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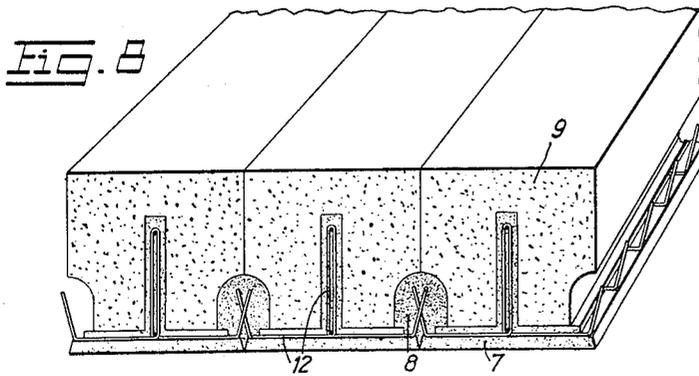
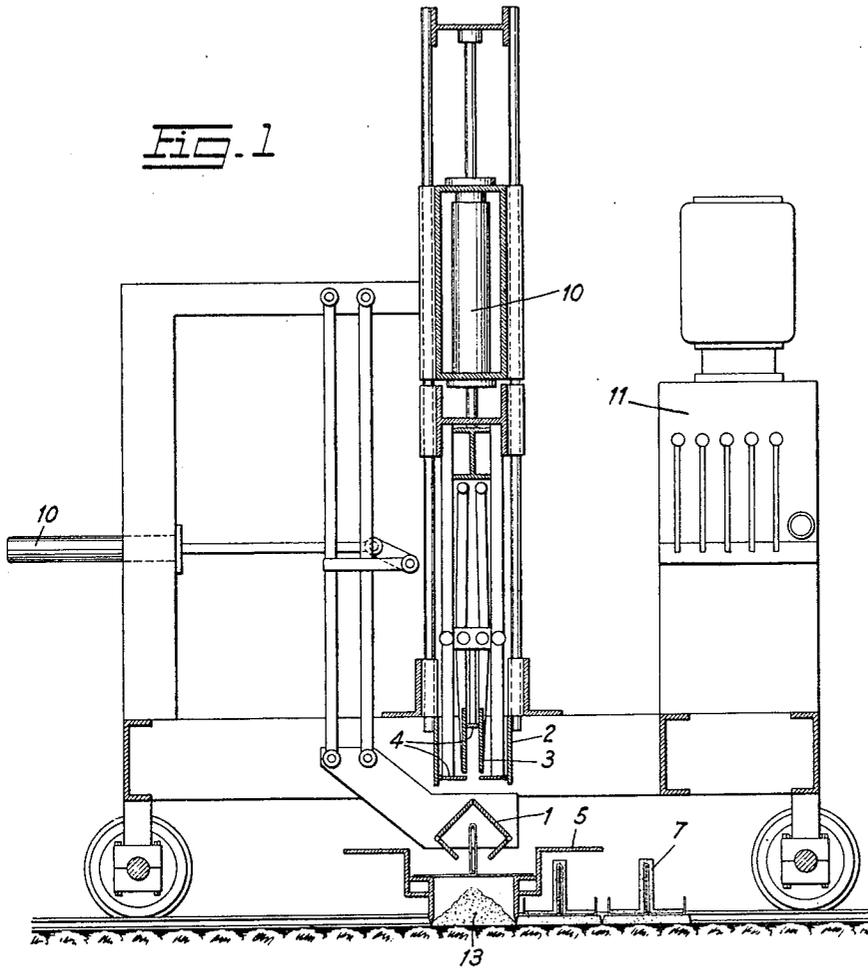
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METHOD FOR PRECASTING A STRUCTURAL BUILDING ELEMENT

