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(12) # EUROPEAN PATENT APPLICATION

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(54) **Improvements relating to in situ cast beams.**

(57) During the construction of an in situ cast concrete beam in a slot cut in a building wall, the wall (28) above is temporarily supported from the wall (17) below by a stool (11). The stool consists of a top plate (12), a bottom plate (13), and an intervening body comprising an upper plate (14), a lower plate (16), and a leg (15). The body and plate (12) are lifted, so as to tighten any looseness in the wall (28) above by hydraulic jacks (29). Packing is then inserted between the lower plate (16) and bottom plate (13) and the jacks (29) are removed before a beam is cast incorporating the stools. In this way only inexpensive parts are sacrificed within the beam and the jacks, and possibly containment (19) for the packing are recovered and reuseable.

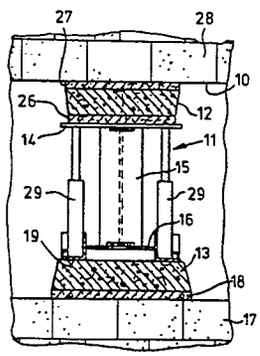

Fig. 2A.

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IMPROVEMENTS RELATING TO IN SITU CAST BEAMS

The invention is concerned with the construction of in situ cast beams in the walls of buildings. Such beams are used in the underpinning and repair of buildings, for example when underpinning a cracked wall, the foundations of which have been subject to subsidence. The beam is inserted in the wall of the building parallel to the plane of the wall and the load will then be redistributed by the beam onto the foundations, which may be renewed at the same time. Such beams are also used as lintel beams which are inserted into the wall prior to cutting away the wall beneath the central portion of the beam.

The beam is conventionally constructed by a method, hereinafter referred to as of the kind described, involving cutting away the wall and inserting stools at horizontally spaced positions. The stools are built in to support the wall above. With the intervening wall between the stools cut away, reinforcement is inserted, formwork is erected, and an in situ concrete beam is cast incorporating the reinforcement and stools.

We have previously proposed the use in conjunction with the stools of a screw jack so that when the stool is built in, the jack may be extended to tighten up the stool and develop the reaction to be transmitted through the stool, and also possibly to lift the wall above to

close any cracks in the wall. The provision of the jacks has involved extra expense and we have therefore also previously proposed that after the wall above has been pinned up from the beam between the stools, usually by packing earth damp mortar into the gap between the top of the beam and the wall above, the jack is recovered from the top of the stool after contraction of the respective jack. These jacks provide little lift as they are limited in thickness by the restriction that they must not project downwards so far as to interfere with the reinforcement in the beam and by the undesirability of cutting out more brickwork courses to accommodate a thicker jack. Consequently we have made the screw jack an integral part of the stool. However, the costly jack has then inevitably been sacrificed with the stool and to reduce the expense we have suggested recovering a top plate from the top of the stool, after pinning up the wall above from the beam and retracting the jack. In any case the removal of a part from the top of the stool at this stage is not entirely satisfactory as it is important that the wall above remains properly supported from the beam. Removal of a part from the top of the stool necessarily interferes with the support at the places where the maximum load bearing reaction is concentrated and leaves the wall above temporarily supported on the mortar packed into the gaps between the top of the beam and the wall above. However carefully this mortar has been packed into the gap, and difficulties arise in packing it tightly when the wall is a cavity wall, it will be unlikely that the wall will be as well supported as by the stools and some slipping of the wall may occur, particularly if there is any looseness in the wall above between the stools. Furthermore, even if no slipping occurs, a second careful packing operation must be carried out to fill the space

left by the removal of the part from the top of the stool so that the wall remains properly supported from the stool, and hence from the beam with which the rest of the stool is by then rigid.

In accordance with the present invention, in a method of the kind described, each stool comprises a top plate and the stool is built in by applying to the top plate an upward reaction by means of a removable jacking device. The top plate is then packed up from the wall below in a manner to transmit the full load bearing reaction between the wall above and the wall below, and the jacking device is removed before the beam is cast.

