

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: **80101618.9**

(51) Int. Cl.³: **E 04 C 2/04**
E 04 B 1/04

(22) Date of filing: **26.03.80**

(30) Priority: **26.03.79 US 23671**

(43) Date of publication of application:
01.10.80 Bulletin 80/20

(84) Designated Contracting States:
BE DE FR GB IT NL

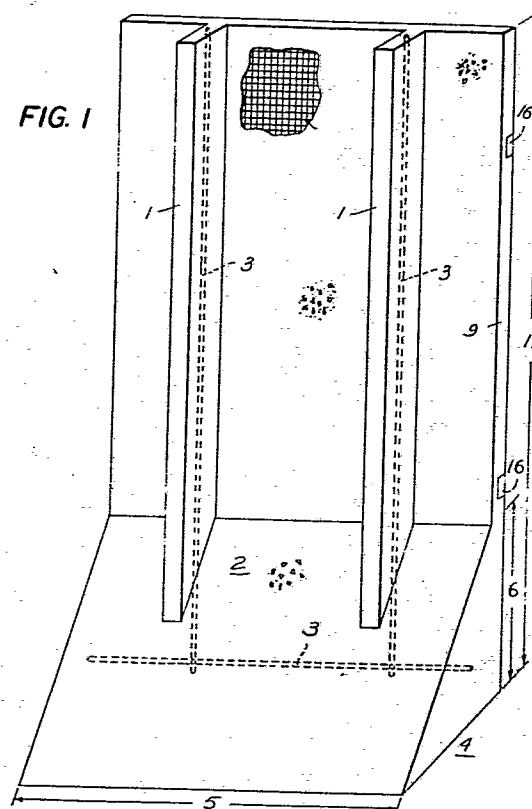
(71) Applicant: **Oakwood Investments, Limited**
c/o BVI International Trust Company, Limited Columbus
Center P.O. Box 662
Roadtown Tortola British Virgin Islands(GB)

(72) Inventor: **Fields, Earl L.**
3218 West Platte Avenue
Colorado Springs Colorado 80904(US)

(74) Representative: **Weickmann, Heinrich, Dipl.-Ing**
Patentanwälte Dipl.Ing.H.Weickmann et al,
Dipl.Phys.Dr.K.Fincke Dipl.Ing.F.A.Weickmann
Dipl.Chem.B.Huber, Dr.-Ing.H.Liska Möhlstrasse 22
D-8000 München 86(DE)

(54) **Pre-cast building unit, building and method utilizing same, and casting form therefor.**

(57) **An elongated pre-cast integral building panel comprising a planar wall-forming section, a foot section integral with said planar section and located at one end thereof, whereby said foot section has a relatively wide base and a tapered body terminating adjacent said one end of said planar section.**



DCH

EU 89

- 1 -

PRE-CAST BUILDING UNIT, BUILDING AND METHOD UTILIZING
SAME, AND CASTING FORM THEREFOR

This invention relates to construction systems and methods, and more particularly to a building construction utilizing pre-cast panels, each of which is an integral unit providing both the foundation foot portion and a
5 complete vertical segment of the wall of the building, and to casting forms for making such panels.

It is an object of the invention to provide a pre-cast building unit, a building structure and method, and a
10 casting form, all of which make it possible to erect building walls substantially without pouring any concrete at the building site.

The ultimate aim of the invention is to make it possible
15 to erect a building with cast concrete walls without the labor and time normally required for building concrete forms and reinforcement structures at the building site as well as reducing the waste of time and labor involved in pouring the concrete into the forms, allowing it
20 to cure, and removing the forms.

It also is an object of the invention to eliminate the cost of transporting to the building site special equip-

ment such as concrete mixers and framing materials. Additionally, it is intended to avoid the waste of materials which sometimes occurs when concrete forms are discarded after use at a building site.

5

It is another object of the invention to improve the consistency of the quality of buildings built of cast materials by building the panels at a manufacturing site at which the effects of weather variations on the curing of the concrete and personnel changes can be minimized.