Filed July 5, 1963

4 Sheets-Sheet 1



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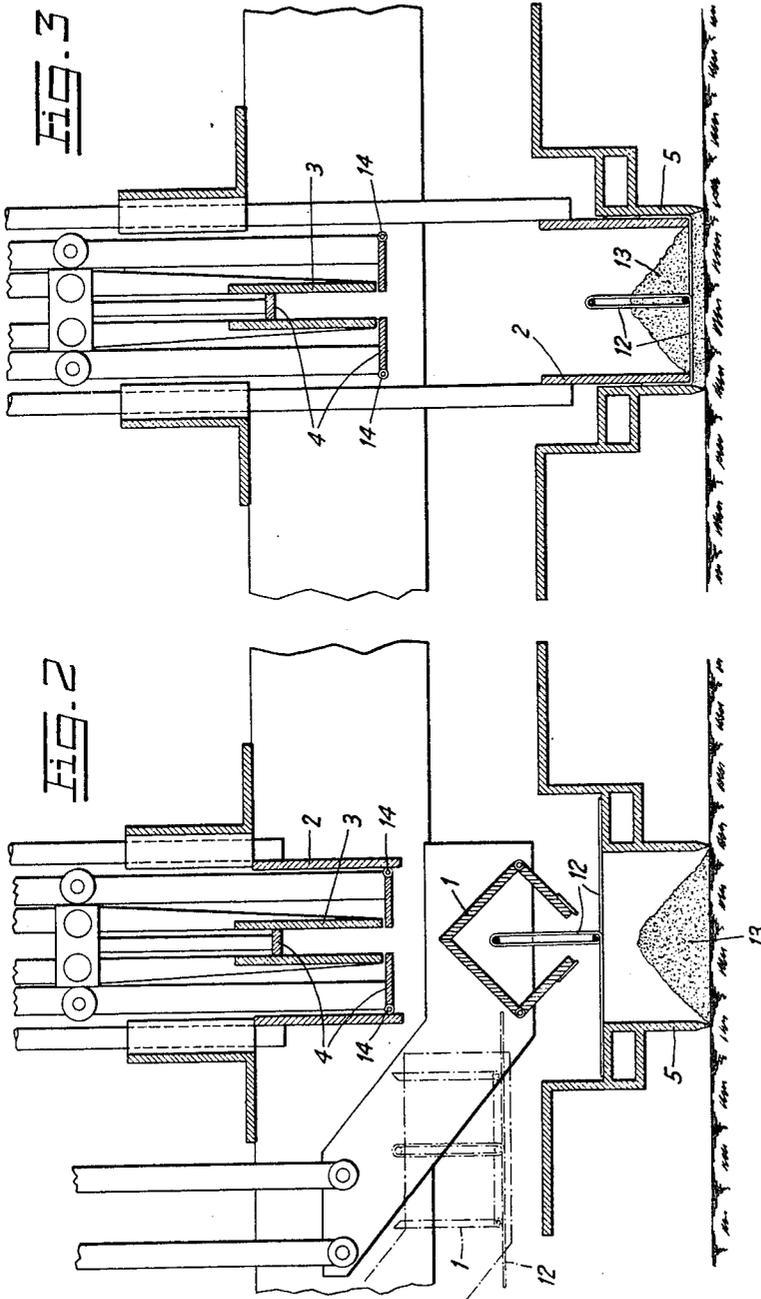
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METHOD FOR PRECASTING A STRUCTURAL BUILDING ELEMENT