With this arrangement there is no limit to the lift which can be applied via the jacking device to the top plate and hence to the wall above, and no problem of sacrificing the jacking device.

The jacking device may be operated out of the plane of the wall and involve for example lifting arms extending into the slot cut into the wall and engaging the underside of the top plate, or a scissor mechanism extending into the slot and taking a reaction from the wall at the bottom of the slot, either directly or indirectly.

Preferably, however, the jacking device is interposed between the top plate and a bottom plate which is bedded on the wall below, and the top plate is packed up by packing interposed between the top and bottom plates. The jacking device may then consist of two upright, preferably hydraulic, jacks standing one at each side of the stool within the slot.

In order to transmit the vertical reaction through the stool, whilst allowing reinforcing rods to be inserted extending past the stool, the stool preferably incorporates at least one leg depending from the top

plate and the top plate is packed up by packing up the bottom of the leg from the wall below. It would be possible to use the inverted arrangement in which the leg extends upwards from a bottom plate and packing is inserted between the top of the leg and the top plate but it is usually more convenient for the packing to be manipulated whilst resting on the bottom plate or wall below. To provide the cheapest possible construction of stool which will be sacrificed in the beam, a single central leg, for example of I-section may be used. However, when used in a cavity wall, the vertical reaction through the leg will be aligned with the cavity and, in order to spread the load, a thick strong and consequently expensive top and/or bottom plate is required. For use particularly with a cavity wall therefore there may be a plurality of legs which diverge in the upward direction so that at least one leg supports the top plate beneath each leaf of the wall above.

The packing may be mechanical packing, such as sliding wedges which are forced together to pack up the top plate and develop the necessary load bearing reaction in the stool, prior to removal of the jacking device. The vertical adjustment of the packing device, as the load is developed, can be quite small as the movement is only that necessary to develop the load bearing reaction in the stool, and not lift the wall above, this already having been done by the jacking device.

Mechanical packing devices contribute a significant proportion of the cost of the stool and, particularly when provided at the bottom of the stool, may be recoverable after the beam has been cast and set. Thus the packing device may be enclosed in a housing having walls so shaped that release of the packing device from the cast beam and withdrawal of the device through a face of the beam is facilitated. For example the side

walls of the housing may converge in the direction into the beam. Removal of the packing device, after it has served its function, does not introduce any of the disadvantages previously referred to in connection with the removal of a part from the top of the stool as the body of the stool will by then be rigid with the beam and the concentrated support for the wall above from the top of the stool is undisturbed. The opening left at the bottom of the stool after withdrawal of the packing device can be filled with mortar to provide a neat appearance but this of little structural importance.

Instead of the packing being a mechanical device, the more conventional technique of using a packing of mortar may be utilized. This is particularly convenient when the leg or legs are connected to a lower plate and the packing is introduced between the lower plate and the bottom plate.

One of the conventional disadvantages of using mortar to build in a stool, namely that the mortar has to set so that the stool can sustain the full load before the next section of wall is cut away and the next stool built in, may be avoided if the mortar packing is contained by side walls. As the mortar has very little fluency this is sufficient to enable the full vertical load to be developed through the mortar immediately after packing, so that the jacking device can be removed, the next section of wall cut away and the next stool built in, without waiting for the mortar to set.

The side walls may be sacrificed with the stool if for example they are formed integrally with the bottom or lower plate. Preferably however they are provided by a containment strap which is removable after the mortar packing has set and before the beam is cast.

An example of the construction of a beam in accordance with the invention is illustrated in the accompanying drawings, in which:-

Figure 1 is a diagrammatic front elevation showing a completed beam in a wall;

Figures 2A, 2B and 2C are elevations showing successive stages in the construction of the beam;

Figure 3 is a perspective view of a containment strap;

Figure 4 is a perspective view of a part of the stool;

Figure 5 is a perspective view of an alternative stool part; and,

Figure 6 is an elevation showing the use of the Figure 5 stool at a stage between the stages of Figures 2A and 2B.

