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Otsuki et al.

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[54] **APPARATUS FOR PRODUCING PRECAST CONCRETE MEMBERS**

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[52] **U.S. Cl.** **425/404,** 264/228, 425/88, 425/455

[51] **Int. Cl.** **B28b 11/00**

[58] **Field of Search** ..... 264/228, DIG. 43; 425/404, 425/88, 455

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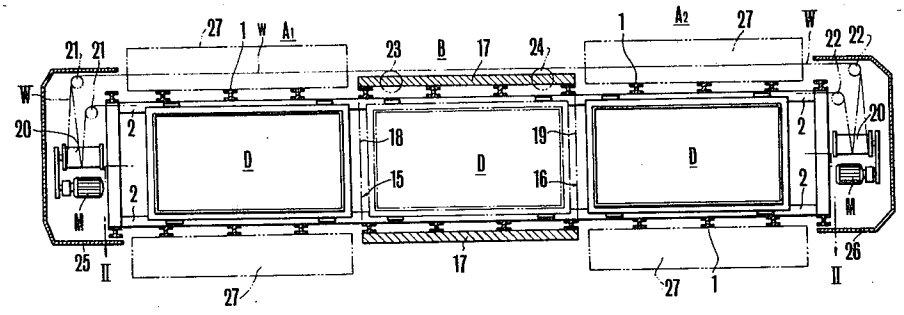
[57] **ABSTRACT**

An apparatus for producing precast concrete members which is efficient, mobile and cost saving, and comprises at least: a curing chamber having openings on opposite sides, each of which sides faces a respective concrete placing section; the curing chamber having a plurality of horizontal motion transferring means to support and transfer form members leaving predetermined distance apart, concrete placing sections in which necessary work for concrete placing is carried out, the placing sections are provided with horizontal motion transferring means, and a predetermined number of precast concrete form members which are disposed and separately move horizontally and between said curing chamber and said concrete placing sections.