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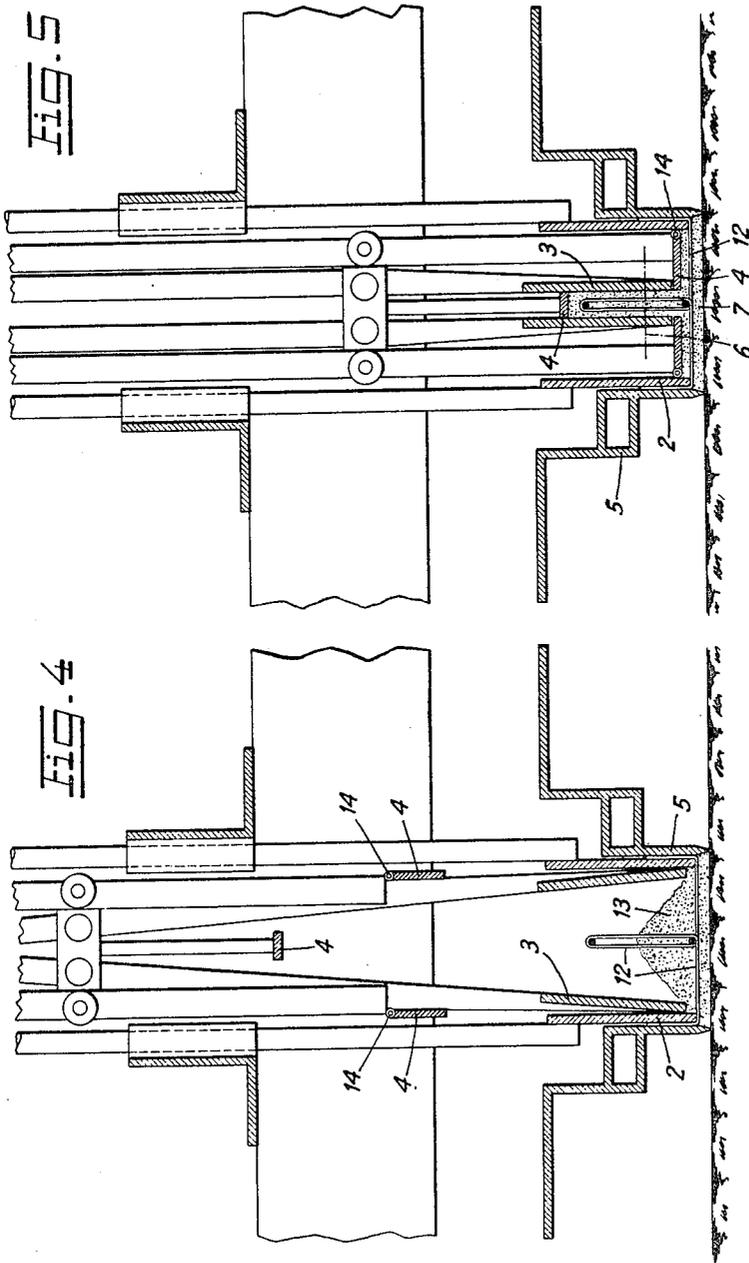
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METHOD FOR PRECASTING A STRUCTURAL BUILDING ELEMENT