In the construction of the beam, an opening 10 is cut through the wall, usually at one end of the beam, and a stool 11 is built in. As shown in Figure 2A, the stool comprises a precast top plate 12 of reinforced concrete, a similar bottom plate 13, and an intermediate stool body which, as better shown in Figure 4, is a steel fabrication and consists of an upper rectangular plate 14, a leg 15 of I-section and a lower plate 16. The stool is assembled by bedding the bottom plate 13 on the cut wall 17 at the bottom of the opening 10 with an interposed layer 18 of mortar. A containment strap is then placed on the bottom plate 13. This containment strap, as shown in Figure 3, is a steel fabrication comprising two side angle pieces 19 with locating lugs 20 and 21, and an end plate 22 interconnecting the pieces 19. A separate slotted end piece 23 cooperates with slots 24 in the side pieces 19 to provide an open topped and open bottomed box 25 the plan area of which just accommodates the lower place 16 of the stool body.

The containment strap, without the removable plate 23, is located on the bottom plate 13 with the lugs 20 engaging over the front edge of the plate.

The next stage in assembling the stool is to position the top plate 12 on top of the upper plate 14 with an interposed layer 26 of mortar, and, with a further layer 27 of mortar on top of the plate 12, this sub-assembly of stool body and top plate are offered up into the opening 10 so that the mortar layer 27 beds against the underside of the cut wall 28 above. This can conveniently be done by engaging a pair of hydraulic jacks 29 against the underside of the upper plate 14, and manoeuvring the sub-assembly into the opening by an operator holding one of the jacks in each hand. In manoeuvring the sub-assembly into position, the lower plate 16 of the stool body will be caused to slide between the angle pieces 19. Alternatively the stool body and upper plate could be inserted into the opening 10 before the jacks 29 are inserted. The manipulation of the two jacks may be simplified if they are interconnected by a U-shaped stirrup which embraces the leg 15 of the stool body. The two hydraulics jacks 29 are then extended so that the stool body and upper plate 12 are lifted upwards relatively to the containment strap, bottom plate 13, and wall 17 below, the lower plate 16 of the stool body riding up inside the containment strap. At the same time any looseness in the wall 28 above is taken up as the wall is lifted as well.

When the desired lift has been achieved, the gap between the lower plate 16 and the bottom plate 13, within the containment strap, is packed with earth damp mortar 30 as far as the slots 24 and the plate 23 is then inserted to contain the mortar. The jacks 29 can then immediately be removed leaving the wall 28 above safely supported from the wall 17 below as a result of

the top plate and stool body effectively being packed up from the bottom plate and wall below by means of the mortar packing 30. This is shown in Figure 2B.

The opening 10 is then extended along the wall to form the next portion of the slot in which the beam will subsequently be cast. The next stool 11 is built in and packed up, and the jacks removed, and these steps repeated until all the stools have been built in. After about 48 hours, the packing 30 in each of the stools will have set and the containment straps are removed by lifting out the plates 23, lifting and flexing apart the free ends of the angle pieces 19, and sliding the box off the respective bottom plate 13. Reinforcement including rods 31 is then fitted into the slot usually by attachment to the stools 11, formwork is erected at the front and rear of the slot, and a mass 32 of concrete is cast to produce a beam incorporating the stools 11 and reinforcement. When the cast concrete has set, the gap between the top of the cast concrete beam and the wall 28 above is usually filled by packing in a layer 33 of earth damp mortar. The wall 28 above is then supported from the full length of the beam. It will be appreciated that the beam is formed using only a single pair of the hydraulic jacks 29, and one of the containment straps for each stool, and these parts are all recovered for reuse.

