of the invention and designed to support formwork elements 1 and 2 by way of additional corner panels 1A, 2A arranged to form an internal corner. Waling beams 3 are provided, as before, and a main support 11 of generally triangular cross-section is located at the formwork corner with the elements 1A and 2A engaging respective sides 11A and 11B of the support 11 and secured firmly thereto, as by bolts or screws. In this arrangement, the ties 7 are replaced by force transmission devices 12, in this case identical with the supports 11 and connected to the latter, and thus to the panels 1A and 2A by bolts 13. These devices 12 abut clamping devices 10 at either side thereof by way of flanges 14 which are arranged to engage the clamping abutments 10 at locations spaced from the flanges 3A to which the clamping abutments are attached, so that a couple is produced tending to tilt and jam the clamping abutments on the waling beams as a result of pressure imposed by the poured concrete at the opposite side of the formwork elements 1 and 2. It would be possible to provide such an arrangement for each pair of waling beams 3, although it may be found sufficient in practice to omit this for some beams and use it, for example, for alternative pairs of beams. The other beams may be simply connected to the member 14 by means of standard clips 15 bolted to the waling beams and embracing the free edges of the member 14.

It will be understood that for any given corner defined by the formwork elements 1 and 2, these elements will be arranged in pairs of inner and outer elements in order to define a channel therebetween into which concrete will be poured. It will consequently be

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normally necessary to employ the arrangement of Figure 1 on the outer surfaces of the outer pair of elements 1 and 2 and the arrangement of Figure 3 on the inner surfaces of the inner pair of elements.

5 The arrangement illustrated in Figure 4 is used to define the free end of a wall or block 16 for which it is necessary to define two external corners, this entailing the use of spaced parallel formwork elements 1 and 2, as before, with the addition of an end element
10 100 at right-angles to and abutting both of the elements 1 and 2. In this arrangement, horizontal waling beams 3 are arranged against the formwork elements 1 and 2 and themselves supported at intervals by vertical soldiers (not shown). The end formwork
15 element 100 is supported by vertical supports, two of which are illustrated at 17 as timber beams and one of which is illustrated at 18 as a profiled metal beam similar to the waling beams 3. It would, of course, be possible to employ beams of all one type or a
20 combination of such beams, as desired. In this arrangement, the bursting pressure of the poured concrete 16 is resisted by ties 7 which pass through horizontal channel-shaped beams 19 laid across the beams 17 and 18 and secured to clamping abutments 10,
25 of which only one is illustrated. Tension may be applied to the ties 7, as before, by means of nuts 8 which in this case abut the outer surface of the horizontal beams 19 and further nuts or similar abutments are attached to the ties 7 at the sides of
30 the clamping abutments 10 remote from the nuts 8 so that tightening of the nuts 8 will apply a force through the ties 7 to the clamping abutments 10 causing tilting and jamming of the latter as the force increases, as described above.

Figure 5 illustrates a preferred form of the clamping abutment 10 which is generally C-shaped having a curved main body portion 20 terminating in opposed parallel arms 21 and 22. Each arm is provided with a threaded aperture 23 to receive a clamping bolt (not shown) and further apertures 27 are provided through the body portion 20. The body portion 20 is provided with a through hole 24 extending at right angles to the holes 23 and being of a diameter such as to readily receive therethrough a standard tie element such as the tie 7.

The inner surface of the body 20 and the opposed surfaces 21a, 22a of the arms 21 and 22 may be machined to a curved configuration to provide relatively sharp edges 25 and 26 which assist in providing the jamming action described above, when used in the context of the present invention. Additionally, said surfaces 21a, 22a of the arms may be serrated, as shown in the drawing, or roughened by the provision thereon of pointed formations, for example.