10

It is yet another object to reduce costs attributable to the ordering of either excessive or insufficient quantities of concrete or other materials usually used at the building site.

15

In accordance with the present invention, the foregoing objects are met by the provision of a pre-cast construction unit or panel which includes both a foot portion and a wall portion. The foot portion is substantially wider than the wall portion so that the foot portion will provide a broad, stable, heavy base to support the wall section in a vertical position.

20

25

The width of the foot portion changes gradually with its height, thus giving it a sloping face. This forms an extremely strong structure, able to be transported to the building site with little danger of damage, while being relatively simple and easy to manufacture. The sloping foot portion ends near the lower end of the panel (below the earth level when installed), thus minimizing the cost of materials used, and ensuring that the wall will be straight.

30

35

Means are provided on each panel for attaching it at the side to another such panel so as to form a wall. Preferably, the attachment means has a substantial vertical extent so that the panels can be secured together without expensive leveling procedures, despite irregularities in the elevation of the ground surface upon which the panels stand.

Means are provided for attaching floor and roof supports to the panels. These means also are adapted to avoid the labor and time required for leveling the panels, by permitting attachment at a variety of vertical positions without changing the levels of the surfaces supporting the floor and roof.

The form used for casting the panels is highly adaptable. It has movable barriers for easily varying the dimensions of the cast panels, thus saving the cost of making many different forms for use in making panels having different dimensions. One type of form can be used either to form two separate panels in one pouring, or can be used to make one very tall panel. Thus, the adaptable form and the method of manufacture have unobvious versatility and greatly reduce the time and cost of manufacture.

The foregoing objects, features and advantages of the invention will be set forth in or apparent from the following description and drawings.

In the drawings:

Fig. 1 is a perspective view of the pre-cast construction unit or panel of the present invention;

Fig. 2 is a side elevation view of the panel of Fig. 1;

Fig. 3 is a partially schematic elevation view showing a plurality of the panels of Figures 1 and 2 connected together to form a building; and Fig. 4 is a perspective view of a casting form constructed in accordance with the present invention.

Fig. 1 shows a preferred embodiment of the panel 10 of this invention. The panel 10 has two stems 1, a flange 9, and a foot section 2. The panel 10 is cast of concrete in one piece; that is, it is monolithic.

Preferably, the panel is reinforced with steel mesh 7, and with steel reinforcing bars of pre-stressed cable at locations indicated by the dashed lines 3. The panel 10 is shown resting upon the earth at 4.

In Fig. 2, as well as in Fig. 1, it is shown that the foot section 2 has a sloping face. The width 13 of the foot section 2 is considerably greater than the thickness 20 of the flange 9 and the thickness 8 of the stems 1. The height of the foot section 2 is such that the foot section ends in the lower portion of the panel. The height 6, the width 13 and the angle of the sloping face of the foot section all are variable, as is the width 5 (Fig. 1) and the height 11 of the whole panel 10. It may be seen that variation in the height 6 of the foot section dictates the variable width 13 of the footer, depending upon the angle of slope of the face of the foot section.

The thickness 8 of the stems 1 and the thickness 20 of the flange 9 are variable, and determine the thickness of the panel 10. The depth of penetration of the panel into the earth 4 is represented by the dimension 12,

and also is variable.

Steel weld-plates 16 are cast-in-place at the side edges of the flange 9. The plates 16 allow the panels 10 to be joined together welding. The weld plates 16 may be formed by bending the ends of the reinforcing bars which span the width of the panel. Thus, when the weld plates 16 are welded together, this welds the ends of the bars together and creates a continuous reinforcement band around the building perimeter (except where interrupted with voids forming doors, windows, etc.). Thus, a plurality of adjacent panels which are welded together form completed walls, including a footer, a foundation and the wall surfaces.

Steel bolts or studs 14 are cast in place and extend into the stems 1. The bolts 14 preferably are tied or otherwise secured to the steel mesh 7 and steel rod or steel cable reinforcements 3 before the concrete is poured during casting.

