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(54) **PROCESS FOR FABRICATING IN SITU A LIGHT ALVEOLAR PLATE, PLATE THUS OBTAINED
AND ITS APPLICATION TO THE CONSTRUCTION OF HOUSES**

(57) Procedure for the fabrication of light cellular form which, using the same type of sliding concrete moulding machine for continuous production on a pre-stressing line, precasts a concrete slab of 120 cm in width and having a thickness of about 3 cm, and with 4 or 5 vertical ribs, 2 of which are at the edges. The ribs are about 4 cm in thickness and are finished in a small dovetail at the top; and the two at the edges have the

outermost face shaped like the edge of cellular form. Between the concrete ribs, once set, and having the same height, polystyrene fillers are inserted at the factory, said fillers having their upper corners bevelled, in such a way that the concrete of the cell dome, which is poured on site, solidifies on the ribs forming the actual cellular form, with the same thickness as the traditional frame which is replaced and the same properties and applicable standards as the cellular form.

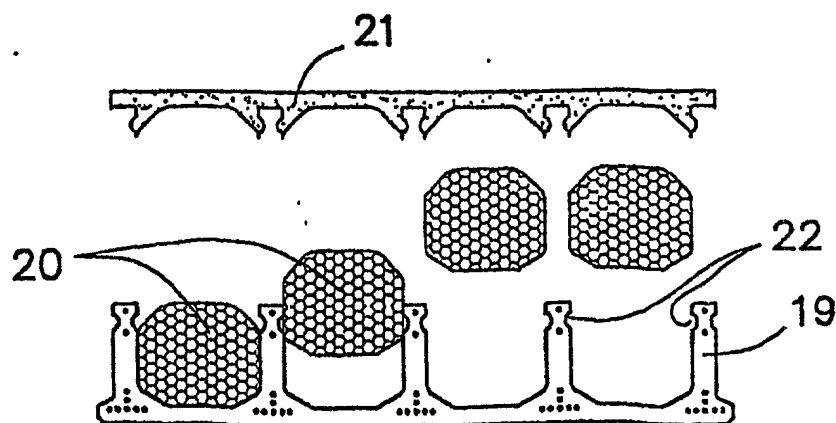


FIG. 9

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Description

OBJECT OF THE INVENTION

[0001] The present invention refers to a procedure for the fabrication of light cellular forms of prestressed or reinforced concrete, for building structures, which overcomes the main problem of weight encountered with conventional cellular forms for use in high-rise house construction.

[0002] Conditioned by the fabrication process, a cellular form is heavy in weight, being only slightly lighter than a solid slab and making it suitable for large loads and wide spans, but not for use in high-rise home construction, where normally they would have to rest on flat beams, the thickness of the frame being conditioned by the strength of said beams, normally of reinforced concrete. Thus the cellular forms would prove very heavy for transporting and lifting, their resistant characteristics being underemployed when said forms are applied to high-rise housing with flat beams.

[0003] The object of this invention is to create a fabrication system whereby the weight of these cellular forms is greatly reduced while retaining their essential nature, namely that of a self-bearing element, in which transversal loads are distributed very well by the "tubular" effect of their cells, highly resistant to torsion, and very acceptable for being left open to view on the underside in garages and shopping centres.

[0004] The object of this invention is to define the fabrication process by extrusion or moulding machine of the pre-stressed joist or cellular form types, in such a manner that in the factory only one half of the form is formed, it being necessary to provide on site the concrete for the upper part of the form, and join it appropriately to the heads of the ribs of the prefabricated or precast element.

[0005] The system is intended to replace the traditional filler and joist structure by this prefabricated form in the "flat" structures characteristic of the housing that is presently being built in Spain and in countries with a warm climate. The classic joist and filler structures are presently the most economical housing structures in countries with a Mediterranean or tropical climate.

BACKGROUND TO THE INVENTION

[0006] The "flat" joist and filler frames are those most employed, due to their great savings in material and manpower for manufacturing and erection. In Scandinavian and Central European countries, where temperatures are low nearly all year round and rainfall is abundant, working time on site has to be reduced to the least possible in order to avoid increasing labour costs and reduce the danger of freezing in concrete poured on site. This means that in northern countries extensive use is made of prefabricated frames of the semi-slab type, both prestressed and reinforced, or of the prestressed cellular type of slab, there being in no case classic

frames of the joist and filler type.

[0007] Another of the reasons for using prefabricated frames is that of safety in the workplace; suffice to say that the majority of accidents in building work occur during the structure erection phase, and specifically the most frequent accident is that of workers falling due to fillers breaking. This has led more prosperous nations to lay down regulations making the use of safer systems mandatory, or to plank the entire floor to prevent the breaking of fillers.

[0008] At the present time in Spain, the new safety regulations make planking of all frame mandatory, and the use of joists is therefore starting to diminish.

[0009] The employment of cellular forms in housing construction results in the beams having to have a greater thickness than the forms, which signifies a greater cost in manpower to produce the beams and also makes necessary the installing of false ceilings which makes houses still more expensive in comparison to the traditional plaster finish. For this reason they are not used on pillar structures for housing.

[0010] The reason, as already explained, is due to the fact that the form of similar thickness to that of the traditional flat beams of 26 to 30 cm is excessively heavy, meaning that form thickness has to be kept low, and consequently increased in beams.

[0011] There are forms of the semi-slab type such as those of figures 6 and 7 with thick upper ribs, the strengthening element of which is the rib itself, the broadened head of the rib being the part which withstands the compressive forces produced by the positive moments of all the faces, and failing to make use of the compression layer poured on top.

[0012] These forms do not behave in the same manner as the cellular type with respect to transversal loads, behaving in a manner similar to that of the joist and filler frame. Moreover the polystyrene fillers are fitted on site, with the consequent cost in organisation and manpower, their fitting being more expensive than if carried out in the factory.

[0013] This type of slab is most usually employed without weight-relieving fillers, a coat of concrete being poured on site and the whole behaving like a solid slab all of which was concreted in place.