10 Claims, 5 Drawing Figures



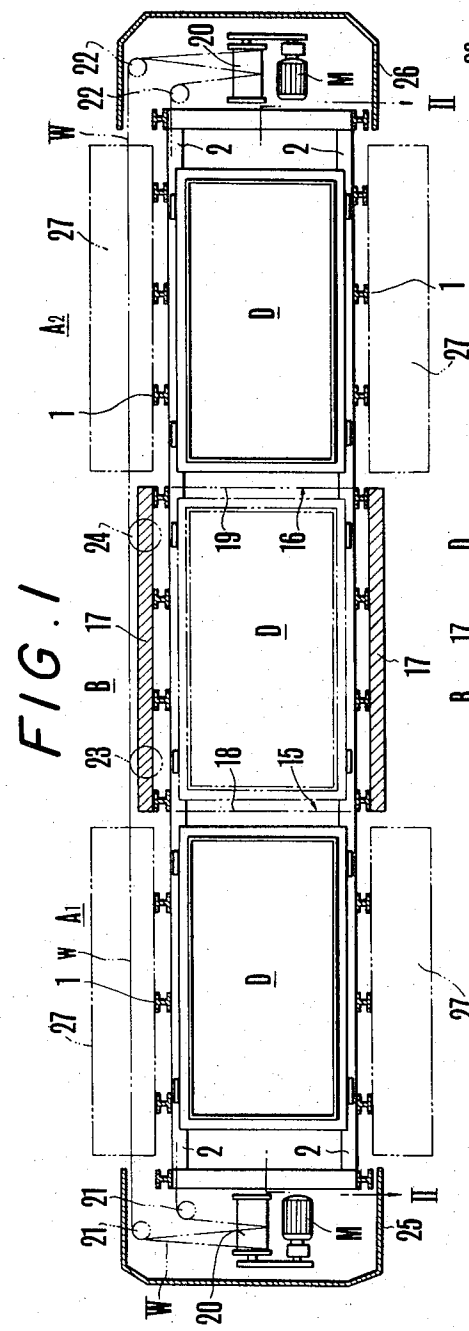


FIG. 1

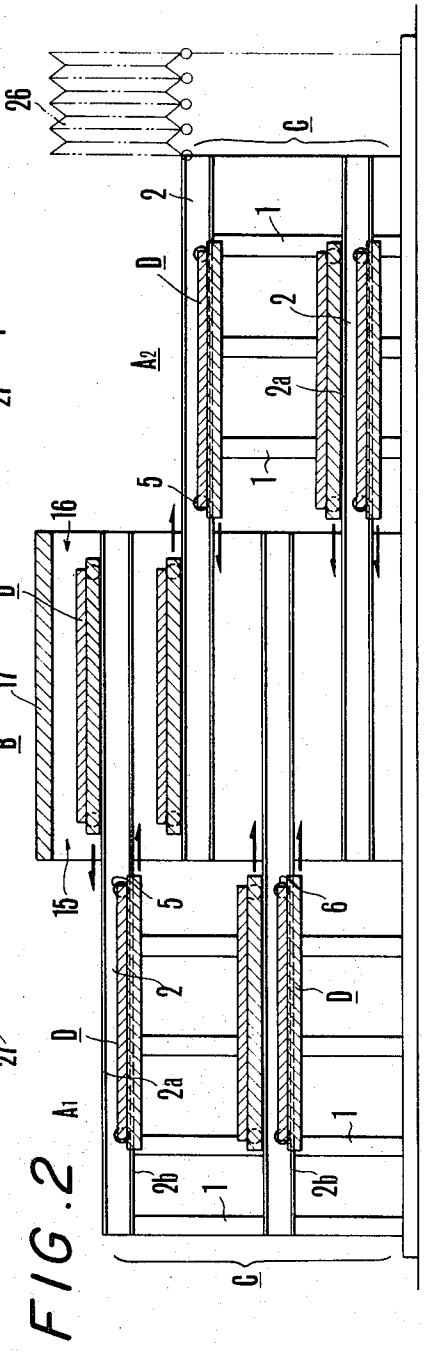


FIG. 2

FIG. 3

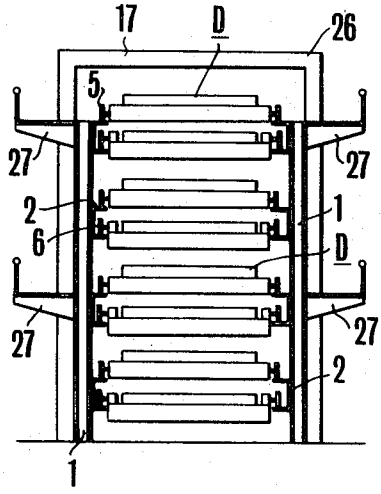


FIG. 4

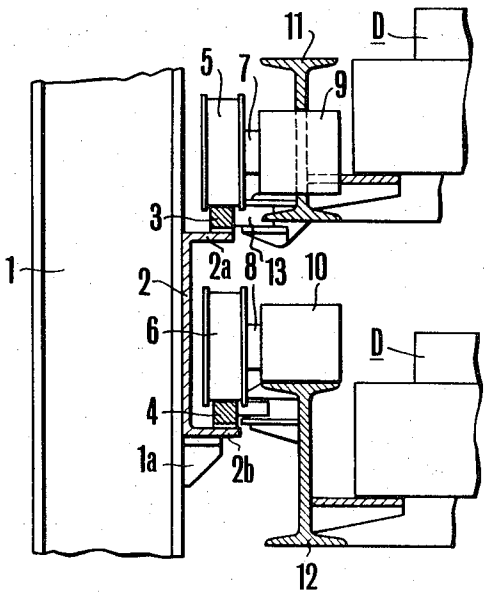
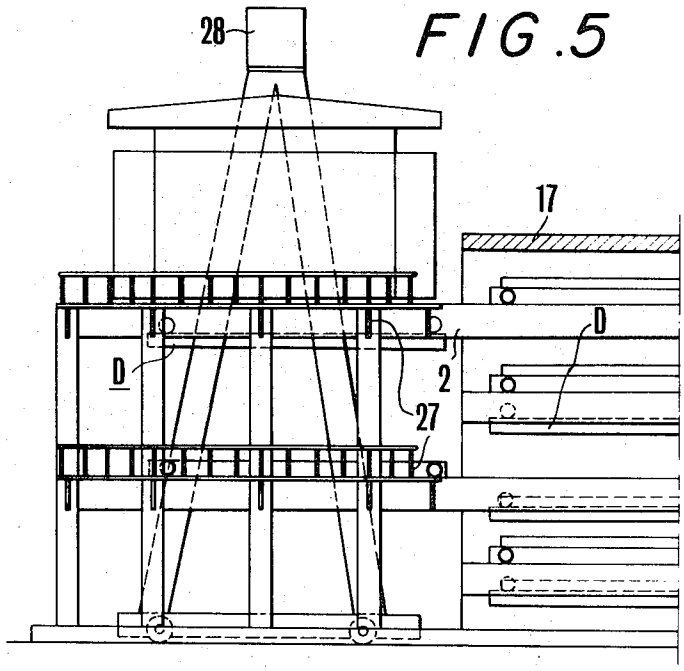


FIG. 5



APPARATUS FOR PRODUCING PRECAST CONCRETE MEMBERS

The present invention relates to an apparatus for producing precast concrete members (hereinafter referred to as "PC member"), in which the concrete placing and curing are performed in a multilayered arrangement and in a continuous manner, in which the production of the PC members can be produced at the construction site, and which apparatus is compact and mobile.