Bearing-support ledges 15, which may be made of wood, steel or other suitable material, are secured to the panels 10 by means of the bolts or studs 14. The bearing-support ledges 15 support the floor joists 17 of the building, and the whaler 18, at the top. The whaler 18 supports the roof structure 22 (see Fig. 3).

The first step in the method of erecting a building is to determine the engineering and construction specifications. These specifications include the desired number of floors, live- and dead-load requirements, and soil loading and soil characteristics. Then, the panels 10 are ordered and cast. The dimensions of the panels are determined to conform to the specifications,

and include: the width (and number) of the stems 1;
the width 5 of the panel unit 10; the height 6 (and
dependent dimensions) of the footer section 2; and
width 13 of the foot; the depth 8 of the stems; the
5 thickness 20 of the flange 9; the resultant total
thickness or depth of the panel 10; the height 11
of the panel 10; the number and location, vertically,
of the steel bolts or studs 14; and the depth 12 to
which the panel is to be set in the ground, which di-
10 mension bears upon determination of the total length
11. The steel weld plates 16, are cast at suitable
locations according to the dimensions of the panel 10.

The panels are cast from a mold, and the completed,
15 cured panels are delivered to the construction site
when the earth has been prepared to receive them.

The construction crew assembles the panels, joins them
by welding together the weld plates 16, sealing the
20 seams between panels as required. Joined panels may
be sealed to prevent moisture transfer by use of any
suitable waterproofing agent and/or "Visqueen" or
other suitable plastic sheeting material. Any suitable
caulking material may be used to seal the panels above
25 ground. Then the whaler 18 is attached, and the joist-
supporting support ledges 15 are attached to the steel
bolts or studs 14. A completed panel 10, when installed,
may immediately receive floor joists and roofing con-
struction, with no delay in construction.

30 Voids may be cast into the panel as required for door
and window openings, and for construction requirements
such as plumbing and electrical entrances. Voids may
be cast in the base of the footer section, to allow
35 for any necessary relief to accommodate soil expansion.

Panels may be cast without stems, where flat panels are desired; the variable-thickness flange may be increased in thickness in its casting to provide requisite load bearing capacity.

5

Reinforcing may be deleted; or carbon, glass, plastic, wood, paper or other reinforcement materials and methods may be employed, if desired.

10 Fig. 3 is an illustration of a plurality of panels 10 connected integrally to provide an enclosed building structure having a floor 17 and a roof 22. As illustrated, each of the panels 10 is placed on the previously prepared foundation. The drawing shows, in magnified
15 form, the effect of having an imperfectly level foundation. The panels 10 are shown with their bottoms at distinctly different levels. Therefore, the top of each panel 10 is displaced vertically from the top of adjacent panels.

20

The panels 10 are joined together by welding the weld plates 16 together. The weld plates 16 have a substantial vertical dimension so that they have sufficient overlap to accommodate differentials in the vertical
25 positions of the panels 10.

The bearing support members 15 preferably are relatively wide wooden beams; e. g. boards two inches thick by six or eight inches wide. The bearing mem-
30 bers 15 are positioned so that their upper surfaces are level at the height required for the floor or roof, and then holes are drilled in the members 15 to accommodate the bolts 14. Note that the bolts 14 for each of the two members 15 illustrated in Fig. 3
35 are shown at different heights, corresponding to the

differential that exists in the foundation elevation of each panel. In this manner, panels 10 are integrally joined by plural means, comprising both the weld plates 16 and the bolted members 15.

5

As illustrated, the floor 17 is positioned on top of the lower member 15, and may be secured thereto by any conventional means desired. On top of the upper member 15 is positioned the whaler 18, on top of which are positioned rafters 20, with the roof 22 secured to the rafters 20. It is noted that, subject to any limitation on the overall length of the panels 10 that might exist for a particular building, there may be a plurality of additional floors.

15

Fig. 4 shows a preferred casting form 30 for use in casting the panels 10.

20

The form 30 includes side walls 32, end walls 33 and a bottom wall 34, and a supporting structure 36.

