

July 31, 1928.

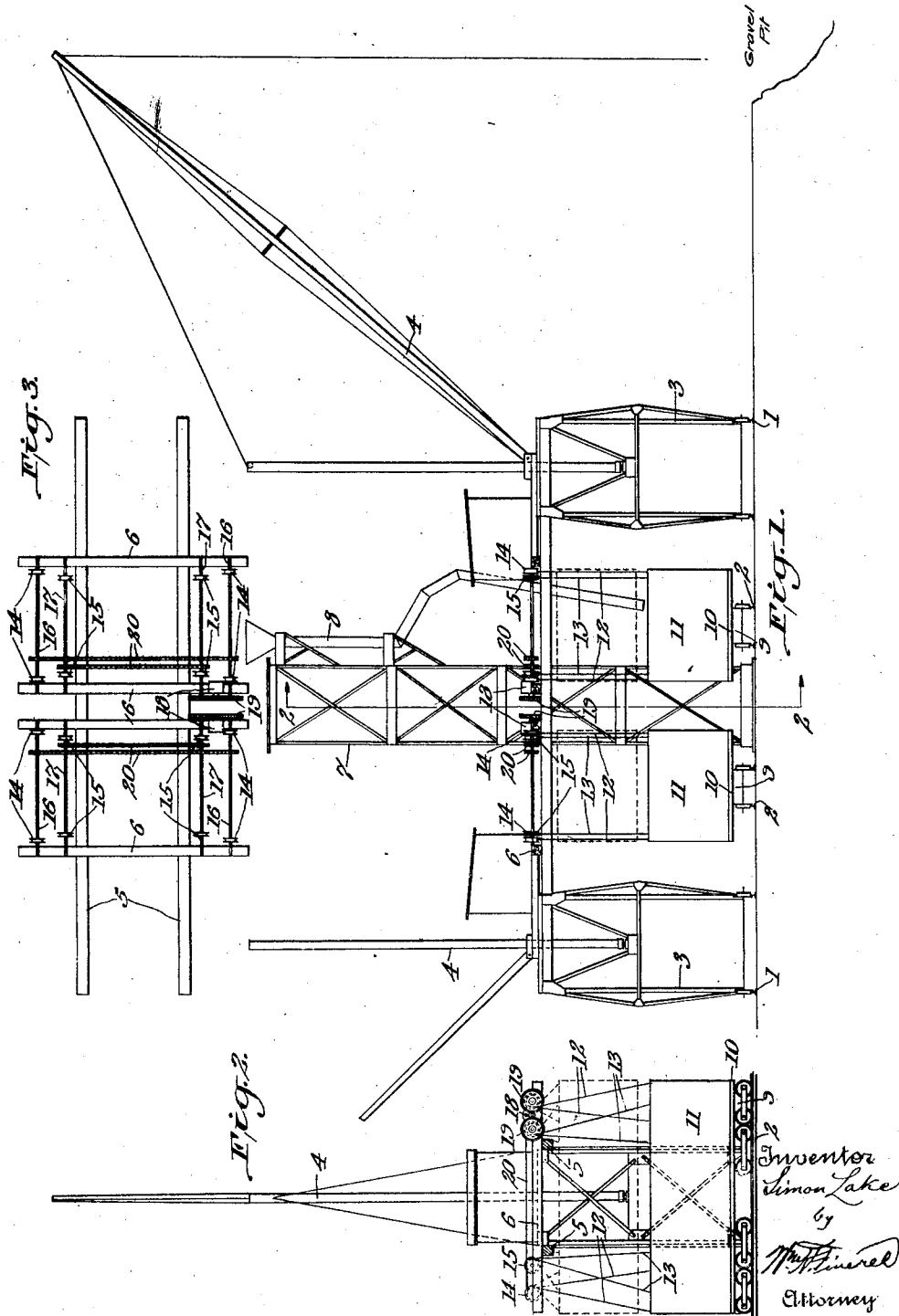
S. LAKE

1,679,040

CONCRETE BUILDING CONSTRUCTION

Filed Sept. 10, 1920

5 Sheets-Sheet 1



July 31, 1928.