[0014] Finally, there also exists another patent for a cellular form lighter than earlier ones, which is held by a Canadian company called Span-Deck, which, to sustain the concrete dome, make use of arlite balls poured between the recently concreted rib walls. The concrete of the top slab is then poured and, once set, the surplus arlite is removed by merely tilting the form.

DESCRIPTION OF THE INVENTION

[0015] The invention object of the present specification relates to a type of prefabricated, prestressed form which by combining the advantages of prefabrication with the subsequent reduction in job execution times

through not having to assembly the frame on site and the absence of shuttering or bracing struts on the underside, facilitates a diminution in the weight of the form for its transport and lifting.

[0016] The advantage offered by being self-bearing, signifies a reduction in on-site erection work, since there is no need for the traditional bracing of joists and fillers.

[0017] The form can be used with classic unidirectional flat beam shuttering (used to support the beams and joists of the frame), and can also be used for support on brick bearing walls, on metal structures, etc.

[0018] Furthermore it shall be seen that using embedded polystyrene filler between the ribs provides significant thermal insulation.

[0019] The form consists of a solid concrete slab of 2 to 4 cm in thickness, with or without internal mesh, and of between 0.6 m and 1.25 m in width, the most typical width being 1.2 m for reasons of transportation and the weights that can be lifted by the tower cranes currently employed on building sites. This width of 1.2 m makes it possible to have a slab thickness of less than 3 cm, since if the production width of the form were increased, it would be necessary to increase the slab thickness for it to withstand handling without breaking.

[0020] To position the lower mesh in the event of this being fitted, it need only be unwound on the prestressing line before proceeding to concrete with the moulding machine.

[0021] From this lower slab project the ribs of the cellular form, equally spaced from each other, which terminate in lateral recesses or protuberances for engaging with the top layer of concrete poured on site. Two of the ribs shall be located on the rims of the slab and provide stiffening to counteract small impacts during handling. These two side ribs shall constitute an articulated arrangement, just like that of the traditional cellular forms, to facilitate good stress transmission between one form and the next transversally.

[0022] These solid concrete ribs are slender, between 3 and 5 cm thick, and are of a height similar to that of the conventional frame, less 4 cm for the compression layer which shall be poured on site and the 3 cm of the base. These ribs stiffen the form and obviate bracing or shoring on site, being therefore of the self-bearing type, as is the case with cellular forms. These ribs can be of different shapes, the most characteristic being those that are rectangular in shape, though logically they can also include small variations that are trapezoidal, cylindrical, harpoon tip in order not to allow the fillers to escape, covered with protuberances, etc.

[0023] The top part of the rib shall support the compression produced by the positive moment during the stage of erection and concrete-pouring on site. Once the concrete of the top layer has set, it shall be this layer which counteracts the compression resulting from other loads standing on the frame. This is therefore an important difference with the semi-slab forms of the type shown in figures 6 and 7 in which the upper part of the

rib has to withstand the compression applied by the positive moments of all the loads that stand on the frame during the useful lifetime of the form, for which reason it is larger in size and of greater weight than the form described herein.

[0024] The lifting of the pre-cast unit is carried out using by gripping two centrally-located ribs, the upper longitudinal protuberances ensuring greater security for this operation.

[0025] By using polystyrene fillers embedded between the ribs, said fillers allow the upper filler of the cells to be formed with the span desired and with the arc or shape that has already been prepared on the fillers.

[0026] The length of the form is variable, depending on the span between the beams of the structure. The thickness can also be variable according to the span between beams and the building loads, however most usually it is 20 to 35 cm, 26 cm being the most typical value for the conventional frames calculated for spans of between 3 and 6 metres and typical housing loads of 660 kg/cm² total loading.

[0027] The ribs have some lateral grooves or channels, which shall serve to provide good bonding of the concrete of said compression layer with the rib itself and so constitute the tubes or cells characteristic of the cellular forms. These lateral channels shall impede the detachment of the top concrete layer, through the effect of tensile forces that arise when the form is twisted. They shall also serve to transmit the so-called shearing force between the two concretes, in such a manner that the bending compression forces are transmitted between rib and top layer. In order to ensure even more this shearing force between the concrete of the rib and the concrete of the top layer, side channelling can be made on the ribs, and the upper part of the rib concrete can even be scored, as is done with the prestressed joists.

[0028] Just as with the cellular forms, behaviour with respect to negative moments shall be excellent, thanks to the lower compression head.

[0029] Logically the steel to withstand the positive moments of the frame is incorporated in the lower part of the ribs during their fabrication. The steel to withstand the negative moments shall be positioned on the form, prior to pouring the top layer of concrete, being confined by this concrete layer and transmitting its compression to the rib and the lower part of the form through the join between the concrete bodies. This formation of negative moments can be distributed over steel rods of less diameter and spread over the whole of the upper face of the forms, it not being necessary that they be concentrated above the ribs.

[0030] The steel to be emplaced in the prefabrication shall be of the prestressed type, with the consequent saving in steel for the construction work, since the higher yield strength of this steel permits a considerable reduction in cross section with respect to reinforced concrete.

[0031] Then, on site, by the positioning of a steel mesh on top and pouring 4 or 5 cm more concrete over

all the forms, the actual frame itself is formed. Thus the performance of all the forms shall be enhanced by the mesh, increasing the "tubular effect" of the cellular form so constituted.

[0032] The improvement in this process of fabrication lies mainly in that only half of the form has to be transported and, that by making use of the poured-in-place compression layer, the dome is formed for the cells of the actual form. In this way there is no duplication of concrete layers. Also since it does not have to support the vault of the cells alone, a greater clear span can be produced and the number of ribs reduced, making the form lighter.

[0033] Once the initial prefabricated element has set (the day following, for example), the factory hand press-fits the fillers between the ribs, even before cutting with the diamond disc, the efficiency being improved if this process is carried out on site.

[0034] This filler has the job of supporting the concrete of the compression layer, and consequently of supporting the domes of the cells, until setting is complete. It is also sufficiently strong to support the weight of the workers when walking over it on site.

[0035] The fact that there is a continuous concrete slab underneath during the erection phase, provides great security for the frame, since when the workers walk over the fillers there will be no danger of falling as occurred with the traditional joists and fillers.