25

The side walls 32 and end walls 33 are vertical, and the bottom wall 34 is horizontal in the central areas, but has two sections 38 which slope downwardly so as to form the sloping foot portions 2 of the panels 10 when the form 30 is filled with concrete.

30

The bottom wall 34 has longitudinal recesses or slots 40 which are used to form the stems 1 of the panels 10.

35

In accordance with one aspect of the present invention, the form 30 is easily adaptable to make panels 10 of varying dimensions, and also can be used to make two panels simultaneously with only one pouring of con-

crete. For these purposes there are provided two movable end bulkheads 42 and 44, and one or more movable central bulkheads 46 and 48. All of the bulkheads extend up to or above the top of the side walls 32 and end walls 33 and span the full width 50 of the form 30.

The bulkheads 42 and 44 can be moved longitudinally in order to increase or decrease the height 6 (see Fig. 2) of the foot section 2 of the panel 10. Simultaneously, such movement will increase or decrease the width 13 of the foot section 2, because of the slope in the section 38 of the form. Blocks or wedges of various materials can be inserted between the bulkheads 42 and 44 and the end walls 33 to hold those bulkheads in a given position.

The bulkheads 46 and 48 can be moved to vary the height 11 of the panels 10. Each bulkhead 46 or 48 has a pair of extensions 47 or 49 which fit into the recesses 40. The bulkheads slides along the surface of the bottom wall 34, and is clamped in a desired location by conventional clamping means (not shown).

In order to increase the thickness of the flange 9, rails can be attached to the top of the side walls 32 and end walls 33 to raise the height of those walls.

With the bulkheads in the positions shown in Fig. 4, two panels 10 can be made simultaneously. Concrete is poured into the areas between bulkheads 48 and 44, and also between bulkheads 42 and 46.

If, on the other hand, the desired height of the panel is too great to permit two panels to be made, one

of the bulkheads 46 or 48 can be removed. Then, the extra height is provided by the additional area in the center of the form that is left by the removal of the bulkhead.

5

The form 30 preferably is made of steel sheets. The support structure preferably is made of welded steel reinforcing bars, angles or the like. However, the materials of which the form and its support are made can be wood, metal, fiberglass, etc.

10

The lengths 52, 54 and 56 of the center and two end sections are variable, as are the width 50, total length 58, and height 60 of the form 30.

15

However, an angle of around 45° for the foot section 2 is preferred. Therefore the sloping form walls 38 preferably are at an angle of 45° .

The maximum height presently contemplated for each panel 10 is approximately thirty-four feet. In order to achieve that dimension, the sum of the distances 52 and either 54 or 56 should be slightly greater than thirty-four feet.

25

In a form which has been built and used successfully, the recesses 40 had a width of four inches and a depth of six inches. The width 50 of the form 30 was eight feet, the centers of the recesses 40 were each two feet from the nearest side wall 32, and the recesses 40 were four feet apart. Of course, all of these dimensions can be changed as desired.

30

In using the form 30, the engineering and construction specifications for the panel are determined as descri-

35

bed above. If the stems 1 are not desired, then the recesses 4a can be filled with wood or other materials.

5 Next, the central bulkheads are either inserted or removed depending on whether one or two panels are to be case, and then all of the bulkheads are located so as to produce a panel 1a having the desired dimensions.

10 Next, the steel reinforcing members, bolts 14 and welding plates 16 are located in the form 3a. If needed, additional form members may be added to form voids for doors, windows, and soil expansion chambers in the foot section 2. Also, an eye bolt (not shown) can be positioned in the form so as to provide a means for
15 lifting the panel 1a out of the form when cured.

Then, the concrete is poured into the form, cured and the panel or panels are lifted out.

20 From the foregoing, it can be seen that the invention satisfies the objectives set forth above. The invention makes it possible to erect cast concrete walls at a building site without having to pour concrete at the building site. The structure of the building panels is simple, strong, and relatively easy to make.
25 Moreover, the tops of the building panels can be leveled in a simple procedure. The casting form and method used to cast the panels is extremely versatile and permits variations in the panel dimensions to be
30 made with relative ease.