The formwork system illustrated in Figure 6 is used to define an end or side of a wall or soffit 50 and includes a base formwork panel 51 together with an end shutter 52 arranged at right angles to the base, the system including a supporting beam 53 which may conveniently be an aluminium beam of the type illustrated in Figure 8. The end shutter is supported by a triangular frame consisting of vertical and horizontal struts 54 and 55, braced by a raking strut 56, all the struts being conveniently of timber. In order to react the bursting force of the poured concrete acting on the panel 52, the supporting frame abuts against a restraint device in the form of a clamp 10, conveniently of the kind shown in Figure 5, embracing the upper flange of the beam 53 and locked in

position on the beam by means such as bolts, one of which is shown at 57, passing through the holes 23 provided in the arms 21, 22 of the clamp. Abutment between the frame and clamp is localised at a position
5 spaced from the beam, which may conveniently be adjacent to the hole 24 of the clamp, so that the bursting force of the concrete applied through the frame to the clamp causes tilting of the latter and a
10 corresponding increase in the resistance of the clamp to movement along the beam.

In Figure 7, the restraint device of the invention is shown applied to a lifting device which comprises a beam 3, conveniently of the kind shown in Figure 8 of the kind shown in Figure 5, clamped around the flanges
15 31 and 36 thereof. Two pairs of clamps are illustrated in the present embodiment, although the number of clamps for each pair of flanges may be varied as desired, depending upon the load to be supported by the lifting device. A generally inverted U-shaped support
20 device 50 is engaged through the holes 24 of the clamps and secured by nuts 51 secured onto threaded free end portions 52 of the support device. A suspension device 53 is engaged with the support device 50 and can be lifted by a crane or similar means.

25 As illustrated the lifting device is arranged to lift a formwork shutter 54 of which a batten 55 is illustrated secured to a timber insert 32 within the channel formation 30 of the beam 3 (Figure 8). When the assembly is lifted by the suspension device 53, force
30 will be applied through the device 5 to the clamps 10 at locations spaced from the beam 3, the effect of which is to apply a tilting couple to the clamps causing them to jam on the beam and thereby provide

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increased resistance to slipping of the clamps along the beam, such resistance increasing in accordance with the load to be lifted. Instead of being secured to the timber insert as described, the shutter may be secured to the beam by standard clamps.

CLAIMS.

1. A force restraint system characterised by a transversely flanged beam (3), a restraint device (10) for mounting on the beam, said device being such as to embrace a flange (3A) of the beam transversely thereof, means for locking the device at a desired position on the beam, and means (6A) engagable with the device at a predetermined location thereon such that the application of force via said means to the device at such location, in use, increases the reactive effect thereof to movement longitudinally of the beam.

2. A system according to Claim 1 characterised in that the restraint device (10) is a clamp adapted to be clamped on the flange (3A) embraced thereby, said location being spaced from the flange whereby application of force to the clamp at said location causes tilting and consequent jamming of the clamp thereby to increase said reactive effect to its movement longitudinally of the beam.

3. A system according to Claim 1 or Claim 2 characterised in that the beam (3) is of substantially 'I' or 'T' cross-section.

4. A system according to any one of Claims 1 to 3 characterised in that a plurality of said beams (3) are arranged to support a plurality of uprights (4, 5) which support abutting formwork elements (1, 2) in mutually angled relationship disposed in a formwork support system to define an external surface of a corner structure to be cast, said system including force transmission means (7) interconnecting a pair of said uprights (4, 5) associated respectively with said formwork elements (1, 2), the restraint devices (10)

being arranged to provide a reaction against forces transmitted between said uprights through the force transmission means in such a manner that the application of said forces to the devices increases the reactive effect provided thereby to movement along the beams.

5 5. A system according to Claim 4 characterised in that the force transmission means (7) are ties extending between said uprights (4, 5).

10 6. A system according to Claim 4 or Claim 5 characterised in that said means engagable with the device (10) are respective intermediate members (6) each interposed between and engaging a restraint device (10) and the adjacent upright (4, 5), the restraint devices (10) being engaged by the intermediate members (6) each at a location spaced outwardly of the respective flanges (3A) mounting said devices.

20 7. A system according to any one of Claims 1 to 3 characterised in that a plurality of beams (3) are arranged to support abutting formwork elements (1, 2) in mutually angled relationship disposed in a formwork support system to define an internal surface of a corner structure to be cast, said system including force transmission means (12) arranged at the junction of the formwork elements and abutting a pair of restraint devices (10) mounted respectively on beams (3) at either side of the force transmission means, the restraint devices being arranged to provide a reaction against forces transmitted by the force transmission means from said elements (1, 2) in such a manner that the application of said forces to the devices increases the reactive effect provided thereby to movement along the beams.