[0036] The construction of the form with fillers set in the factory offers the advantage of reducing costs when compared their assembly on site, since there the manpower is usually more expensive, and the performance achieved is less than in the factory. In addition by fitting the fillers prior to cutting, one avoids having to trim the filler ends of each form on site in order to obtain the desired length.

[0037] The change in frame thickness is achieved instantly by using a regulating mould on the extrusion machine or a higher mould and fillers which are more or less thick and thereby able to adapt to greater or lesser spans and loads.

[0038] In contrast to the cellular forms, longitudinal cutting of a form is simpler and faster, as it is only necessary to cut the lower concrete of less thickness, whilst in the cellular form both the upper and lower forms have to be cut. It also makes possible the marking of a small longitudinal channel on the lower slab, in such a way that it is weakened at this point so that, on receiving an impact, it breaks along this line and does not break arbitrarily leaving the consequent disagreeable appearance.

[0039] The weight of the finished frame is the same as that of the traditional frame which it replaces, so for a thickness of 26 cm, the weight, including the on-site concreting, comes to 280 kg/cm².

[0040] The weight of the prefabricated form so obtained is of the order of 840 kg (for a thickness of 22 cm, width of 1.2 m, and length of 5 m, typical of the type

employed in house building), which means that the tower cranes supporting 750 kg to 1000 kg at the tip can lift these forms comfortably. Also transport shall be less costly than for cellular forms having the same application, and equal to that of filler and joist. Thus, it is possible to transport twice the weight than with cellular forms of the same depth.

[0041] The fabrication of forms having an angle at the support, is carried out directly by using the diamond disc to cut the angle desired on the prestressing line.

[0042] The forms can have 3 to 6 ribs, as required by the manufacturer or the project designer. The ribs can have miscellaneous shapes as already explained, though rectangular shall be the most usual and in order to assure the engagement of the fillers with the rib, it is possible to have a saw-tooth arrangement on the walls of said ribs to provide a harpoon effect.

[0043] Engaging the fillers on the ribs in this manner prevents them from falling out in transportation or lifting, and also the tendency to float of the polystyrene when pouring concrete on site.

[0044] The lower part of the form has a perfectly smooth finish if fabricated on a sheet-metal-encased line. The form shall also have less camber than traditional cellular forms, since the eccentricity between the centre of gravity of the reinforcing and that of the concrete is very small.

[0045] The connectors for withstanding a tensile force equal to the shear force at an indirect type support, can be housed in the lateral form-to-form articulations, or else bevel the two fillers of the central rib and fill out by 10 to 15 cm. This connection assembly shall be lodged in this filled out part and shall overlap with the rib by means of the concrete poured on site.

[0046] The form does not need shear resisting reinforcement (other than in exceptional cases), since the widths of rib concrete per linear metre are greater than those of the conventional frame that it replaces.

[0047] Since high strength steels are employed together with likewise high strength concrete, and the thickness is considerable, it is possible to distribute the forms on the frame and arrange for a rib to be situated at the perimeter rim of the job and serve as edge band on which stands the building curtain walls, thereby saving the traditional edge band.

[0048] In the case of heavier loads, it is possible to remove the polystyrene from one of the cells, and locate therein the ironwork of the edge band or stair well. When pouring the concrete of the compression layer, this band shall also be concreted but with no need to erect shuttering on site.

[0049] The main advantage offered by this new system shall therefore be of an economic nature since, if a calculation is made of all the costs involved in its fabrication and erection, there shall be a reduction in concrete in manufacture, in transportation, in hoisting and in concrete on site, with respect to the traditional cellular form.

[0050] A new possibility shall be to use machined or moulded polystyrene fillers with voids and webs, in order to employ less polystyrene material and therefore reduce form cost.

[0051] The general summary of the fabrication process of the prestressed form consists in positioning the steel cables on the production line, concreting the lower slab and the ribs with a moulding machine, allowing to set for some hours, inserting the fillers between the ribs, stacking in the factory, transporting to site, lifting and positioning on its supports, laying the upper mesh (though it is possible to do without this), lay the negative moments steel, and finally pour the concrete of the upper layer to form the actual cellular form.

[0052] The moulding machine requires no more than the design of a regulating mould with the desired measurements, but does not need any other kind of adjustment or special utensil, with respect to that employed with cellular forms.

[0053] The form so obtained or the frame so configured, has a weight equal to that of the traditional ceramic or concrete joist and filler frame which, for a thickness of 26 cm, is approximately 280 kg/cm². This weight cannot be obtained with traditional cellular forms of 26 cm thickness, especially if used with a compression layer poured on site.

DESCRIPTION OF THE DRAWINGS

[0054] To complement the description being made and with the object of assisting in a better and more straightforward understanding of the features of the invention, a set of drawings is attached to this descriptive specification, said drawings forming an integral part thereof, in which in an illustrative and not restrictive manner, the following is illustrated:

[0055] Figure 1. - Shows a cross-sectional view of a conventional cellular form with 9 cells (1) and 1.2 m in width. In said figure it is possible to appreciate the significant thickness and large number of ribs (2), making the form heavy for use in housing with the classic pillar and beam structure.

[0056] Figure 2. - Shows a cross-sectional view of the frame made with the aforementioned cellular form with no compression layer, in which only the lateral articulations (3) are filled with concrete for junctions with other forms.

[0057] Figure 3. - Shows a cross-sectional view of the foregoing cellular form, with the articulations (3) filled and the compression layer (4) poured. For high-rise housing with beams and pillars, it could be used in this form, with a mesh in the compression layer, however it proves still more heavy both for lifting and due to the increase in beam and pillar steel.

[0058] Figure 4. - Shows a cross-sectional view of another cellular form, fabricated with another type of machine (more expensive) employing a drier concrete the result of which is fewer cells (5) since the fresh dome

(6) has a better support. The lateral articulations (7) are also of another type. In any case it continues to be very heavy when compared with joist and filler.