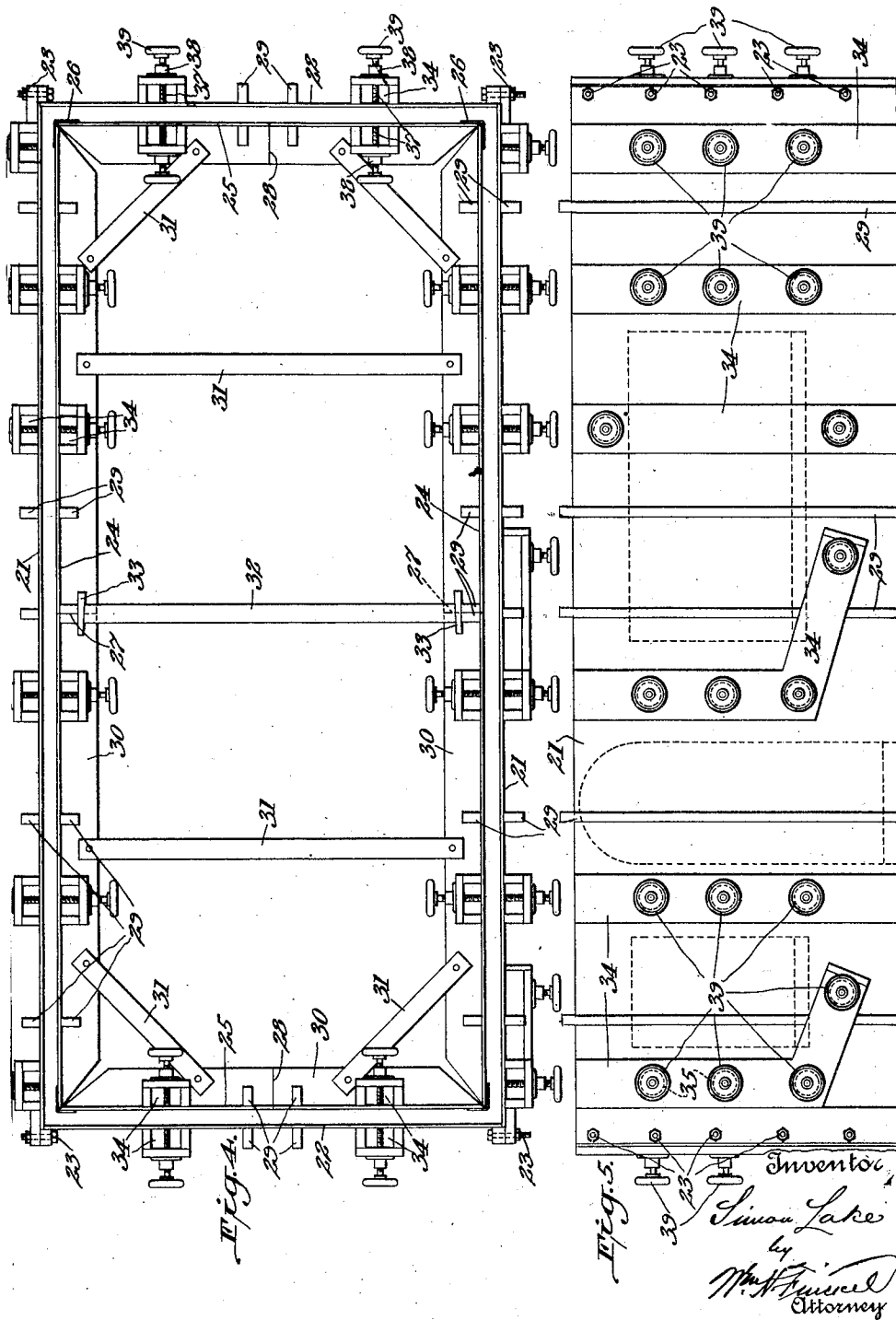
S. LAKE

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CONCRETE BUILDING CONSTRUCTION