Figure 2A shows the two hydraulic jacks mounted one on each side of the stool substantially in the central plane of the wall. This is acceptable when the wall has only a single leaf, and indeed in the case of a cavity wall when the reaction from the jacks is spread by the angle pieces 19 and upper place 14 to the parts of the plates 12 and 13 engaging beneath the inner and outer leaves of the wall. However, for greater security against cracking of the plates 12 and 13 owing to the

jack reaction being applied in alignment with the wall cavity, and in cases in which a metallic spreader, such as the containment strap or upper plate 14 is not used, it may on some occasions be desirable to reposition the pair of jacks across, rather than along the wall, so that their reaction is directly in alignment with the inner and outer wall leaves. However, when the jacks have been removed, the leg 15 of the stool body still applies a substantially central reaction to the top and bottom plates, thereby leading, in the case of a cavity wall, to some slight danger of cracking of the plates, unless the plates are made very thick, or contain a large quantity of reinforcement, both of which involve additional expense.

An alternative solution to this problem involves the use of a stool body such as that shown in Figures 5 and 6, with multiple, and preferably upwardly diverging legs 34. In this case the legs are secured to an angularly domed steel bottom plate 35 and have feet 36 at their upper ends. The upper ends of the legs could be connected by an upper plate 14 such as that in the first example but the feet 36 are adequate for engagement directly against the top plate 12, and in positions beneath the leaves of a cavity wall. The upper ends of the legs are prevented from splaying under load by a peripheral steel wire 37 preferably welded to the legs 34. As shown in Figure 6, the reaction from the jacks 29 may be applied in this example to the wire 37 by means of a cross head 38 which seats on the upper ends of the jacks and engages beneath the wire 37. Otherwise the stool body is used similarly to that of the first example.

CLAIMS

1. A method of constructing an in situ cast beam in the wall of a building, the method comprising cutting away the wall and inserting stools (11) at horizontally spaced positions, building in the stools to support the wall (28) above, and, with the intervening wall between the stools cut away, inserting reinforcement, erecting formwork, and casting an in situ concrete beam incorporating reinforcement and stools; characterised in that each stool comprises a top plate (12), and the stool is built in by applying to the top plate an upward reaction by means of a removable jacking device (29), packing up (30) the top plate from the wall below in a manner to transmit the full load bearing reaction between the wall above and the wall (17) below, and removing the jacking device before casting the beam (32).

2. A method according to claim 1, in which the jacking device is interposed between the top plate (12) and a bottom plate (13) which is bedded on the wall below, and the top plate is packed up by packing interposed between the top and bottom plates.

3. A method according to claim 1 or claim 2, in which the stool incorporates at least one leg (15) depending from the top plate and the top plate is packed up by packing up the bottom of the leg from the wall below.

4. A method according to claim 3, particularly for

use with a cavity wall, in which there are a plurality of legs (34) which diverge in the upward direction so that at least one leg supports the top plate beneath each leaf of the wall above.

5. A method according to claim 3 or claim 4, when dependent upon claim 2, in which the leg or legs are connected to a lower plate (16,35) and the packing (30) is introduced between the lower plate and the bottom plate.

6. A method according to any one of claims 3 to 5, in which the top plate (12) is a concrete plate and the leg or legs are connected to an upper plate (14) which is bedded against the underside of the top plate, the jacking device acting on the underside of the upper plate.

7. A method according to any one of the preceding claims, in which the packing is removable after the beam has been cast and set.

8. A method according to any one of claims 1 to 6, in which the packing is provided by a packed mass of mortar (30).

9. A method according to claim 8, in which the mortar packing is contained by side walls (19,22,23) so that the jacking device may be removed before the mortar packing has set.

10. A method according to claim 9, in which the side walls are provided by a containment strap which is removable after the mortar packing has set and before the beam is cast.