[0059] Figure 5. - Shows a cross-sectional view of another form, fabricated with an extrusion machine (still more expensive) employing a very dry concrete, with fewer cells (8), in this case circular in outline, and having lateral articulations (9) of another type. As can be seen, the aptly described tubular effect is maintained therein and also the lateral joining articulations. Despite the lightening in weight, they still prove to be too heavy.

[0060] Figure 6. - Shows a cross-sectional view of a pre-slab type form (10) with vertical ribs (11) which shall serve to support the compressive forces due to the positive moments of the form. It is filled on site with an insulating material (12), has very large lateral articulations (13) and the thickness of the lower slab (10) is usually 4 to 5 cm at least. The head of these ribs is usually large since, during the useful lifetime of the frame, they support all compression due to positive moments. The do not usually work under negative moments, due to the large in-fills that have to be implemented.

[0061] Figure 7. - Shows a cross-sectional view of the same pre-slab as above, but mounted in the frame and topped with a compression layer. It can be seen that the concrete of the compression layer does not enclose the upper part of the vertical ribs (15) and therefore there is no transmission of forces between the two elements, since these slabs, as already stated, support the compression produced by all loads in the heads (16) of the ribs themselves (thickened for this purpose).

[0062] Figure 8. - Shows a cross-sectional view of the cellular form, object of this invention, in which it can be appreciated that once the concrete is poured, there is no difference with the traditional cellular structure, having the closed cells (17) of the foregoing, as well as the lateral articulations (18).

[0063] Figure 9. - Shows a cross-sectional view and in different stages of the fabrication procedure of this cellular form. In the lower part can be seen the half of the form (19) produced in the factory, then the polystyrene fillers (20) being inserted in the cellular half-form, a task also performed in the factory and finally, in the upper part, the outline of what shall be the upper concrete form (21), being the only concrete poured on site and constituting the closure of the cells. As may be appreciated, the total thickness of the upper slab which acts as the compression layer, is 4 cm, in contrast with 7 cm found in the traditional cellular form with compression layer poured on site (figure 3).

[0064] Figure 10. - Shows a cross-sectional view of the cellular form (26) so obtained with the top concrete layer (28) already poured on site, in which can also be appreciated the cells (25), the prefabricated ribs (27), the precast lower slab (27), and the prestressed steel (24). Only the filler has been suppressed from the drawing in order to highlight the morphological equality with the traditional cellular form.

[0065] Figure 11. - Shows a cross-sectional view of a form the same as the previous case but with one cell less, during its fabrication stage, and the concrete poured on site (29) shown as a top-piece in process of assembly.

[0066] Figure 12. - Shows a cross-sectional view of the cellular form so obtained, lighter than the previous case (figure 10).

[0067] Figure 13. - Shows a cross-sectional view of the previous same form, in which the junctions between concrete elements have been erased in order to illustrate the tubular effect (30) of its cells, and that morphologically speaking, it is the same as a traditional cellular form.

[0068] Figure 14. - Shows a cross-sectional view of a form with four cells, in which some arrows (31) represent the torsion effect supported by the cells when transmitting transversal loads, which confers upon the form the same properties as the cellular forms fabricated in a single piece.

[0069] Figure 15. - Shows a cross-sectional view of the form, with the neutral axis (32) in positive bending, in which it can be observed that the shaded area is the only part which supports compression (33) from positive moments.

[0070] Figure 16. - Shows a cross-sectional view of the semi-slab type form of figure 6, in which the neutral axis (34) is lower, due to the lack of width in the compression heads (35), which results in an increase in the build-up of positive tension (36).

[0071] Figure 17. - Shows a cross-sectional view of the precast part of the cellular slab object of this patent, in which can be seen the slenderness that can be achieved in the ribs (37) of about 4 cm in thickness, given that there is no need for a large compression head as they need only support the weight itself during the erection stage; and the lower slab (38) with about 3 cm in thickness.

[0072] Figure 18. - Shows a cross-sectional view of two types of polystyrene fillers, one solid (39) and the other lightened or shaped (40).

[0073] Figure 19. - Shows a cross-sectional view of the pre-casting of the form object of this invention, with the polystyrene (41) already inserted and ready for transporting to site.

[0074] Figure 20. - Shows a cross-sectional view of the previous form, in which the interface between concretes has been suppressed in order to better appreciate the effect of cells (43) firmly closed through the pincer action (44) of the concrete poured on site over the ribs.

[0075] Figure 21. - Shows a cross-sectional view of the frame (45) constituted by the forms of the previous type, in which can be seen the filling of the articulation (46), on pouring the concrete of the top compression layer (49). It is also possible to see the mesh (48) and the negative moments steel rods (47).

[0076] Figure 22. - Shows a cross-sectional view of a

rib with protuberances (50) in order not to reduce the cross section of the rib, said longitudinal protuberances being rounded in shape. On the right is shown another rib with the protuberances in the shape of a harpoon tip (51) for preventing the filler from escaping after being pushed into place, and also to enhance security when lifting.

[0077] Figure 23. - Shows a cross-sectional view of how it is possible to insert the ironwork (52) of a beam parallel to the frame, which could serve as edge band or staircase header, whereby there is no need for shuttering on site.

PREFERRED EMBODIMENT OF THE INVENTION

[0078] With reference to the figures attached, a description is given hereafter of a manner of embodying the present invention relating to a procedure for fabrication of a light cellular form (26) comprising a lower concrete slab (27) of about 3 cm in thickness and 120 cm in width pre-cast in a factory, 4 or 5 concrete ribs (23) of 19 cm in height fabricated joined to the pre-cast slab (26), by means of a continuous production concrete moulding machine on a prestressing line. Also in the factory and once the concrete has set, polystyrene fillers are inserted between the ribs having an upper side recess (22), which shall serve to permit the concrete top layer (28) of 4 cm poured on site with or without mesh, to grasp the sides of the ribs of the pre-cast half-form. The fillers shall withstand until set the upper dome of "fresh" concrete of the cells so formed. Inside the ribs are laid the reinforcing bars (24) necessary to withstand the positive moments of the frame.