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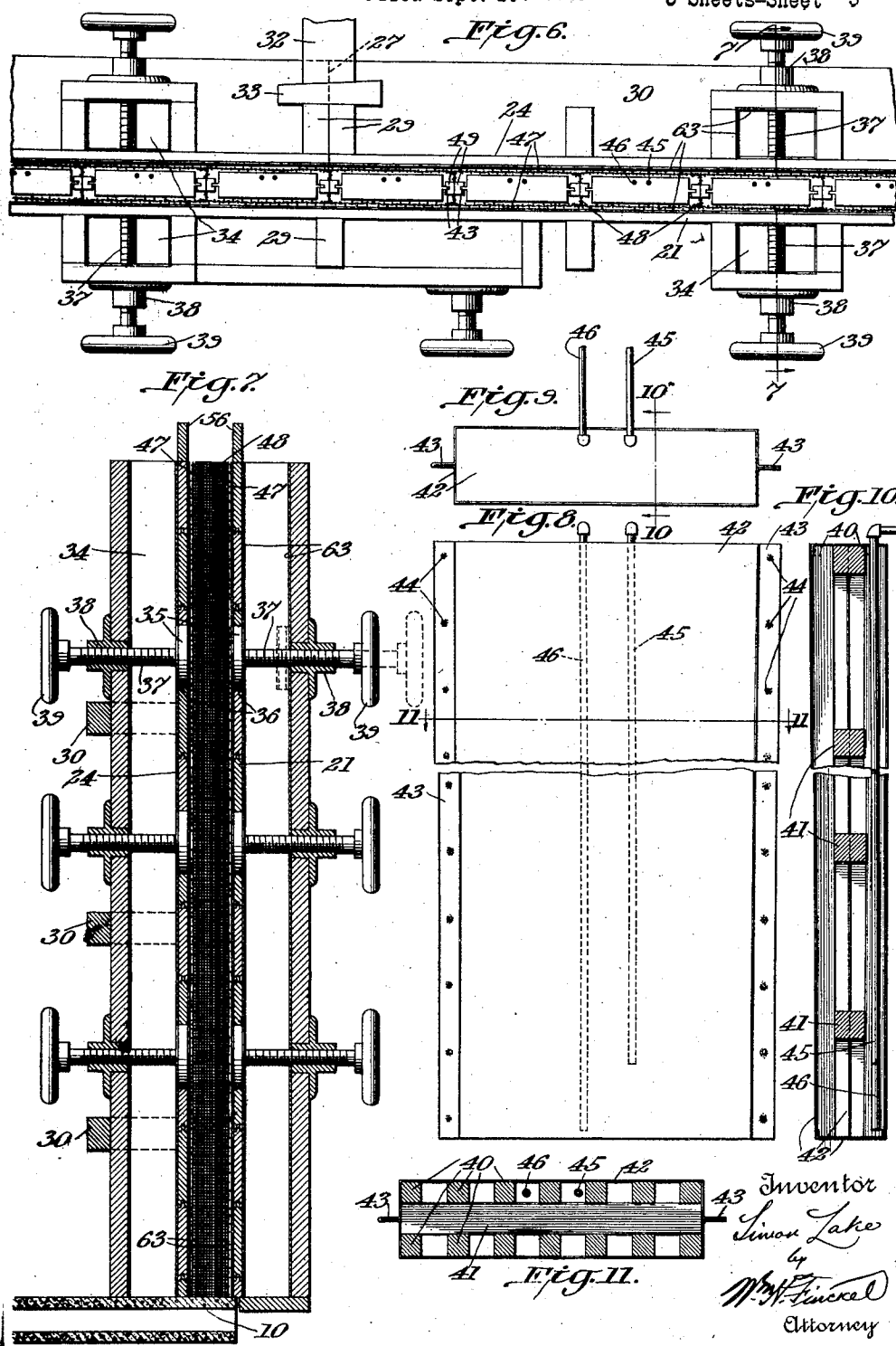
S. LAKE

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Inventor
Simon Lake
by
W. H. Linckel
Attorney

July 31, 1928.

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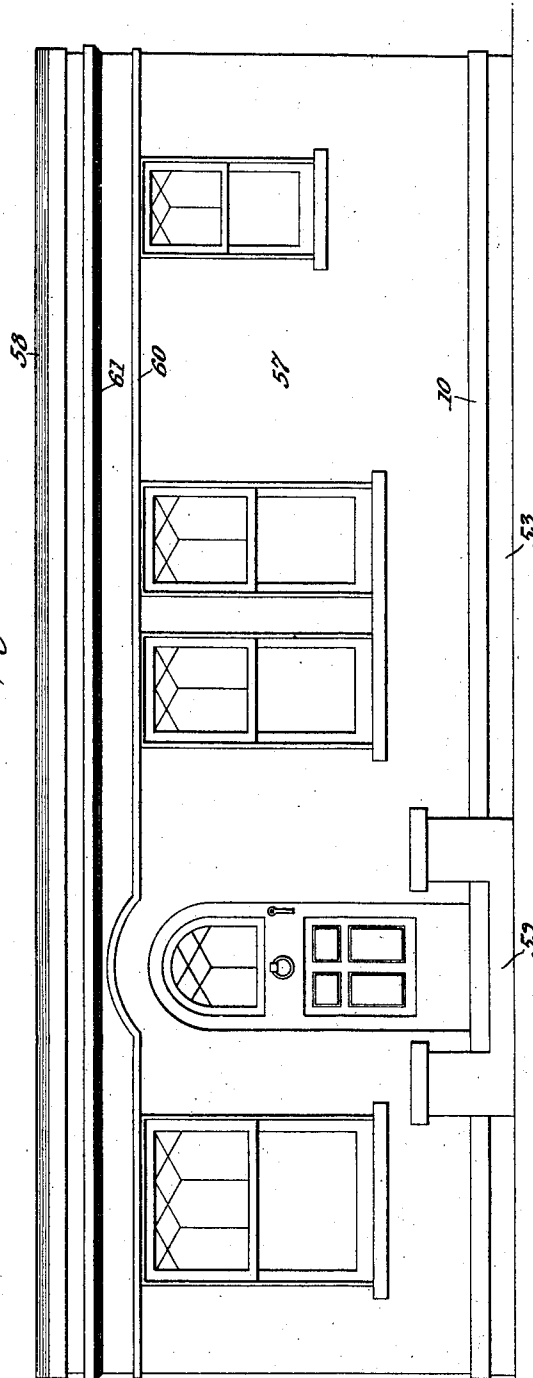
S. LAKE