8. A system according to Claim 7 characterised in that the force transmission member (12) engages the restraint devices (10) at respective locations spaced from the mounting locations of the restraint devices on the beams (3).

9. A system according to any one Claims 1 to 3 characterised in that a plurality of beams (3) are arranged to support abutting formwork elements (1, 2) in mutually angled relationship disposed in a formwork support system, force transmission members (7) being arranged longitudinally of the beams (3) to resist forces applied in that direction and being engaged with restraint devices (10) at locations spaced from the respective flanges (3A) mounting the devices (10).

10. A system according to any one of Claims 1 to 3 characterised in that a first formwork element (51) is supported on a beam and a second formwork element (52) is supported at right angles to the first by a frame (54, 55, 56) also supported on the beam and constituting said engagable means.

11. A system according to any one of Claims 1 to 3 characterised in that said engagable means constitutes part (50) of a lifting device and is arranged to transmit lifting forces via said restraint device (10) to said beam (3), enabling the latter to lift articles (54) attached thereto.

12. A system according to any one of the preceding claims characterised in that each restraint device (10) is a generally 'C' shaped clamp, of which the arms (21, 22) embrace a beam flange (3A).

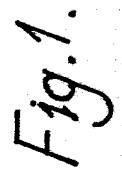


Fig. 1.

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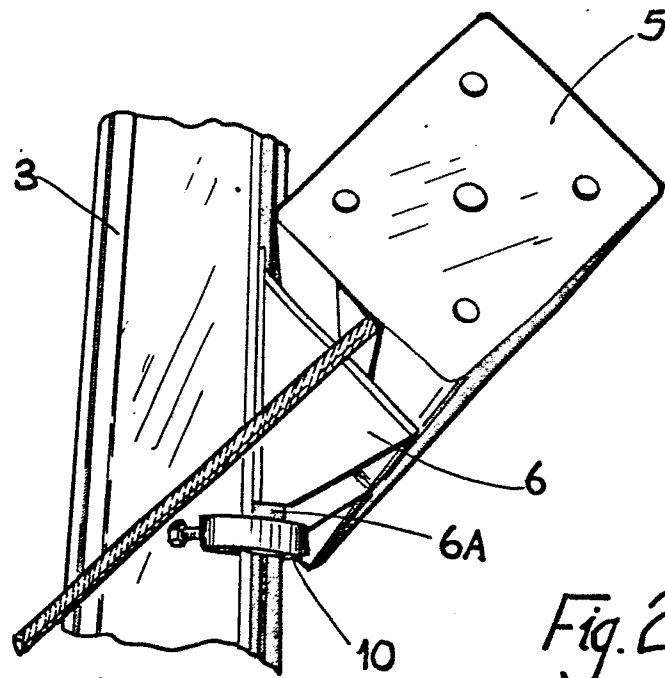


Fig. 2.