[0079] In order to implement the frame (45) on site, the forms are laid together in parallel, resting on the load-bearing beams of the structure, after which said frame is completed by collocating the reinforcement (47) to withstand negative moments and adding also on site a steel mesh (48), though this can be avoided, and a concrete compression layer (49) of reduced thickness, normally about 4 cm.

[0080] The ribs (19) of the forms can adopt various shapes, the most usual being rectangular, and incorporate some side channels (22) which permit the concrete poured on site (49) to penetrate into such cavities (22) and prevent the upper concrete layer (21) from separating from the ribs (19). These side channels can be replaced with longitudinal protuberances, in order not to weaken the rib when lifting the form.

[0081] It is also possible to score the upper face of the ribs (42) in order to favour the longitudinal shear between the two concretes.

[0082] To locate connectors on central ribs, where necessary, the ends of the fillers can be extended by 10 or 15 cm and so make said area solid with the connector.

[0083] Finally, for lifting and handling the pre-cast element, use can be made of gravity or pressure grips, applying these to the channels or projections (22) for

greater security.

[0084] It is not considered necessary to extend this description further for any expert in the subject to comprehend the scope of the invention and the benefits arising therefrom.

[0085] The materials, shape, size and arrangement of the constituent elements shall be capable of variation provided that the essential nature of this invention remains unaltered.

[0086] The terms in which this specification is drafted must always be taken in the broadest sense and not restrictively.

Claims

1. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, of the type of FABRICATION in continuous manner on long prestressing production line, with concrete extrusion or moulding machine; **characterised in that** the longitudinal steel is placed on the prestressing line and a form is moulded consisting of a concrete slab of reduced thickness without mesh (27), with 4 or 5 internal vertical ribs (23) rectangular in section, with a dovetail finish at the top or lateral grooving (22), and with two of the ribs located on the outer edge of each one with the typical edge (18) shape of a cellular form. Once the ribs have set and in the factory, expanded polystyrene fillers (20) are embedded between the ribs, in such a manner that the former are held by pressure (41) between the latter. The upper part of the fillers is at the same height as the upper part of the ribs (42), this height being the same as that of the traditional joist and filler frame that they replace, or the same as that of the traditional cellular form that they replace, in such a manner that when the top layer of concrete (49) with mesh (48) is poured on site, the rib and the fillers are covered with concrete, the polystyrene filler fitted in the form supporting the dome (28) of fresh concrete of the cells (17) of the form being finished on site. In the upper part of the fillers beside the ribs, a recess (44) is formed in the fillers in such a manner that the concrete which is poured on site can enfold or clinch the upper part of the precast ribs (42), and their dovetail or lateral grooves, in such a manner that a solidity is established between said concrete poured on site and the concrete of the rib of the precast element. In this way the actual cellular form is constituted, being of identical behaviour insofar as distribution of transversal loads and all other properties are concerned, to the traditional cellular form (figure 1) that it replaces.
2. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, in accordance with claim 1; **character-**

ised in that it can incorporate on the side faces of the ribs longitudinal protuberances (50) in such a manner that the upper ones are embedded in the concrete (49) poured on site, and the lower ones serve to guide and fix the polystyrene fillers (20) in place, reducing the volume of base material. These longitudinal protuberances can have the form of a harpoon pin (51) to engage the fillers with greater effect once the latter are in place.

3. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, in accordance with claim 1; **characterised in that** a reinforcing mesh can be laid inside the lower slab precast in factory, requiring only that the unrolling of a mat on the production line, prior to the concreting of the form.
4. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, in accordance with claim 1; **characterised in that** it is possible to dispense with the upper mesh (48) implemented on site, since for the distribution of transversal loads, this form has no need for the mesh, it being the cell tubes that offer great rigidity to torsion (31), enhancing this characteristic behaviour of the cellular forms with respect to transversal loads.
5. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, in accordance with claim 1; **characterised in that** the head of the ribs (42) can be scored to favour the longitudinal shear at the junction between the ribs and the concrete of the filler, poured on site.
6. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, in accordance with claim 1; **characterised in that** it can also be fabricated with smaller widths and 3 minimum ribs only, and also with more than 6 ribs and greater form thickness.
7. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, in accordance with claim 1; **characterised in that** the fillers arranged between ribs can be of the cellular type (40), produced either by machining or by moulding, and can be of any low density material.
8. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, of the type of prestressed cellular FORM; **characterised in its form in that** the form obtained (figure 8) has fewer cells than the traditional cellular form that it replaces and has a con-

tinuous concrete top layer (49) over all the forms collocated alongside each other on site, which does not occur with the traditional cellular form (figure 2), unless they are emplaced with an upper compression layer (figure 3).

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9. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, in accordance with claim 8; **characterised in that** one of the cells of the form can be used as hidden self-bearing shuttering for a beam (52), it only being necessary to remove the polystyrene inside said cell and replace it with the ironwork cage of the edge band or stairwell head, in such a manner that when pouring the upper concrete slab, said beam is filled with no requirement for auxiliary shuttering or bracing. 10 15
10. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, in accordance with claim 8; **characterised in that** the lower slab can be marked with a small longitudinal channel such that should it be wished to divide the precast element longitudinally, the lower slab splits along this so weakened part and a straight cut is obtained. 20 25
11. Procedure for fabrication of light cellular form implemented on site, form so obtained and its application to housing, of the type of APPLICATION of the cellular forms for terraced houses or for buildings on precast pillars and beams; **characterised in that**, given that its thickness is equal to that of the flat in-place beams of the traditional house structure, with the same weight as the joist and filler which it replaces, it can be used with indirect type support on these typical flat beams of current housing practice, a possibility which does not prove economic with traditional cellular forms. 30 35 40

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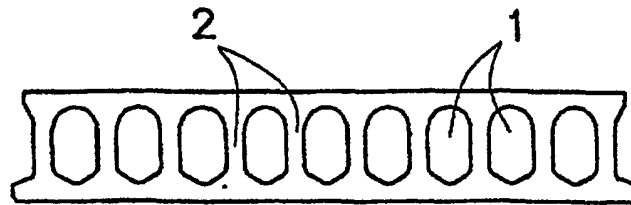