CONCRETE BUILDING CONSTRUCTION

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Fig. 13.



Inventor
Simon Lake
by
Wm. F. Finnerel
Attorney

July 31, 1928.

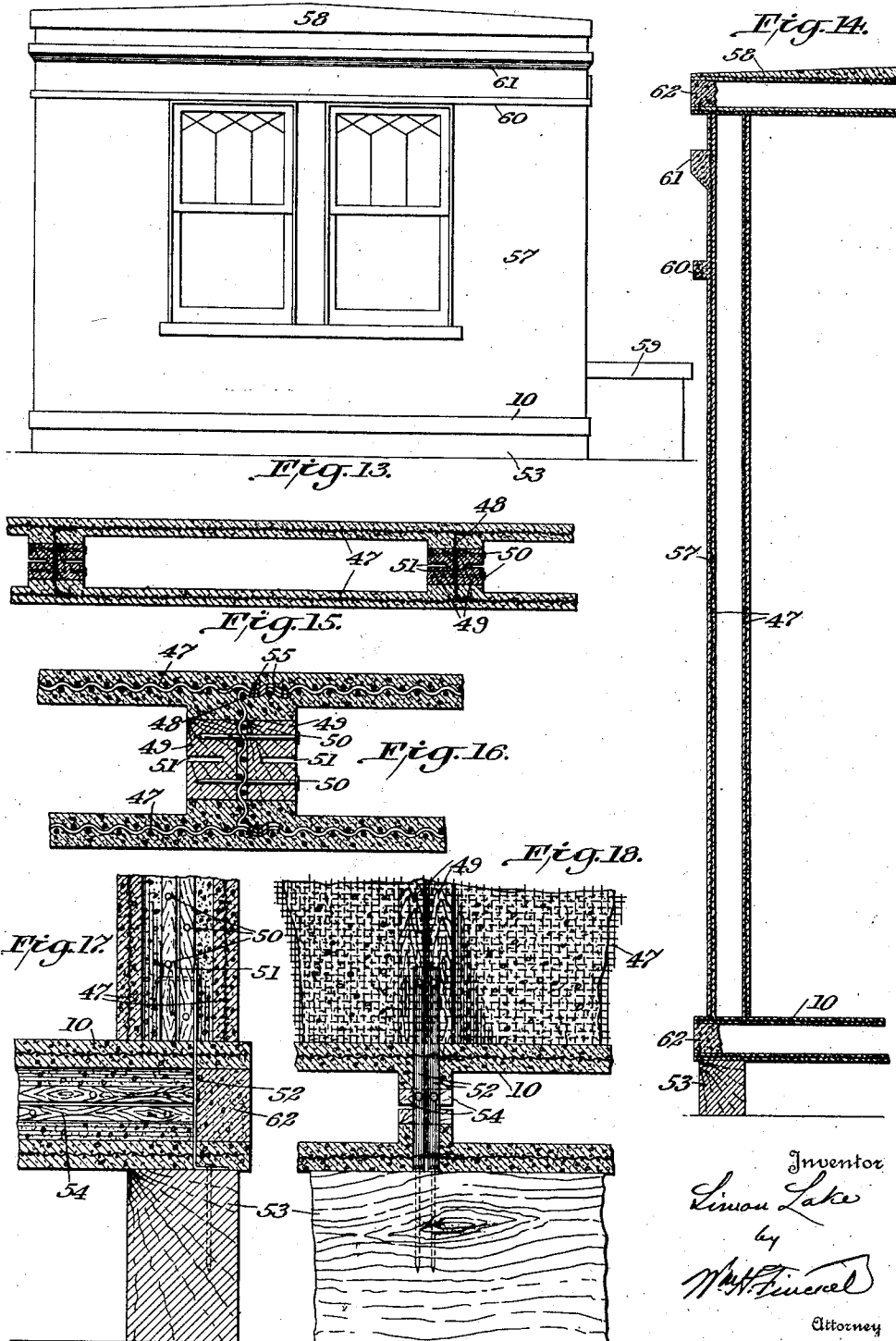
S. LAKE

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CONCRETE BUILDING CONSTRUCTION

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5 Sheets-Sheet 5



Inventor
Simon Lake
by
W. H. Finckel
Attorney

UNITED STATES PATENT OFFICE.