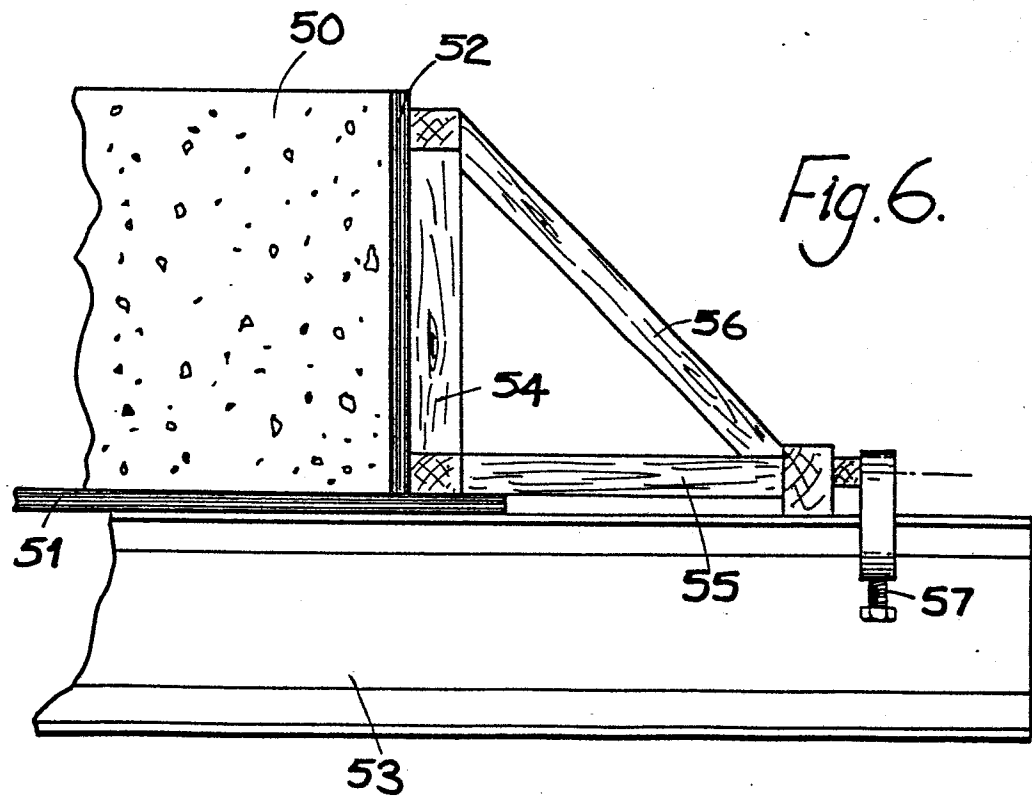
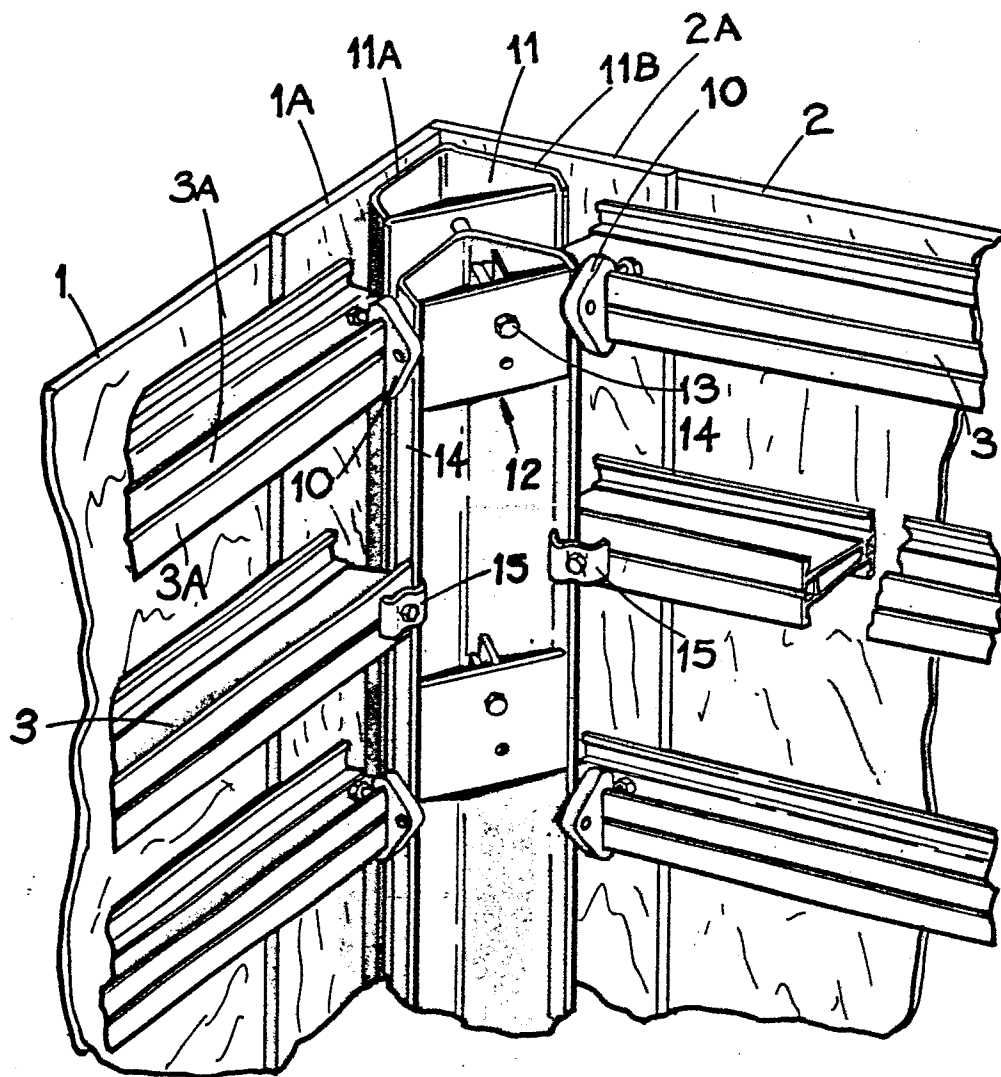