- 1 -

CLAIMS:

1. An elongated pre-cast integral building panel comprising a plana wall-forming section, a foot section integral with said planar section and located at one end thereof, charaterized in that said foot section has a relatively wide base and a tapered body terminating adjacent said one end of said planar section.
5
2. A building panel as in Claim 1 characterized in that said foot section has a substantially triangular cross-sectional shape.
10
3. A building panel as in Claim 1 oder Claim 2 characterized by securing means integral with said panel for securing said panel to an adjacent panel.
15
4. A building panel as in any of Claims 1 through 3 characterized by support projections integral with and extending outwardly from said planar section for supporting a floor and/or a roof of a building.
20
5. A building panel as in Claim 3 characterized in that said securing means comprises a metal member at one side edge of said panel.

6. A building panel as in Claim 3 characterized in that said securing means comprises a metal member integral with and extending transversely of said panel with at least one end being exposed at one side-edge of said panel.

7. A building panel as in Claim 6 characterized in that said metal member is a reinforcing bar extending completely across said panel with each end exposed at one side of said panel.

8. A building panel as in any preceding claim characterized by a plurality of reinforcing ribs integral with and extending longitudinally of and outwardly from said planar section.

9. A building structure comprising integral, vertically elongated pre-cast building panels buried at one end in the earth and secured to one another in side-by-side relationship to form a wall of said building, characterized by a platform support member extending transversely of said panels and secured to each of said panels, said support member having a vertical dimension greater than the difference in elevation of the lowest and the highest ones of said panels, integral fastening means on each panel at a predetermined location, said platform support member being secured to said panels by said fastening means at varying elevations, whereby said support member defines a platform supporting surface whose level is independent of the elevations of the individual panels in said wall.

10. A structure as in Claim 9 characterized in that said tapered portion is buried in the earth

supporting said building, and said panels are fastened together at their edges.

11. A structure as in either of Claims 9 and 10 characterized by a metal reinforcing member integral with and extending across each panel, the end of each member being fastened to the end of the member in an adjacent panel so as to form a continuous reinforcing member spanning said panels.

12. A structure as in any of Claims 9 through 11 characterized by two of said platform support members, with a roof secured to one and a floor secured to the other.

13. A structure as in any of Claims 9 through 12 characterized in that said foot section has a relatively wide base and a tapered body terminating adjacent said one end of said planar section.

14. A method of constructing a building, comprising the steps of designing said building, selecting a site for said building, evaluating the soil conditions at said site, determining the proper size of the walls of the building based on the design of the building and the soil conditions at said site; precasting said walls of concrete at a casting location in mold means sized in accordance with said determination, and erecting said walls to form said building, whereby no additional concrete need be poured at said site, said pre-cast walls forming foundation, footer and walls of said building.

15. The method according to Claim 14 wherein said walls each comprise a plurality of panels, said panels

being joined to one another during said erection step.

16. The method according to Claim 15 wherein said
panels comprise cast-in means for being joined to
5 others of said panels.

17. A casting form for pre-cast building panels,
said form having side walls and a bottom wall, said
bottom wall being characterized by a substantially
10 horizontal section and a sloping section formed by
an inclined recess at one end.

18. A form as in Claim 17 characterized by movable
means in said sloping section for varying the horizon-
15 tal extent of said sloping section.

19. A form as in either of Claims 17 and 18
characterized by a second sloping section opposite
the first sloping section, and movable barrier means
20 in said horizontal section for separating said slo-
ping sections from one another.