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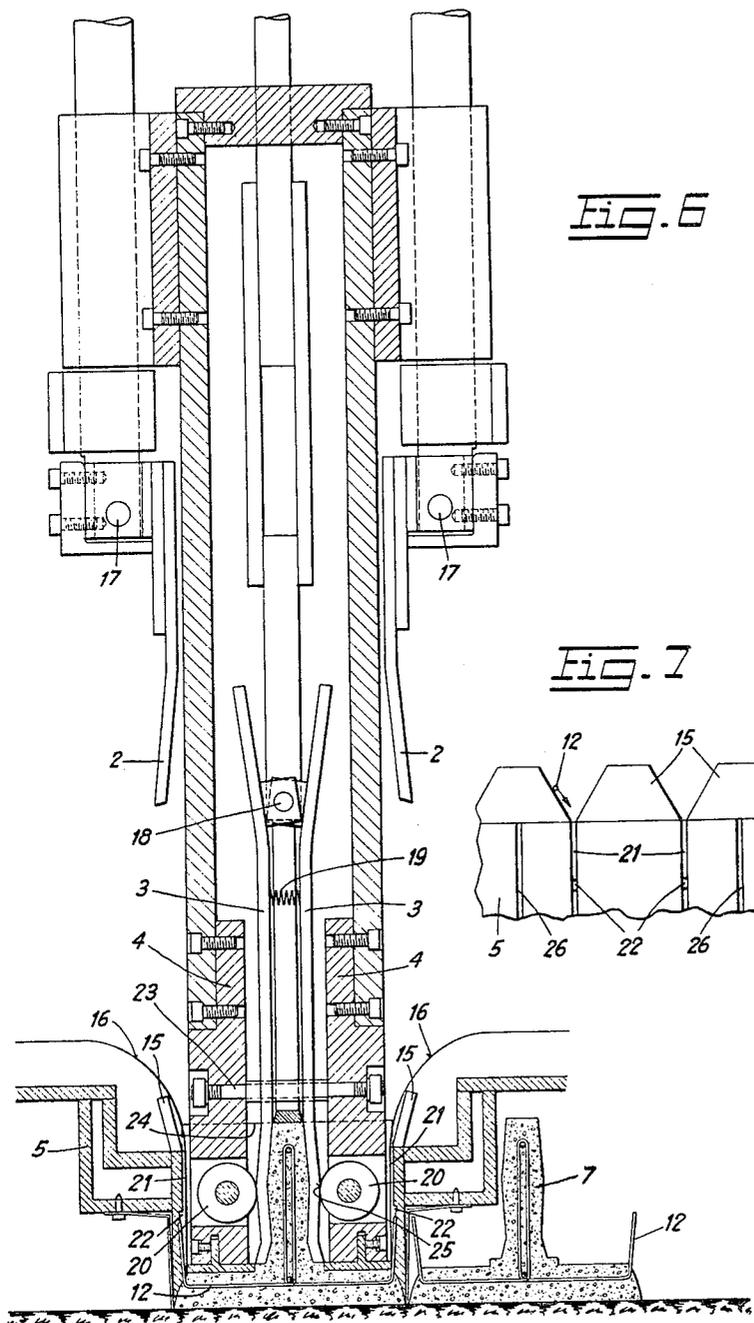
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METHOD FOR PRECASTING A STRUCTURAL BUILDING ELEMENT

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**METHOD FOR PRECASTING A STRUCTURAL BUILDING ELEMENT**

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5 Claims. (Cl. 264—163)

The present invention relates to a method of producing structural elements in the form of planks or beams destined for the erection of walls and load-carrying ceilings.

The methods used so far in the erection of buildings and structures are neither rational nor efficient and economical, since they do not allow satisfactory use of prefabricated elements.

Most known methods require mounting a formwork, inserting the reinforcements in situ, and finally the provision of a mortar coat or the like to produce a smooth surface. All of these operations not only require a great deal of material and cause or necessitate much waste but also call for great care and relatively many skilled workers.

The present invention, in contra-distinction to such requirements of prior art, allows to make available to the building industry prefabricated elements by the use of which the mounting of form-work and the insertion of reinforcements in situ is obviated to a large extent and which render possible the erection of smooth walls and ceilings of which the surface no longer requires any finishing work.

In the method disclosed by the present invention a plurality of juxtaposed reinforced elements of T-shaped cross-section are produced from concrete on a working platform, the webs pointing upwardly, then casting a layer of porous heat-insulating material over a series of said elements and smoothing down such layer, a tunnel-shaped space being kept free of said porous material above the joints where the flanges of said elements abut against each other and the ends of the cross-reinforcements projecting into said space, and cutting said layer in vertical planes passing through said joints.

The installation or apparatus for carrying out said method, is movable on rails arranged on both sides of the working platform to bridge the latter in its entire width, and comprises a formwork box lowerable to the ground, first metal sheets lowerable in said box along the sidewalls for depressing the reinforcement, second metal sheets lowerable in spread position to occupy the entire width of said box and pivotable towards the centre for heaping concrete to form the T-web and horizontal thirds metal sheets for pressing the T-flanges and the T-web from above.

The structural element comprises a T-shaped reinforced concrete portion and a layer of porous insulating material of the same width as the T-flange, said layer entirely enclosing the T-web and being recessed above the edges of the T-flange to accommodate the bent-off ends of the cross-reinforcement. When using such prefabricated structural elements according to the invention, the elements are set side-by-side horizontally for the purpose of producing a ceiling or vertically for the purpose of erecting a wall, and filling with concrete the arising tunnel-shaped spaces along the joints between the T-flanges, the end-portions of the flange cross-reinforcements projecting into said spaces.