SIMON LAKE, OF MILFORD, CONNECTICUT.

CONCRETE-BUILDING CONSTRUCTION.

Application filed September 10, 1920. Serial No. 409,370.

This invention relates to concrete building construction, and is in the nature of a development of the invention set forth in my Patent No. 1,273,073, dated July 16, 1918.

5 One object of the invention is to provide a method of and apparatus for constructing concrete buildings which will so simplify the process as to materially lessen the time required for constructing the buildings and
10 reduce the cost of construction to a minimum.

Another object is to produce a concrete building which is of such strength as to be capable of transportation from the place of
15 manufacture to the foundations as a complete unit.

A further object of the invention is to provide a method of and means for filling the molds for the building whereby voids caused
20 by incomplete filling and by trapping of air in the concrete mix are eliminated.

A still further object is to form a concrete building suitable for habitation in warm and cold weather, by forming the
25 walls, roof and floors thereof of heat-insulating construction, such insulation being accomplished by providing the parts mentioned with cored portions, thus in effect forming a double-walled structure through-
30 out and providing dead-air spaces between the outer and inner portions of the parts.

Another object is to provide for coloring the building in such manner as to avoid the unsightly and objectionable blotchy discoloration now common in colored concrete
35 after it has been wet.

With these and other objects in view, the invention consists in a method of and apparatus for constructing concrete buildings and
40 the like, which contemplates erecting suitable forms in which may be positioned reinforcing and tying devices and removable cores, filling the molds thus formed with a concrete mix and allowing this mix to set,
45 after which the cores and forms are removed; the apparatus for performing these steps being of such a nature as to materially lighten labor and hasten and simplify construction, and including collapsible removable inner forms and separable and removable
50 outer forms, same being provided with filling ducts and gates, removable cores provided with means whereby they may be heated to hasten the setting of the concrete, and
55 means for removing the forms from one

building and positioning them for the pouring of the walls of another building; all as I will proceed now to explain and finally claim.

In the accompanying drawings illustrating the invention, in the several figures of which like parts are similarly designated, Figure 1 is a schematic view showing the general arrangement of tracks, derricks, hoisting machinery and trucks for manipulating the forms, buildings, etc. Fig. 2 is a partial section on the line 2—2 of Fig. 1. Fig. 3 is a partial plan view of Fig. 1. Fig. 4 is a plan view of the assembled wall forms, the reinforcing and tying members and
60 cores being omitted. Fig. 5 is a side elevation of the parts shown in Fig. 4, the window and door frames of the building to be constructed being indicated in dotted lines. Fig. 6 is a fragmentary plan view of the
65 forms showing the reinforcing and tying members and cores in position. Fig. 7 is a transverse section taken on line 7—7 of Fig. 6. Fig. 8 is a side view of one of the cores, the central portion thereof being broken
70 away. Fig. 9 is a top view of the core. Fig. 10 is a vertical section taken on the line 10—10 of Fig. 9. Fig. 11 is a transverse section taken on the line 11—11 of Fig. 8. Fig. 12 shows in elevation a form of house
75 which may be constructed by means of the invention. Fig. 13 is an end view of such house. Fig. 14 is an enlarged vertical section taken through the side-wall, floor and roof of the house. Fig. 15 is a further enlarged
80 section taken through the wall transversely. Fig. 16 is a detail showing the arrangement of reinforcing and tying members. Figs. 17 and 18 are respectively a transverse and longitudinal section illustrating the manner of tying the walls to the
85 floor and sills.

Referring to Figs. 1 to 3, I show a number of tracks 1—1 and 2—2, the tracks 1—1 being spaced sufficiently far apart to accommodate a plurality of the tracks 2, two of the latter being shown. Upon the tracks 1—1 are mounted travelling supports 3 carrying derricks 4, and these supports are interconnected by heavy cross-beams 5, provided with stringers 6 upon which hoisting devices, later described, are supported. In the background is shown a tower 7 of any approved construction having a concrete-pouring chute 8 supported thereon, and at
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95
100
105
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the right a gravel-pit is indicated from which sand and gravel may be raised by the derrick and deposited in a grader, and then together with cement and water mixed in a
 5 mixing machine, not shown, from which the concrete mix may be transferred to the chute 8 for pouring.