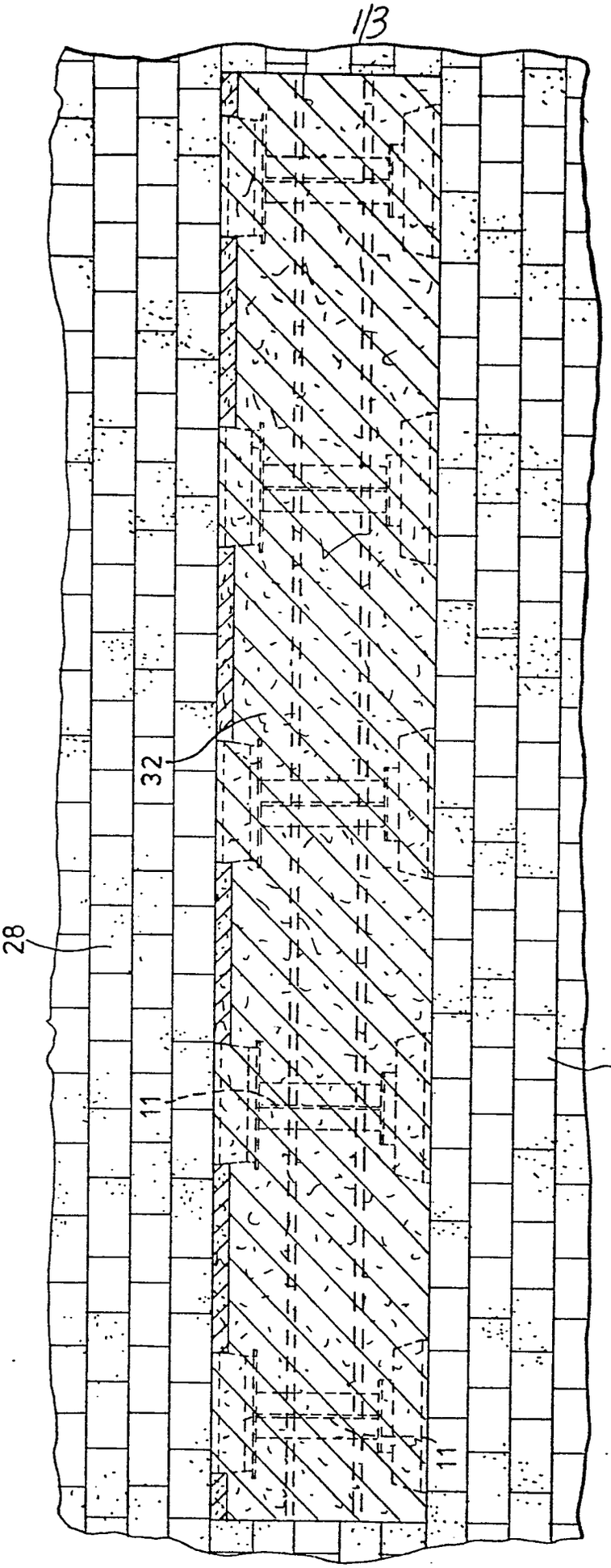

Fig. 1.

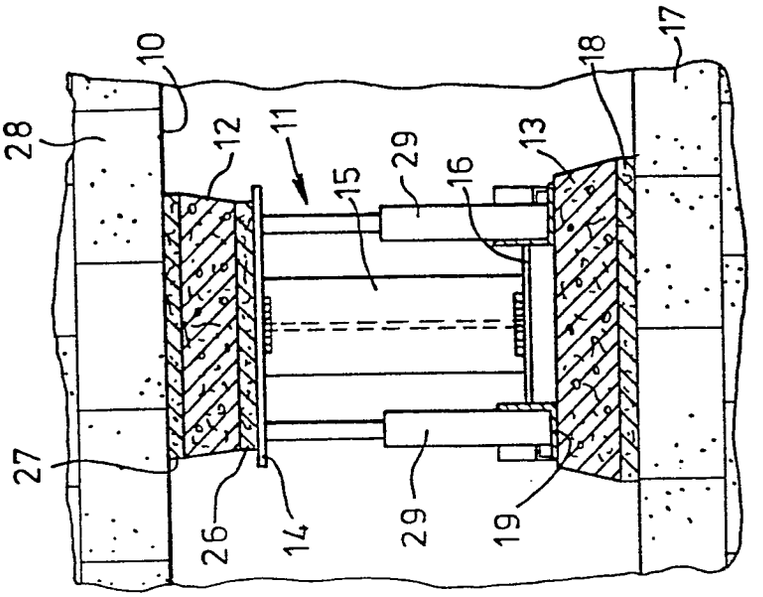

Fig. 2A.