The present invention saves equipments and floor space through the multilayered vertical arrangement and the working of the conveyor system. Further, the apparatus of the invention comprises several unit parts which can be assembled and disassembled without difficulty. Therefore, the apparatus is very convenient for the production of the PC members at the construction site.

In the apparatus of invention, the concrete placing sections, which are provided with precast concrete holding form members, are positioned on both sides of the central curing chamber. The preliminary work and placing of concrete can be carried out separately or concurrently in the concrete placing sections to improve the workability.

Several steps in the production of the PC members by the apparatus of the invention can be carried out independently using separate respective production lines. The control of curing chamber is easy. The inspection of the process is made easy to facilitate the checking for defects. Because of the independence of separate steps, there is no fear of delay caused by performing the preceding and following steps on other PC members.

In addition, each concrete holding form member can be introduced into or taken out from the curing chamber separately. Thus the workability of the PC members can be increased very much.

With the apparatus of the invention, the required working space is small as the apparatus is vertically arranged. The preliminary work for a PC member is carried out on a respective flat truck that is engaged with a multi-layered horizontally movable transferring means. Each flat truck is movable independently with regard to other flat trucks. The order of the work on PC members can be determined at will. The work can be started with any PC member. Thus the work can be done efficiently. The removal of the PC members from the curing chamber can be performed at any time.

In order that the invention may be more fully understood, preferred embodiments and various supplementary features will be described with reference to the accompanying drawings, in which:

FIG. 1 is a plan view partly in section of an embodiment of the invention;

FIG. 2 is a vertical sectional view of the embodiment as shown in FIG. 1;

FIG. 3 is a vertical sectional view of a concrete placing section of the embodiment;

FIG. 4 is an enlarged sectional view showing the horizontal transfer means for the concrete holding form member; and

FIG. 5 is a sectional side view of the concrete placing section and a part of the curing chamber showing the working state;

The embodiment shown in FIGS. 1 to 5 comprises working sections A1 and A2, a curing chamber B, form members D and horizontal transferring means C. The

working sections A1 and A2 are rectangular cross section spaces which extend away from the opposite sides of the curing chamber B. The curing chamber B is tunnel shape with open ends and the working sections are positioned at the openings of the curing chamber. Each form member D includes a flat truck which is supported in verticallyy oriented layer and which moves on said horizontally transferring means.

The dimensions of the working sections A1 and A2 may be large enough to permit performance of several operations relating to the form members D. The working sections are provided with a plurality of said horizontal movement transferring means C which are disposed in vertical layers. The form members D having said flat trucks are shifted on these transferring means C. Supporting frames 1 are spaced along the opposite close sides of the rectangular spaces of said working sections A1 and A2 at regular intervals. Each frame 1 faces a corresponding frame 1 on the other side of the working section. A plurality of vertical layers of rails 2 are attached to frames 1. Each of these rails 2 extends from the outer end portion of its respective working section through the curing chamber B, and still being supported by the frames 1, terminates at the other side of the curing chamber B.

Each rail 2 on one side of a working section is paired with a corresponding rail 2 on the other side of the working section. The horizontal distance between the rails 2 of the pair is enough to receive the form member D with the flat truck, and the space between the pair of rails 2 is open. The horizontal movement transferring means C in working section A1 are disposed on the different vertical levels with respect to the horizontal movement transferring means C in working section A2, and they are layered alternately to form multi-layered arrangement. This is, shown in FIG. 2, wherein the rails 1 of the working sections A1 and A2 are extended from the respective end portion of the respective working section horizontally into the curing chamber B and shifted alternately in the opposite directions. The uppermost rail 2 of the working section A1 is positioned above the uppermost rail 2 of the working section A2. Accordingly, the uppermost rail 2 of the working section A2 is between the uppermost rail 2 and the next rail 2 of the working section A1. The distance between a rail 2 and the next lower rail 2 in one working section may be somewhat larger than the height of men. A rail 2 of the other section deviding the distance by half between them in the curing chamber B.