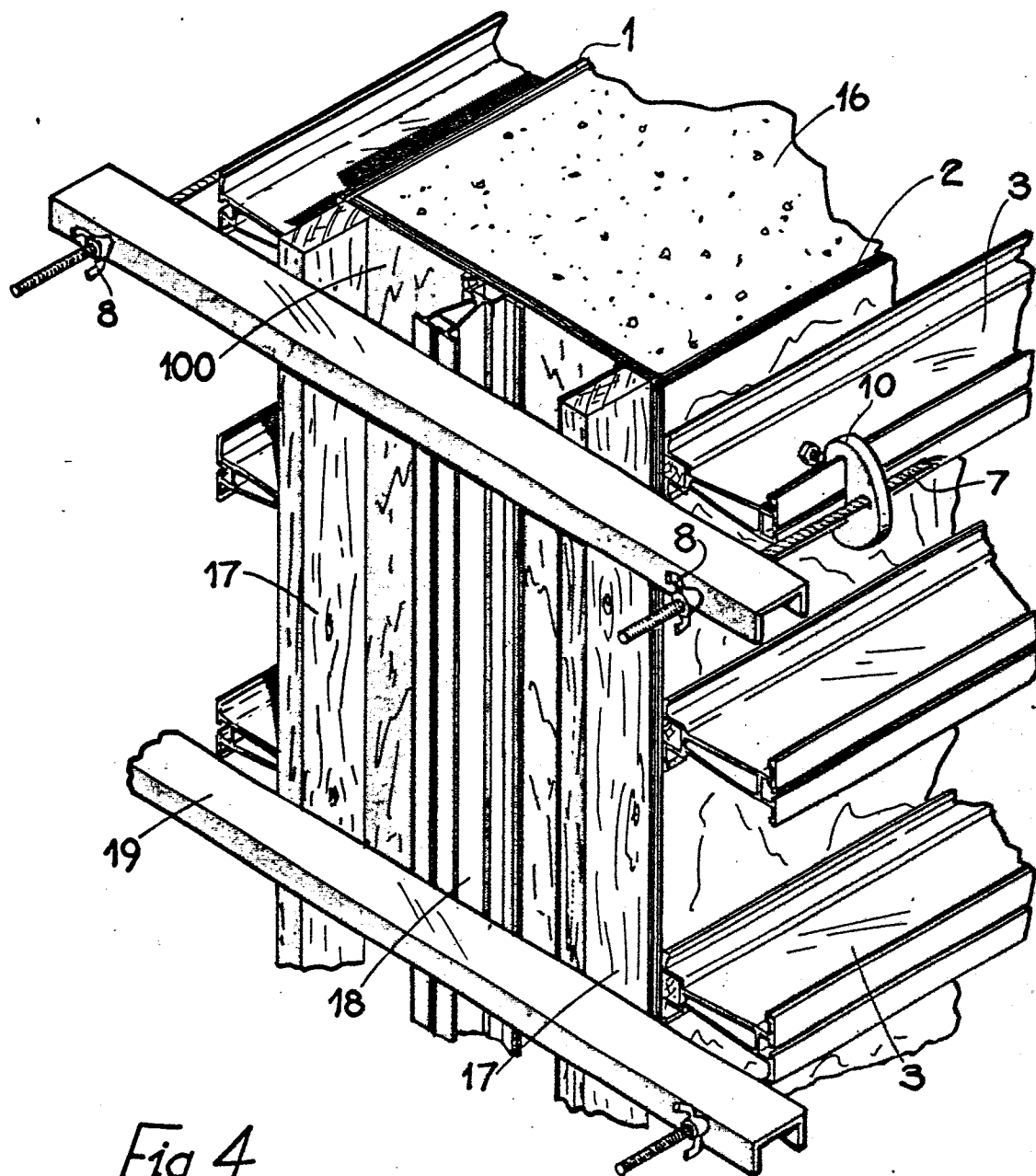