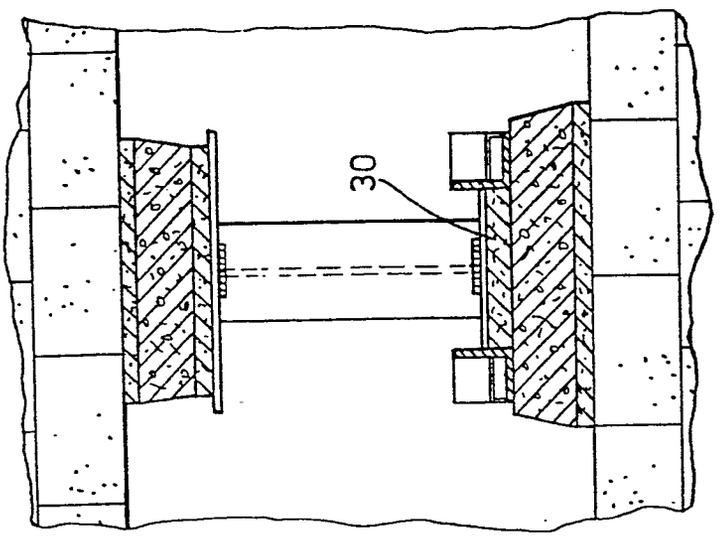

Fig. 2B.

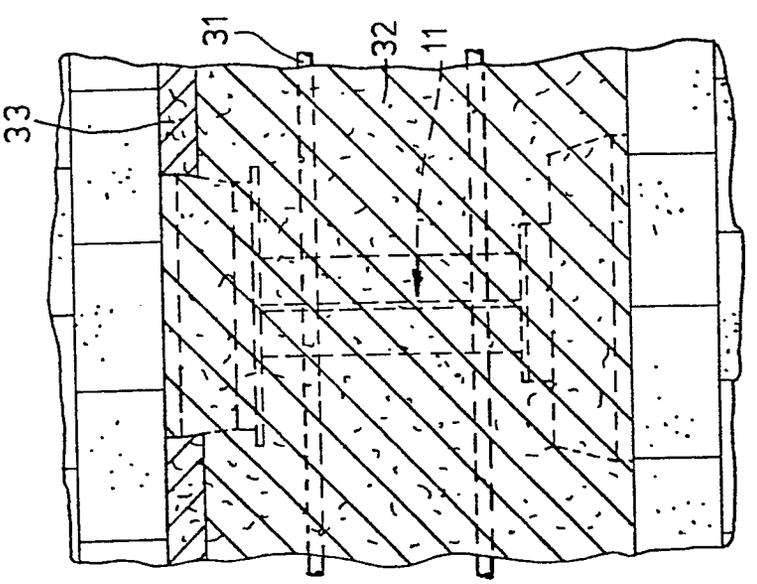

Fig. 2C.

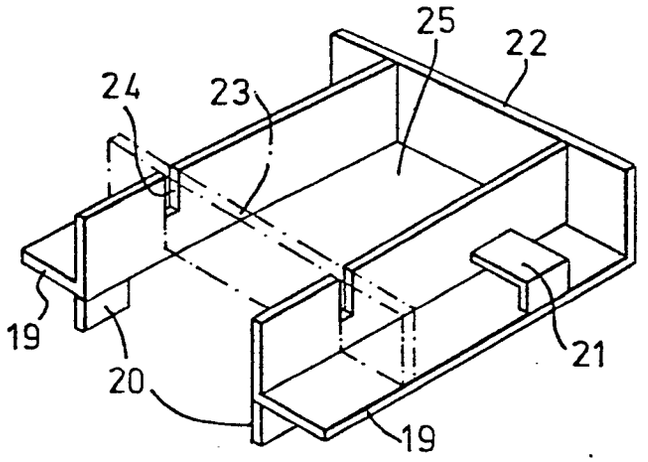

Fig. 3.