FIG. 1

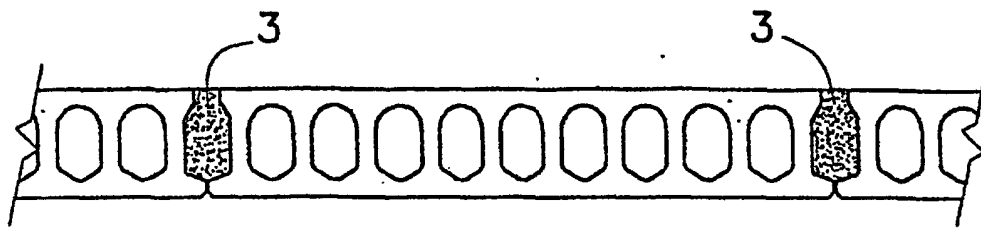


FIG. 2

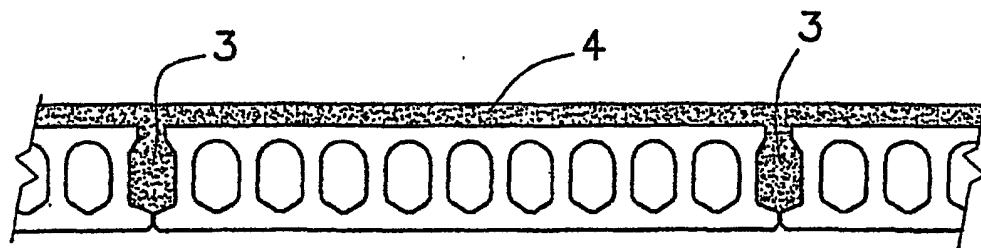


FIG. 3

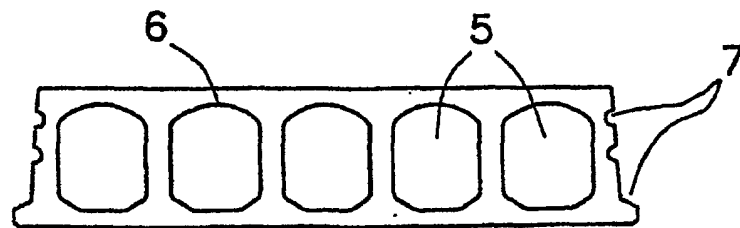


FIG. 4

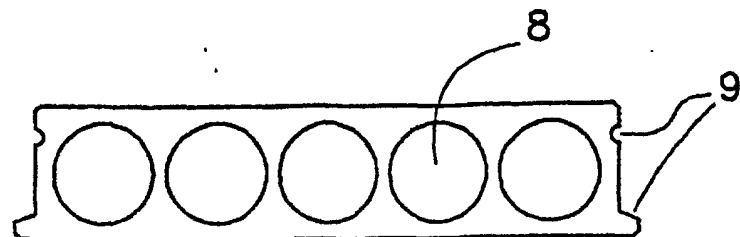
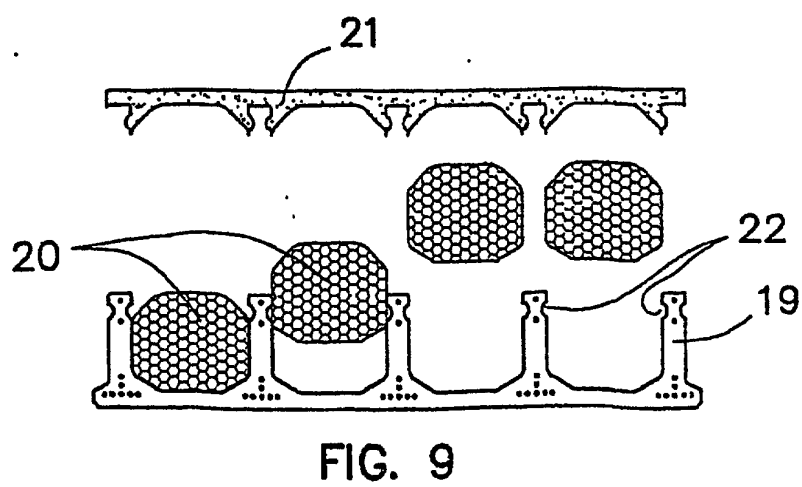
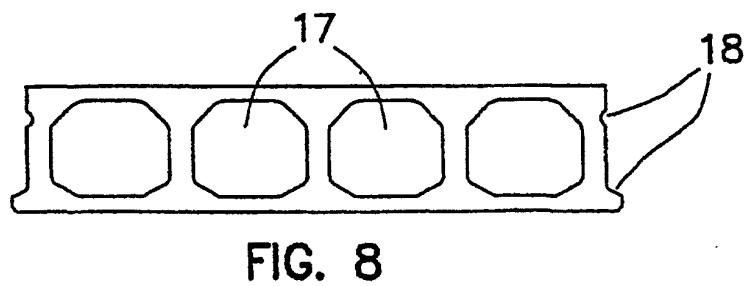