Fig. 6.

*Fig. 3.*

*Fig. 4.*

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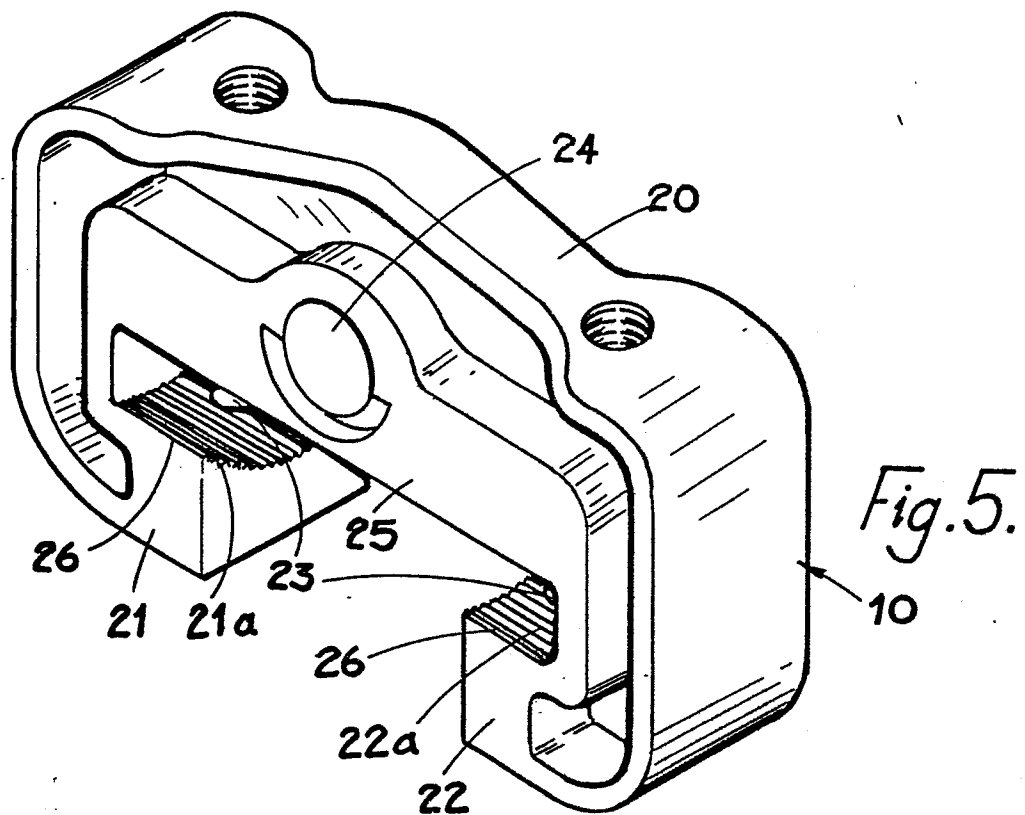


Fig. 7.