Upon the tracks 2 are mounted trucks 9 adapted to support the pre-formed floor or
 10 bed sections 10 of the buildings being constructed, and upon these floors 10 are erected the wall-forms 11. When the walls have been cast and have set sufficiently to remove the forms, the latter are broken away from
 15 the walls, as hereinafter described, and cables 12 and 13 are attached to the outer and inner forms respectively for raising them above the walls so that the trucks 9 or supports 3 may be moved along the tracks to a new
 20 pouring position. These cables 12 and 13 run to drums 14 and 15 respectively mounted on shafts 16 and 17 respectively and all of these shafts are driven by motors 18 through suitable gearing 19 and chain and sprocket
 25 connections 20. It will thus be seen that when the motors 18 are operated, all of the shafts 16 and 17 will be rotated and the forms 11 raised to the positions shown in dotted lines, Figs. 1 and 2.

As above indicated, and referring particularly to Figs. 4 to 7 inclusive, the wall forms comprise outer forms made in sections, the sections here shown being complete side
 30 sections 21 and complete end sections 22, same being bolted or otherwise secured together at the corners as by bolts and nuts 23; and inner forms made of side members 24 and end members 25, these side and end members being jointed at their meeting corners
 40 by means of suitable hinge members 26, such as strips of sheet metal, or, if desired, common hinges, and both the side members and end members of the inner form being parted midway of their length, as at 27 and 28,
 45 respectively, and adapted to fold inward to accomplish the collapsing of the inner form. As shown, the outer form members are provided with girders 29 to strengthen them, and the inner form members are also provided
 50 with similar girders. These girders extend above the top of the forms so as to permit of the use of fasteners, such as ties or bolts, to hold the outer and inner forms in proper relation one to the other and they
 55 may be supported in sockets in the platform.

These form members also have the longitudinal ribs 30 arranged at intervals throughout their height, these ribs furnishing
 60 attaching means for struts and braces 31 to hold the inner form in proper position when distended. In addition to the struts and braces 31 I provide a central strut 32 adapted to be securely wedged between the
 65 side form members by means of wedge pieces

33 cooperating with the abutting batens 29 at the central meeting edges of the side forms.

Both the inner and outer form members are provided with ducts 34 for pouring the
 70 concrete mix into the forms, these ducts being so arranged on the form members as to come directly opposite each other when the forms are set up in pouring position. Arranged in the ducts are gates 35 which co-
 75 operate with suitable openings 36 in the forms, and these gates are provided with threaded stems 37 which pass through complementally threaded bushings 38 and are provided with hand-wheels 39 by means of
 80 which the gates may be opened and closed as desired.

Referring particularly to Fig. 5, in which the door and window frames of the building to be constructed are indicated in dotted
 85 lines, it will be seen that I so arrange the pouring ducts that at least one of the gate openings thereof will extend beneath each of the window frames, for a purpose hereinafter appearing.

Referring particularly to Figs. 8 to 11, inclusive, in which is shown one of the removable cores used in constructing the walls
 90 of the building, it will be seen that this core consists of an interior framework comprising vertical members 40 joined to and held in spaced relation by longitudinal members 41, and this framework is covered with a casing
 95 of sheet metal 42, suitably bent around the framework and providing at the sides of the core ribs 43, the purpose of which will be later explained, the abutting faces of the metal forming these ribs being suitably united
 100 as by spot-welding as indicated at 44, Fig. 8. As shown, the core is preferably made tapered, being larger at the top than at the bottom on all four sides, and this greatly facilitates its withdrawal from the concrete.
 105 Extending part way to the bottom of the core is a steam inlet pipe 45, through which steam may be introduced to the interior of the core for heating it, and the water of condensation may be pumped out of the core
 110 through pipe 46, which extends to the bottom of the core, the upper end of this pipe being suitably connected with a pump. In order to slightly reduce the outside dimensions of the
 115 cores when it is desired to extract them from the formed wall, I coat them with a mixture of asphaltum, pitch and fine sawdust or ground cork, this mixture being
 120 made fluid by the heat of the steam within the core, the asphaltum and pitch impregnating the concrete of the walls, and waterproofing them, and the sawdust or ground
 125 cork adhering to the walls and assisting in insulating them.

Referring to Figs. 6 and 7, wherein the general arrangement of the cores and reinforcing and tying members is shown, it will
 130

be seen that I provide longitudinal reinforcements 47 of wire mesh or the like, and transverse reinforcements 48 of similar wire mesh, which also act as ties between the longitudinal reinforcing members, and these transverse reinforcements, as shown particularly in Figs. 15 and 16, are held between vertical tie-pieces 49, preferably of wood impregnated with some suitable preservative such as creosote, and joined by nails 50 or the like, to hold them in proper relative alinement, and to clamp the reinforcing members 48 between them. These tie-pieces 49 are provided with vertically arranged grooves 51 with which the ribs 43 of the cores cooperate to hold the cores in spaced relation to the longitudinal reinforcing members and the forms.