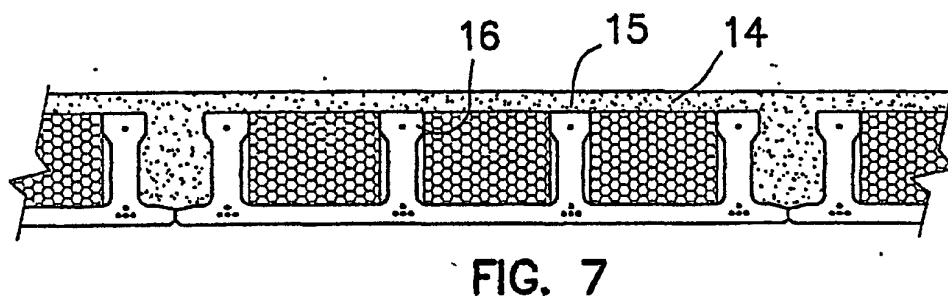
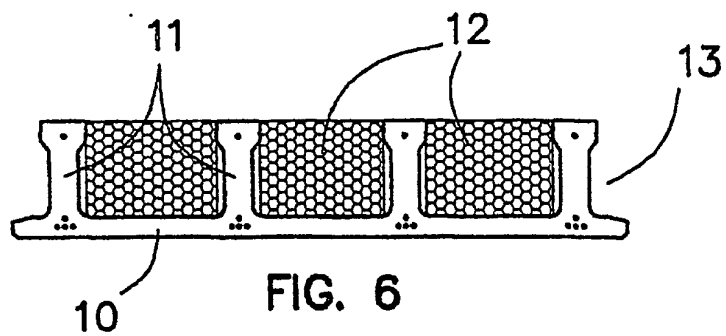
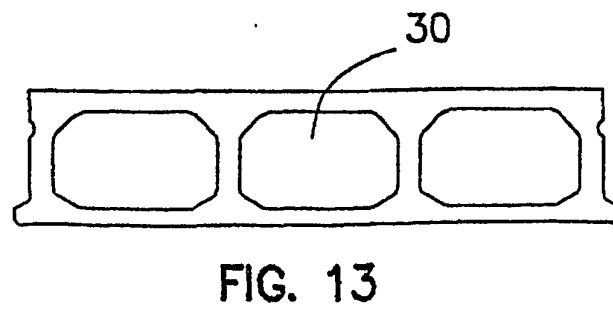
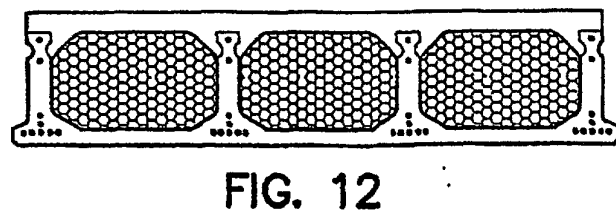
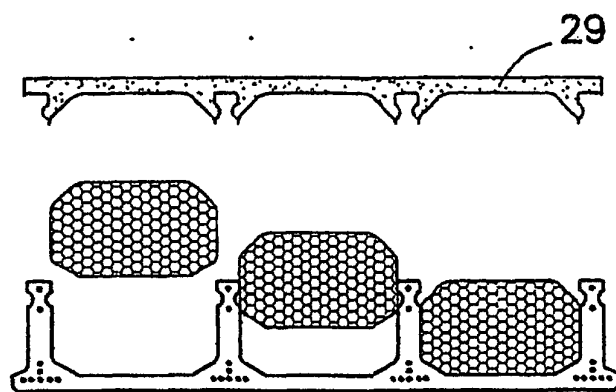
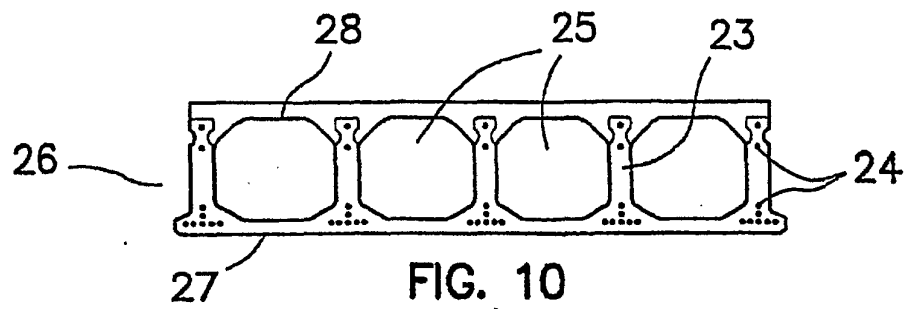