Therefore, the work on the uppermost form member D and that on the next lower form member D can be carried out independently and concurrently in the working section A1. This is so with form members in the other section A2.

The multi-layered rails 2 of the horizontal movement transferring means C receive the form members D and moves them between the respective working section A1 or A2 and the curing chamber B. The horizontal movement transferring means C and form members D are explained with reference to FIG. 4.

The rails 2 are U-shaped and are supported and secured to the frames 1 by brackets 1*a*. The upper and lower horizontal flanges 2*a* and 2*b* of a rail 2 are provided with and carry guide rails 3 and 4, respectively, on which wheels 5 and 6 are rotatably engaged. Flat trucks 11 and 12 are supported by these wheels 5 and

6 through shafts 7 and 8 and supporting members 9 and 10.

On a pair of rails 2, at least two flat trucks 11 and 12 are suspended, and these flat trucks 11 and 12 move independently of each other on the respective flanges 2*a* and 2*b* of the rails 2. Accordingly, each flat truck 11 and 12 must be spaced vertically some distance apart so as not to stand in the way of the other flat truck. For example, the flat truck 11 is positioned on the horizontal level of the flange 2*a*, to which the wheel 5 is engaged, while the flat truck 12 is positioned under the horizontal level of the shaft 8 of the wheel 6.

The layered construction of the horizontal movement transferring means C and of the form members D in the above-mentioned structure are installed in the working section A1 and A2, respectively. As clearly shown in FIG. 2, each rail 2 has a respective pair of flat trucks 11 and 12. They form alternate layers in each working sections A1 and A2. Further, the flat truck is preferably provided with side rollers 13 with proper support shafts. The rollers rotatably engage the side faces of the guide rails 3 to prevent the derailment of the truck 11, 12 and to enhance operation. Each of the abovementioned flat trucks 11, 12, 11*a*, and 12*a* is provided with a pallet on which the fresh concrete is placed. Accordingly, said form member D includes the transferring means. The abovementioned pallet may be fixed to the flat truck, or hinged to one side of the flat truck.

The curing chamber B is a tunnel-like housing 17, which has end openings 15 and 16 that face the working sections A1 and A2, respectively. The height of the curing chamber B is enough to receive the multilayered horizontal movement transferring means C and the form members D. The square measure of chamber B is somewhat larger than that of the form member D. The above-mentioned openings 15 and 16 of the curing chamber B are provided with closing means 18 and 19 to keep closed during the curing operation.

Further, each form member D on the horizontal movement transferring means C may be shifted by human power. Alternatively, it can be provided with driving means on the wheels 5 and 6. Alternatively, as shown in FIG. 2, each working section A1, A2 is provided with a winch drum 20 at the end portion of which is a drive motor M. Around winch drum 20 is wound with a wire rope W which is fixed separately to the front and rear of each of the form member D through pulleys 21, 22, 23 and 24. By this means, each form member D can be moved between the curing chamber B and its working section A1 or A2. Above the machinery rooms containing the motors M are placed covering folding sheds 25 and 26 in order to protect the rooms. Further, both of the outer sides of the horizontal movement transferring means C is provided with decks 27 for operators to stand on and which are used during placing concrete in the form member D. Decks 27 are positioned on the outer sides of the frames 1 which are supporting the rails 2.

The production process for PC members using this embodiment will now be explained.

Each form member D is shiftable on its layer of rails 2 in its working sections A1 and A2. Several operations such as cleaning and fitting of reinforcing steel are carried out separately. For example, as shown in FIG. 5, a workman stands on the deck 27 in the working section A1 using the crane 28 to facilitate the work. The positioning of structural joints, insertion of auxiliary frames for opening portions, pipings and wirings are carried out. After these steps, fresh concrete is placed in the form member D and the form member D is shifted into the curing chamber B. In this process, the placing of concrete to the pairs of form members D can be carried out concurrently with all layers or may be carried out by turns.

After the form member D is moved into the curing chamber B by a horizontal movement transferring means C, it is preheated. After the excessive water disappears, the form member D is removed from the curing chamber B into the working section A1 or A2. Then the surface finishing of the concrete is carried out. Afterward, the form member D is moved again into the curing chamber B to be fully cured. Upon completion of the curing, the form member D is removed from the curing chamber B. The PC member is released from the form member D by crane 28, and the PC member is laid in the depository yard. Then the empty form member D is subjected to several operations, such as cleaning and arrangement of the reinforcing steel. Fresh concrete is placed again into said form member D, then the member D is introduced into the curing chamber B to carry out the same process.