In constructing a building according to my invention, the floor or bed structure 10 is first formed substantially by the same method, as regards the use of cores and reinforcements, as presently described with respect to the formation of the walls, and this floor structure has embedded in it bars 52 secured to sills 53 and to tie-pieces 54, similar to the tie-pieces 49, and extending through the upper face of the floor. These bars 52 are spaced at such intervals throughout the length and breadth of the floor structure along its edges as to be in proper spaced relation for the width of the cores used in the construction of the walls, and to the bars 52 are attached the tie-pieces 49 with their transverse reinforcements in place. The cores 42 are then slid in between the tie-pieces 49 and held in vertical position and alinement by means of the grooves 51, and then the longitudinal reinforcements are put in position and secured to the transverse reinforcements by wrapping wire 55 at suitable intervals.

When the cores and reinforcements are thus positioned the trucks 9 with the floors and reinforcements mounted thereon are rolled upon the tracks 2 into proper position beneath the forms supported upon their cables 12 and 13, and the forms are lowered to position and adjusted for pouring.

As above described, the sand and gravel are raised by means of the derrick 4 from the gravel pit, and together with cement and water mixed in a suitable mixer, hoisted to the chute 8, and from thence conducted to the ducts 34. Before any concrete mix is allowed to escape from the chute 8 into the ducts 34, care should be taken that the chute is well filled and that air has not been trapped therein, and to this end some concrete should be allowed to escape from the chute before it is positioned over any one of the ducts. It is desirable that all of the ducts should be fed with concrete mix simultaneously, and therefore a number of pipes should be led from the chute 8, one

of such pipes running to each of the ducts 34. The concrete mix being now in condition for pouring, it is admitted to the ducts 34, the lowermost gates 35 of which are first opened, particularly those positioned beneath the window frames, and the concrete mix is run into the forms from the ducts of both the inner and outer forms, the forms being constantly agitated to assist in the setting of the concrete therein. When the concrete mix has risen as high in the forms as the pressure head will force it through the lowermost gates 36, the next higher set of gates is opened, and so on until the forms are filled.

It is well understood that in the setting of concrete, considerable shrinkage occurs, and it is therefore necessary to fill the forms to a greater height than the height desired for the finished wall, and in order that this may be done, I provide the tops of the forms with mold boards or risers 56 running around the entire tops of the forms, (Fig. 7) and fill the molds to the tops of these risers. After the initial setting is over and the usual shrinkage has ceased, the risers are removed and any surplus concrete is scraped off.

When the walls being formed are of sufficient thickness to permit it, it is desirable that the concrete in the molds be tamped, but in the type of house shown in the drawings, I propose to have walls of only about one inch in thickness of the concrete, and tamping in this case, of course, is impossible.

It will be understood that as fast as the concrete mix rises in the molds above the gates, the gates will be closed, so that when the molds are filled, their inner surfaces are substantially flush and unbroken, and in order that the gates may be properly adjusted inwardly the threaded stems 37 may be provided with marks (not shown) to indicate the proper point at which inward movement should stop.

After the concrete has been poured steam is admitted to the cores through the pipes 45, and in this way heat is produced in the cores sufficient to melt the outer coating thereon, and lubricate their faces sufficiently to admit of their being easily withdrawn, and also drying out the concrete and hastening its setting. Before the cores are removed or before they are used again the water of condensation should be removed therefrom by means of the pipes 46.

After a sufficient time has elapsed for the proper setting of the concrete, then the gates are forced inward against the walls by means of the hand-wheels, and the forms in this manner broken away from the walls. whereupon they may be raised free thereof as hereinbefore described.

My invention is directed particularly to

the construction of houses of such size that they may be easily transported from the place of manufacture to their foundations as a unit, as above stated, and I have shown in Figs. 12 and 13 a side and an end view, respectively, of such a house. This type of house, constructed according to my invention, would consist of a floor structure 10, comprising a single cored, or, if desired, solid slab, of concrete upon which is erected and to which is tied, as hereinbefore described, the wall structure 57 which forms in a single cored cast of concrete the four walls of the building, and upon this wall section is supported the roof 58, which like the floor may be a single cored slab of concrete, but preferably inclined on its top to form a watershed, as shown in Fig. 13. This roof may be cemented or otherwise suitably united with the walls.