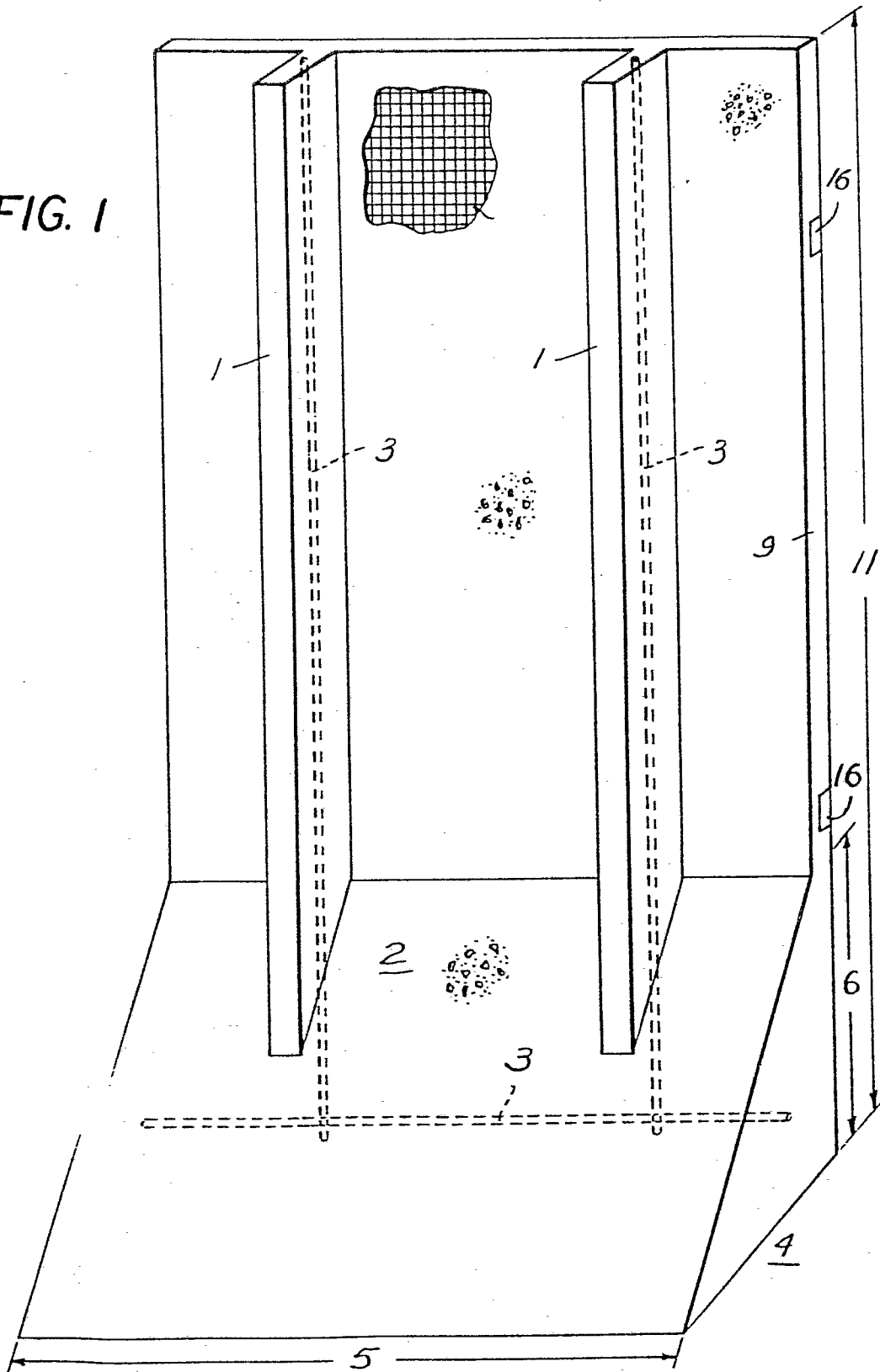
20. A form as in Claim 19 characterized by two of
said movable barrier means in said horizontal section
25 to enable casting two panels simultaneously in the
same form.

21. A method of casting building panels having an
elongated foot portion and a planar wall portion,
30 characterized by using a casting form having a sub-
stantially horizontal section and a sloping section
formed by an inclined recess at one end, and movable
means in said sloping section for varying the horizon-
tal extent of said sloping section, and moving said
35 movable means to adjust the width of said foot portion

at the base to a predetermined value.

22. A method as in Claim 21 characterized by using
a form having, in addition, a second sloping section
5 opposite the first sloping section, and movable barrier
means in said horizontal section for separating said
sloping sections from one another, and moving said
barrier means to adjust the height of said panels
and/or to cast two panels simultaneously.