Examples of the invention will be explained with the aid of the schematical drawings, in which—

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FIG. 1 is a sideview of a first example of the installation of apparatus during the introduction of the concrete and reinforcement;

FIG. 2 is a fragmentary cross-section of this installation in the same operative position as in FIG. 1, but in a larger scale;

FIGS. 3 to 5 depict the same cross-section as in FIG. 2 in other operative positions;

FIG. 6 is a sideview of a second example of the installation, partly in section, the T-shaped structural element being entirely encased in the forms;

FIG. 7 is a fragmentary view of the form-wall of said installation, seen from inside; and

FIG. 8 depicts a few finished or completed structural elements.

Before taking up the details of the method and installation, it may be convenient to give a short correlated review or survey on the procedure of producing the structural elements.

On an even platform first are cast the reinforced T-elements 7 of standard concrete of high compressive strength, side-by-side as shown in FIGS. 1 and 6. Such elements suitably are set over the entire length of the platform.

The elements shown in the drawing are intended for the construction of load-carrying ceilings; for this reason the T-web comprises a heavy reinforcement. In the case of elements for the erection of walls, only the T-flanges are reinforced. The T-web is not reinforced, and, furthermore, made shorter than shown in the drawing.

After the platform has been covered over its entire length with conventional T-beams 7, and after the concrete thereof has sufficiently set, cores or troughs 8 are set up along the joints where two elements abut against each other. Said cores or troughs serve for excluding gas concrete from a tunnel-shaped space 8 when such concrete 9 is cast on the T-beams above the joints at points where the cross-reinforcements protrude from the T-flanges.

As soon as the highly porous gas concrete 9 has set and hardened sufficiently, its layer will be cut in downward direction on its entire width, accurately above the joints of the T-beams and downwardly to the tunnel-shaped hollow space. The structural elements according to the invention now are complete and may be raised from the platform one after another.

By means of the installations shown, the production of said elements is mechanized and automatized to a high degree.

The embodiment of the installation shown in FIGS. 1 to 5 comprises several subassemblies movable singly and in succession with the aid of hydraulic drive mechanisms 10. As a whole, the installation is mounted on a frame or stand movable on rails and of which the length corresponds to the maximum length of the elements. The hydraulic drives are actuated and controlled by means indicated at 11.

Upon completion of a conventional T-beam, the apparatus is moved forwardly for the width of one element (FIG. 1). The formwork 5 then is lowered to the floor, the rear formwork-sheet thus contacting the previously produced element from the outside.

The input chute 1 is in the extended position shown in dot-and-dash lines in FIG. 2. The bottom of channel 1 is closed; by and below same is clamped the reinforcement 12. When producing elements having a reinforced web, the web reinforcement projects from below into chute 1.

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After the concrete has been fed, in the accurate quantity required and in the proper distribution, into chute 1, the latter is retracted over the form and folded (FIG. 2). In this actuation, the reinforcement 12 is released and drops on to the form, the concrete 13 dropping through the reinforcement on the floor where it forms a heap. Chute 1 then is extended again.

For depressing the reinforcement, the sheets 2 are lowered. As soon as the latter hit the transverse reinforcement wires, they bend the ends thereof upwardly and then force said wires through the heap of concrete until the reinforcement has assumed the appropriate height above the floor or ground (FIG. 3).