FIG. 5





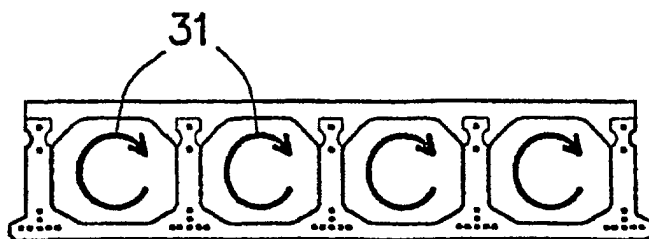


FIG. 14

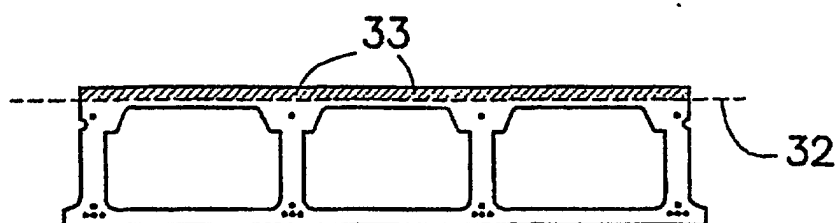


FIG. 15

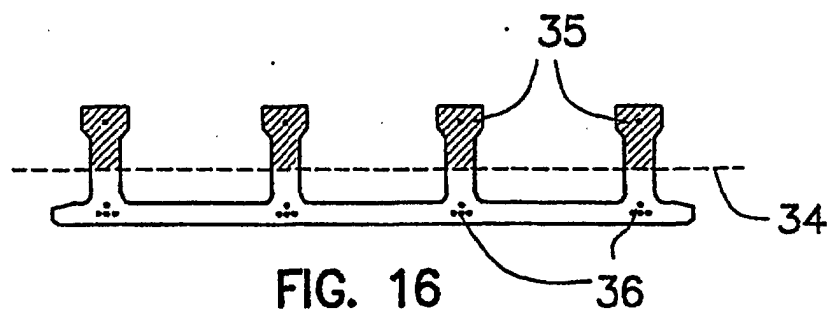


FIG. 16

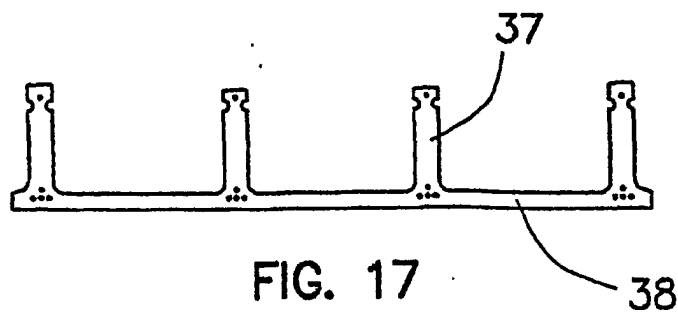


FIG. 17

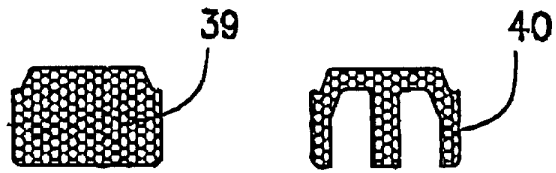


FIG. 18

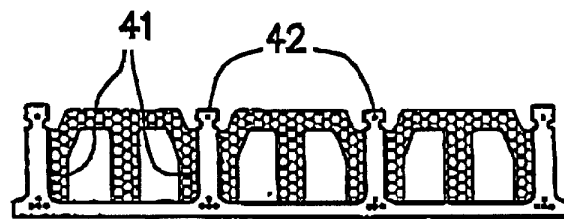


FIG. 19

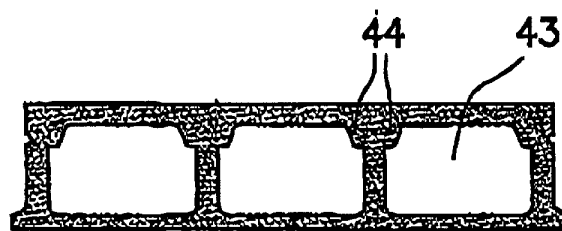


FIG. 20

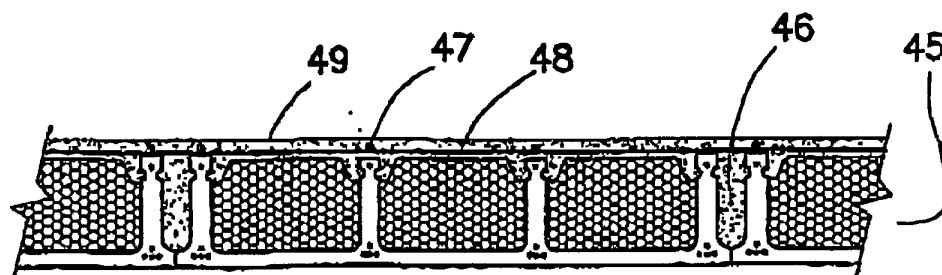


FIG. 21

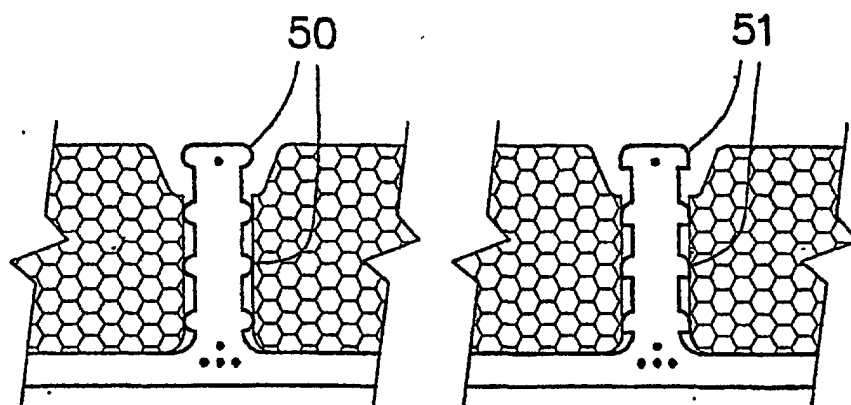


FIG. 22

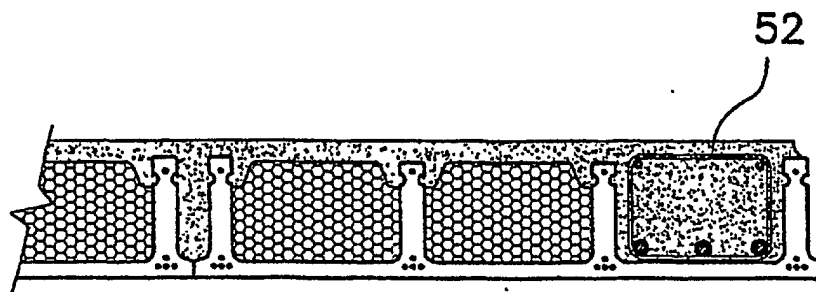


FIG. 23

INTERNATIONAL SEARCH REPORT

International Application No
PCT/ES 01/00177

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 E04B5/04 E04C2/288		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 E04B E04C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00 12834 A (JIMENEZ SANCHEZ JAIME ENRIQUE) 9 March 2000 (2000-03-09) page 5, line 15 - line 25 page 29, line 1 - line 14 page 14, line 23 - line 29; figures 2,4,7,8,14 ---	1,2,5,8,11
A	FR 2 263 349 A (CHATEL GUY) 3 October 1975 (1975-10-03) page 3, line 13 - line 23; figure 3 ---	1
A	FR 2 314 977 A (SIDCO) 14 January 1977 (1977-01-14) page 1, line 11 - line 24 page 2, line 27 - line 30; figure 3 --- -/--	1
☒ Further documents are listed in the continuation of box C. ☒ Patent family members are listed in annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
Date of the actual completion of the international search 26 September 2001		Date of mailing of the international search report 25. 10 2001
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Monica Sanchez Robles

INTERNATIONAL SEARCH REPORT

International Application No PCT/ES 01/00177

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 1 422 473 A (ESKANAZI) 15 March 1966 (1966-03-15) figure 7 ---	1
A	ES 2 089 947 A (ALGAIDA GESTION S L) 1 October 1996 (1996-10-01) the whole document ---	1
A	WO 94 23143 A (DALA CEMENTVARUFABRIK AB) 13 October 1994 (1994-10-13) claims; figures -----	1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

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