It should be emphasized, however, that the specific embodiments described and shown herein are intended as merely illustrative and in no way restrictive of the invention.

What is claimed is:

1. Apparatus for producing precast concrete members, comprising:

a curing chamber in which concrete is to be cured; concrete curing means in said curing chamber; said curing chamber having a first side facing toward a concrete placing section; and a second side facing toward a second concrete placing section;

a first concrete placing section in which work for concrete placing is performed; said first concrete placing section having a first side facing toward said curing chamber first side;

a second concrete placing section in which work for concrete placing is performed and which has a respective second side facing toward said curing chamber second side;

a first plurality of precast concrete form members for receiving and shaping concrete;

first horizontal transfer means for said first form members; said first form members being connected to said first horizontal transfer means so that each said first form member is individually movable by its said first transfer means; said first horizontal transfer means extending into and between said curing chamber and said first concrete placing section; said first form members being reciprocally movable between said first concrete placing section and said curing chamber; said first horizontal transfer means being adapted for enabling such reciprocal movement of said first form members;

a second plurality of precast concrete form members for receiving and shaping concrete;

second horizontal transfer means for said second form members; said second form members being connected to said second horizontal transfer means so that each said second form member is individually movable by said second transfer means; said second horizontal transfer means extending into and between said curing chamber and said second

concrete placing section; said second form members being reciprocally movable between said second concrete placing section and said curing chamber; said second horizontal transfer means being adapted for enabling such reciprocal movement of said second plurality of form members;

said first and second horizontal transfer means and the respective said form members connected thereto are arranged in two respective pluralities of vertically stacked, spaced apart layers; said layers of the said first horizontal transfer means and their respective said form members alternate in the vertical stacking with said layers of said second horizontal transfer means and their respective said form members.

2. The apparatus of claim **1,** wherein said curing chamber and said second sides are on opposite sides thereof and said concrete placing sections are disposed on opposite sides of said curing chamber.

3. The apparatus of claim **1,** wherein each said layer of each said horizontal transfer means is comprised of the two horizontal flanges of a channel shaped, elongated rail element, which said flanges are arranged one above the other, whereby each said channel shaped rail element defines two vertically stacked, relatively closely spaced rails; on each said rail is supported a respective said concrete form member.

4. The apparatus of claim **3,** wherein said rail element of each said horizontal transfer means layer is spaced from the neighboring said layer of that said horizontal transfer means about the height of a man.

5. The apparatus for producing precast concrete members of claim **1,** wherein the said alternation of said layers occurs only in said curing chamber.

6. The apparatus for producing precast concrete members of claim **1,** wherein said horizontal transfer means comprises means for individually, reciprocally, horizontally moving said form members of both said pluralities between said curing chamber and the respective said concrete placing section.

7. The apparatus for producing precast concrete members of claim **1,** wherein said layers of each said horizontal transfer means are spaced from the neighboring said layer of that said horizontal transfer means about the height of a man.

8. The apparatus for producing precast concrete members of claim **3,** in which said form members each comprise a movable truck; said trucks having engaging means which engage the respective said horizontal transfer means.

9. Apparatus for producing precast concrete members, comprising:

a curing chamber in which concrete is to be cured; concrete curing means in said curing chamber; said curing chamber having a side facing toward a concrete placing section;

a concrete placing section in which work for concrete placing is performed; said concrete placing section having a side facing toward said curing chamber side;

a plurality of precast form members for receiving and shaping concrete;

horizontal transfer means for said form members; said form members being connected to said horizontal transfer means so that each said form member is individually movable by said transfer means; said horizontal transfer means extending into and between said curing chamber and said concrete placing section; said form members being reciprocally movable between said concrete placing section and said curing chamber; said horizontal transfer means being adapted for enabling such reciprocal movement of said form members;

said horizontal transfer means comprises horizontal rails which are engaged by said trucks and along which said trucks are movable;

said form members each comprise a movable truck; said trucks having engaging means which engage the respective said horizontal rails;

each said horizontal rail is defined as one of the two flanges of a channel shaped, elongated rail element, which flanges are arranged one above the other, whereby each channel shaped rail element defines two vertically stacked, relatively closely spaced said rails; on each said rail is a respective said truck.

10. The apparatus for producing precast concrete members of claim **9,** wherein said horizontal transfer means comprises means for reciprocally moving said trucks along the respective said rails.

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