FIG. 1



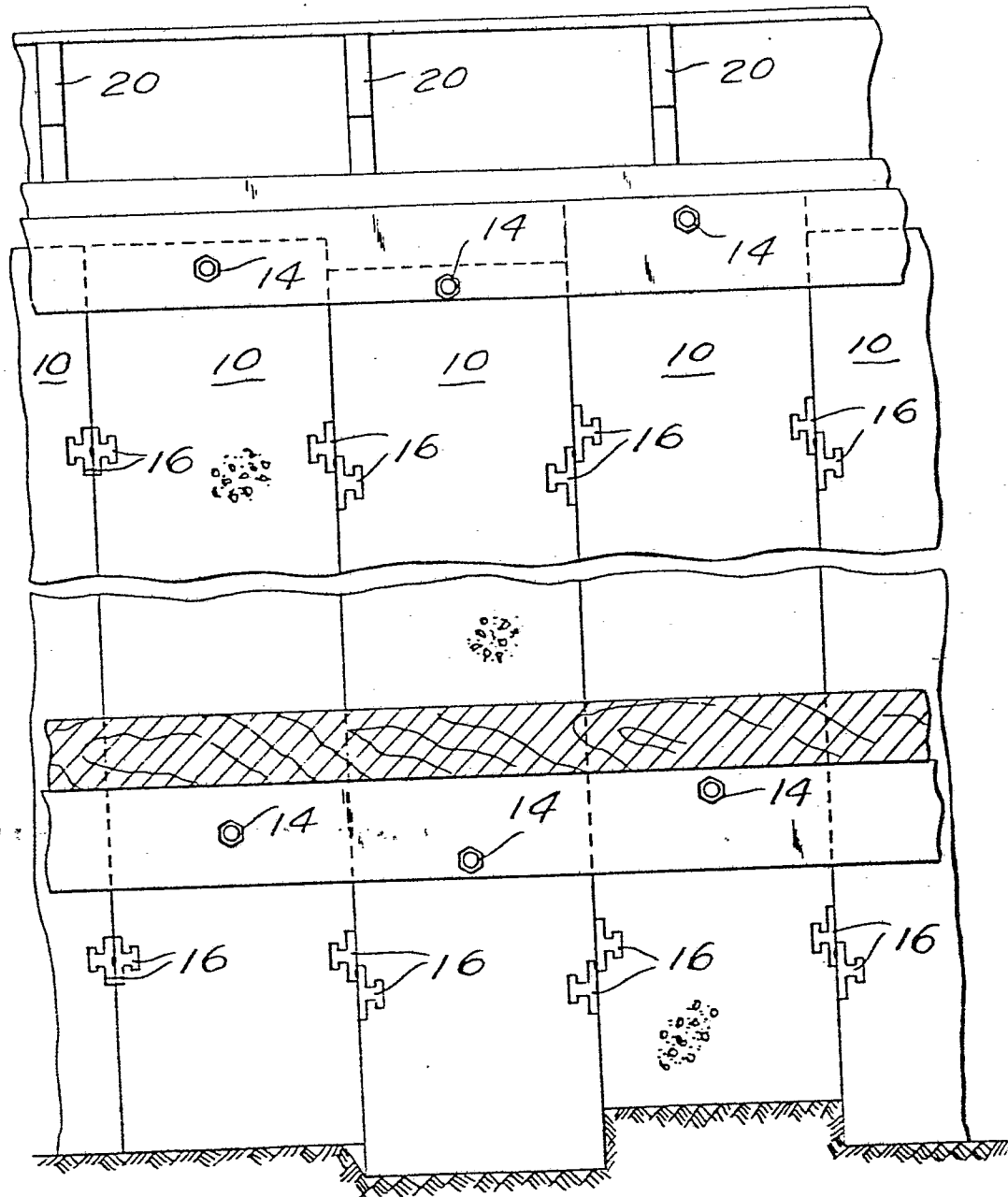


FIG. 3