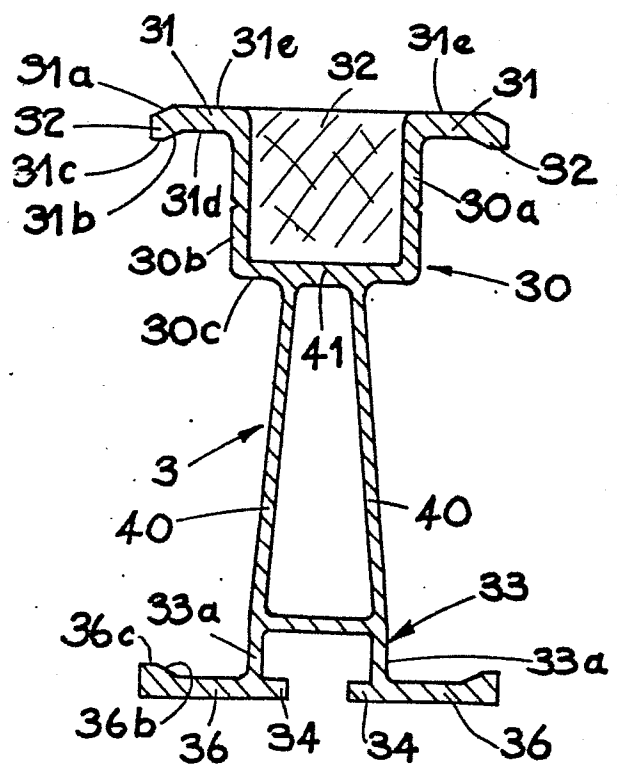
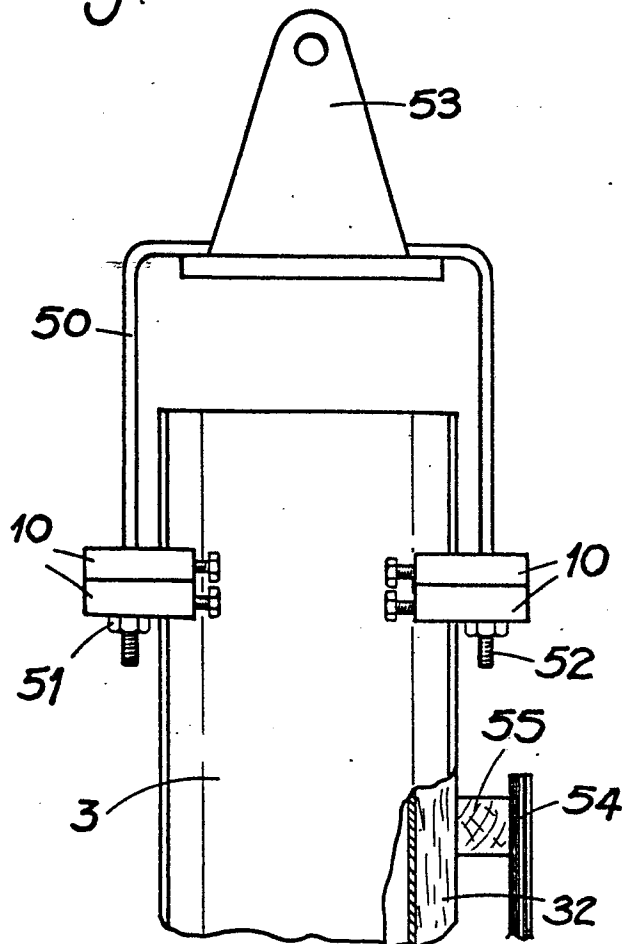


Fig. 8.



European Patent
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EUROPEAN SEARCH REPORT

0112113

Application number

EP 83 30 7392

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	DE-A-2 321 096 (PERI-WERK) * Pages 8-13; figures 1-3 *	1-5	E 04 G 17/04
X	CH-A- 471 298 (HENNER) * Column 2, lines 15-32; figure 1 *	1-3, 12	
A	FR-A-1 589 090 (DEREVIANKINE)		
A	FR-A-1 547 697 (BOURGE)		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
			E 04 G
Place of search THE HAGUE		Date of completion of the search 13-03-1984	Examiner VIJVERMAN W.C.
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