As hereinabove stated, the window and door frames are set up in the mold, before the concrete is poured, and hence become an integral part of the wall structure, but the stoop or porch 59 should preferably be made as a separate unit and later properly placed.

In the house illustrated, a suitable decorative molding 60 and cornice 61 are shown. As will be obvious, these may be formed on the face of the wall when the wall is cast by simply providing suitable jogs in the face of the outer form.

It will thus be seen that I provide a house in which the floor, walls and roof are made of simple and durable construction, and firmly united to each other to form a compact, unitary, portable house.

By reference to Fig. 14, it will be seen that by using the cores in the floor, walls and roof, a double walled structure is formed, the cored space providing protection against heat, cold and dampness. In order to greater enhance proofing of the house against the seepage of moisture through the concrete, which is known to be more or less pervious to water, the use of the mixture of asphaltum, pitch and fine sawdust or ground cork, particularly ground cork, on the cores before pouring of the concrete and the subsequent heating of the cores, is most advantageous, as either the sawdust or the cork has a tendency to absorb any moisture which may seep through the walls and prevent it from condensing upon the inner side of the wall and from forming in drops. The use of ground cork in this connection is well recognized in the submarine boat art, in which the entire interior shell of the boat is painted with a paint containing ground cork to prevent condensation of moisture.

As shown in Fig. 14, in the floor structure and roof the cored openings extend to the outer edges thereof, because it is from these edges that the cores are withdrawn,

and hence these openings must be filled in either with brickwork or with cement as shown at 62.

The particular advantage of admitting the concrete mix to the bottom of the mold and then gradually raising its level therein by opening gates higher up, lies in the fact that in this way voids and air-pockets are practically eliminated, because the air is free to escape upward as the concrete is admitted, as contrasted with the ordinary style of pouring from the top where the air has to find its way out through the inflowing concrete. Moreover, in pouring from the top the concrete is very apt to stick to the walls of the mold and to the reinforcements in the mold, and in that way prevent other concrete from dropping down to the bottom of the mold, and in filling from the bottom first this difficulty is also eliminated.

As shown in Figs. 6 and 7, the inner faces of the forms and gates and the interior of the ducts may be provided with metal linings 63, to facilitate the flowing of the concrete and the subsequent cleaning of the forms and ducts.

When it is desired to color the walls, and in the case of the small portable house shown, both the exterior walls and the interior walls may be colored, and not otherwise finished, their surfaces being made smooth by the metal linings of the forms, coloring matter may be added to the concrete when it is mixed and this coloring matter and the walls themselves, as above suggested, will be waterproofed by the impregnating and waterproofing effect of the asphaltum and pitch with which the cores are coated, this waterproofing preventing discoloration of the inner walls by seepage or condensation of rain or other water. While the walls are heated they may be sprayed with heated liquid paraffin or other compounds which I find penetrate the concrete to a considerable depth and thoroughly impregnates it so that rain does not change its color, which is so objectionable in concrete buildings of the usual construction.

It is to be understood that I do not consider my invention as limited to the specific form of house, or to the specific method of construction and apparatus for carrying out the method, as shown and described, as various changes may be made therein without departing from the spirit of the invention or the scope of the following claims.

What I claim is:—

1. In concrete building construction, a truck adapted to movably support a pre-formed concrete floor structure, forms adapted to be assembled upon said floor structure to form wall molds, a tower provided with means for receiving concrete mix, chutes running from said means to said forms for supplying the mix thereto, and hoisting

means for raising said forms out of contact with said floor structure to permit of said truck with the floor structure and the walls formed thereon being moved from beneath said forms or said forms to be moved from over said poured structure.

2. In concrete building construction, a floor structure, means embedded in said structure for supporting reinforcing and tying members, a wall structure, transverse reinforcing members in said wall structure, tie-pieces secured to the means embedded in said floor structure and between which said transverse members are fixed, and longitudinal reinforcing members attached to said transverse members and suitably spaced thereby.

3. In concrete building construction, a reinforcing frame-work including longitudinal reinforcements and spaced transverse reinforcements connected to the longitudinal

reinforcements, and grooved tie-pieces supported by said transverse reinforcements and adapted to support cores, the cores provided with means for entering the grooves in said tie-pieces and supported thereby and capable of being withdrawn from between said tie-pieces.

4. In concrete building construction, a mold composed of outer and inner forms, window and door frames supported thereby, concrete pouring ducts mounted on said forms and extending below said window frames, said forms provided with openings communicating with said ducts whereby concrete may be introduced directly below said window frames.

In testimony whereof I have hereunto set my hand this 7th day of September A. D. 1920.

SIMON LAKE.