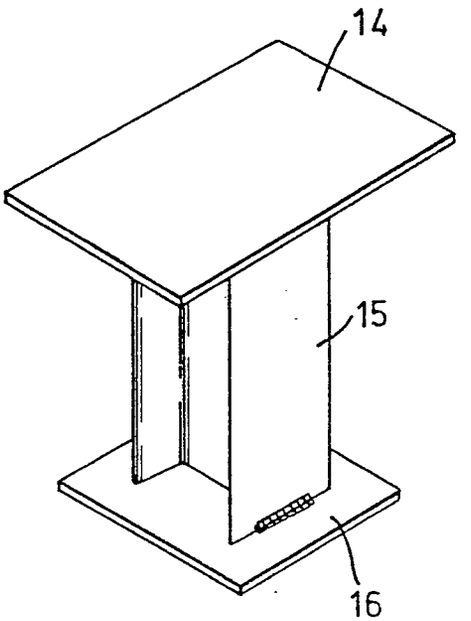

Fig. 4.

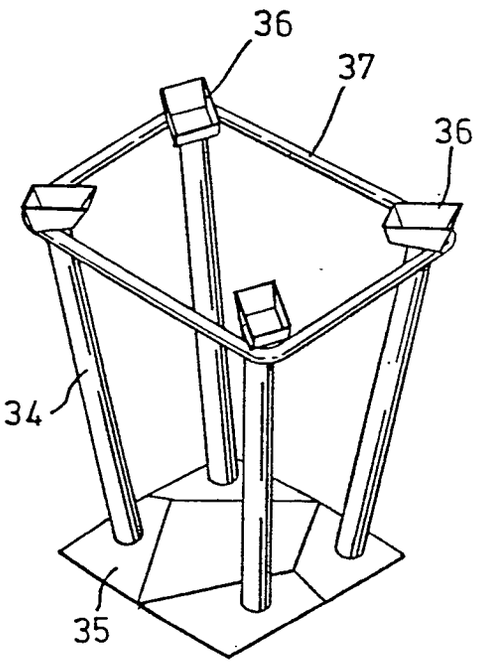

Fig. 5.

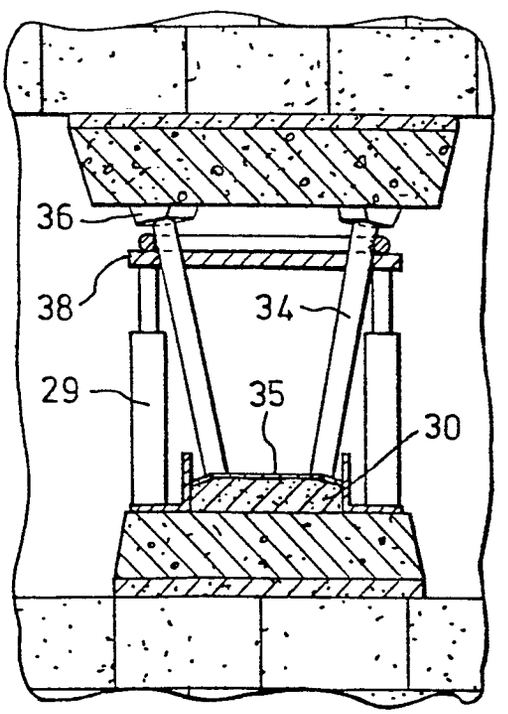

Fig. 6.

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European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 81 30 0440

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 3 796 055 (MAHONY) * Column 4, lines 34-68; figures 6-8 * -- GB - A - 1 497 413 (PYNFORD) * Page 2, lines 45-121; figures 1,2 * ----	

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

E 04 G 23/06
23/04
E 02 D 27/48

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

E 04 G
E 02 D

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	06-05-1981	VIJVERMAN