The T-web is formed by means of the sheets 3. When being lowered, they are spread apart (see FIG. 4). To render this possible, the flange-pressing sheets 4 are moved angularly and downwardly on hinges. The sheets 3 then are folded from the position shown in FIG. 4 into that shown in FIG. 5 and thereby heap the concrete up to above the reinforcement. When making elements having no T-web reinforcement, a correspondingly smaller quantity of concrete is filled in so that it will be heaped by the sheets 3 only up to the line 6. In the subsequent pressing operation, the web-pressing sheet 4 in such case also is lowered down to line 6. During such lowering from the position of FIG. 4 into that of FIG. 5, the flange-pressing sheets 4 execute a pivoting movement on the hinges 14. In this terminal position, the element is mounted in forms on all sides, and, thus, can be very effectively pressed and packed down. Such packing suitably is carried out by pressing only. It is, however, also possible of course to use only vibration, or vibration and pressing, for packing and consolidating. In some of the operations described, for example, when depressing the reinforcement into the concrete heap, or when heaping the T-web concrete by means of the sheets 3, or when swinging the web-pressing sheets 4 inwardly, it may be of advantage to employ vibration.

It further is possible to fabricate prestressed elements by providing means that keep the longitudinal reinforcement members under tension while the concrete is setting.

Stripping the forms from the finished element, i.e. returning the parts of the installation from the position according to FIG. 5 into that of FIG. 2, takes place in the following order:

First the reinforcement depressers 2 are raised, then one after another the external form 5, the pressing sheets 4 and finally the web-forming sheets 3. As soon as all the parts have been raised, the entire installation may be advanced by one step for casting the next-following T-beam.

In practice it has proved suitable and convenient to lay out the installation with a form-width of approximately eight inches, and to subdivide the form box lengthwise also in sections of eight inches. With such arrangement, practically all the element lengths required may be made with the aid of limiting or spacing sheets. Several short-length elements may also be fabricated side-by-side.

The installation shown in FIGS. 6, 7 differs from that shown in FIGS. 1 to 5 in that the sheets for depressing the reinforcement athwart of the forms are pivoted to their actuating linkage, the pressing means are at least approximately of the same width as the formwork, and in that the part thereof which for pressing penetrates into the forms, comprises means for closing the T-forming sheets that have entered into the form and for exercising a lateral pressing action.

The form 5 of this second example of the installation disclosed by the invention, which prior to forming a fresh element 7 is lowered to the floor of the working platform, is similar to that of the first example. The interior walls of this form 5 comprise a vertical groove 21 for each crosswire of the reinforcement 12. Between each pair of grooves 21, sheets 15 having beveled side-edges are mounted on the upper edge of the form walls, said sheets

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forming V-guides with the side edges of the adjacent sheets, which guides during the fall-in on the form lead each crosswire of the reinforcement 12 accurately over the appurtenant groove 21.

The sheets 2 for depressing the reinforcement 12 resting on the form into the latter, are pivoted at 17 to the actuating linkage thereof and are forced by springs into the position shown. When lowering said sheets, they abut against guides 16 by which they are led on the interior wall of the form, being resiliently urged against same, and sweep downwardly along the form walls, thus cleaning same. The ends of the cross-reinforcement wires resting on the form are bent over at right angles and put into the grooves 21. The sheets 2 are lowered until the reinforcement 12 is at the proper height above the floor, whereupon they are retracted from the form into the position shown. Lest the reinforcement during the retraction of the sheets 2 be dislocated, notches 22 are pivoted at the bottom of the grooves 21, in which the ends of the reinforcement wires are hooked.

After retraction of the sheets 2, the sheets 3 are lowered for forming the T-web, said latter sheets being pivoted to their actuating linkage. As soon as the sheets 3 in the lowering step move out of the pressing means 4, their swells 25 will be below the pressing rolls 20 so that the spring 19 may cause the sheets 3 to spread apart. The spread sheets abut against the guides 16 which direct same into the form. They are lowered in spread position until they are properly spaced from the floor.

In the subsequent lowering of the pressing means 4, the pressing rolls 20 glide along the spread form sheets 3 and shove same together again. In such movement the concrete is heaped above the reinforcement, and the web is formed. In the last stage of the lowering movement, the web and the two flanges of the T-beam 7 are subjected to a relatively high pressure from above. Since the sheets 2 during such pressing movement are not in the form, the pressing means may occupy the entire width of the form, whereby the flanges and also the marginal portions are pressed very uniformly.

In the final pressing stage, the pressing rolls 20 are at half the web-height which is very favorable for pressure application. The two punches of the pressing means 4 are of sturdy construction and braced against each other by crosspins 23 for the purpose of taking-up the horizontal thrust of the rolls 20.

Cross-sheets 24 serve, as described in connection with the first example, for subdividing the installation lengthwise in the fabrication of elements shorter than the installation itself. The cross-sheets 24 thereby are held in grooves 26 (FIG. 7) that are disposed in the center of each second panel of the form-walls formed by the grooves 21.

The installation for fabricating the T-elements suitably comprises a plurality, for example three zones or panels flanked by rails and of equal width. When one of these panels is covered entirely by T-elements, the casting apparatus at the end of the panel may be moved transversely to the second panel. While elements are cast in the second panel, the gas concrete may be applied and smoothed down in the first panel. When the casting apparatus is working in the third panel and gas concrete is applied in the second panel, the gas-concrete slab in the first panel may be subdivided in accordance with the width of the T-beams. To such end, conveniently an apparatus is used which moves on the same rails as previously the casting apparatus. The cutting tool of this apparatus consists of a taut steel wire to which are clamped, at short distances from each other, short pieces of steel pipe. When such wire is longitudinally reciprocated in the manner of a saw and at the same time pressed from above against the gas-concrete slab, said pipe pieces act like the teeth of a saw and produce a smooth and perfectly even cut through the entire slab.

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When it is desired to produce a load-carrying ceiling from T-beams according to FIG. 8, the beams are arranged side-by-side on the abutment walls, the gas-concrete slab facing downwardly of course, and mounted so that the load is transmitted directly on to said walls by said beams. After all the T-beams have been properly arranged and supported, the tunnel-shaped hollow spaces in the joints into which project the cross-reinforcement wires from both sides, are filled with plastic concrete which is injected from the side. To such end a movable concrete container comprising a pressing means may be used, said means having a flexible hose with an injection head that may be connected to the entrance of the channels.

After this joint concrete has set, the ceiling at once has its full carrying capacity and is entirely smooth and even. Only a floor covering need be applied thereto.

The T-elements intended for the erection of walls are set side-by-side in alignment. After the vertical tunnel-like hollow spaces have been filled the end-portions of the transverse reinforcement wires here also afford the fast connection of the wall elements. The porous gas concrete imparts to the structural element high insulating capacity against heat, cold and sound.

I claim:

1. In a method of fabricating structural building components in the form of planks or beams destined for the erection of walls and/or load-carrying ceilings, the steps of sequentially producing from conventional concrete on a working platform in side-by-side relationship, a plurality of reinforced components preferably of T-shaped cross-section, the webs of said components standing upright, placing cores over the abutting joints of said reinforced components end portions of transverse reinforcement means projecting into a tunnel-like space formed by said cores, casting a slab of porous insulating material over a series of such components, said cores producing a tunnel-like space above said joints which is free of said porous material, and cutting said slab in vertical planes passing through said joints and said tunnel-like spaces.

2. A method according to claim 1 wherein the step of sequentially producing a plurality of reinforced components comprises placing two spaced vertical form walls

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on a platform, pouring a conical heap conventional concrete between said form walls, pressing reinforcement means into said heap, allowing the end portions of the reinforcement means to extend transversely to the length of the component, bending upwardly said extended portions forming said concrete into an upright median rib and longitudinal flange portions, and exerting pressure on said concrete thereby compacting it according to the form.

3. A method as set out in claim 1 wherein the reinforced components are produced by a movable installation which sequentially produces said components.

4. A method according to claim 1 wherein gas concrete is used as porous insulating material, and said gas concrete slab is cut by a taut wire having a reciprocating motion.

5. A method according to claim 1 in which the production of the reinforced components, casting of porous insulating material and cutting said slab are accomplished by three juxtaposed panels sequentially accomplishing each said operation while passing over a work platform.

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