June 26, 1934. N. GARRETT 1,963,979

METHOD OF MAKING STRUCTURES

Filed Sept. 5, 1931

FIG. 1

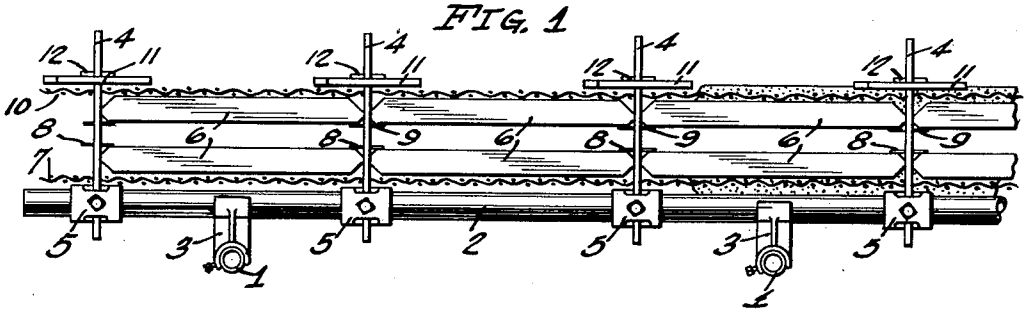


FIG. 2

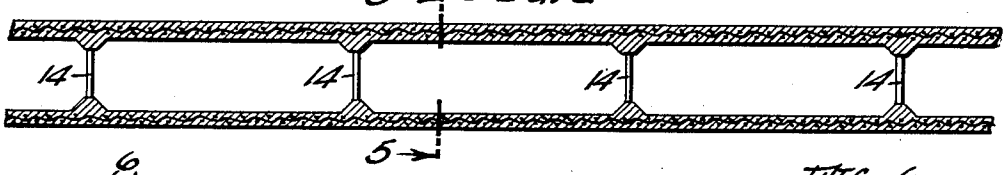


FIG. 3

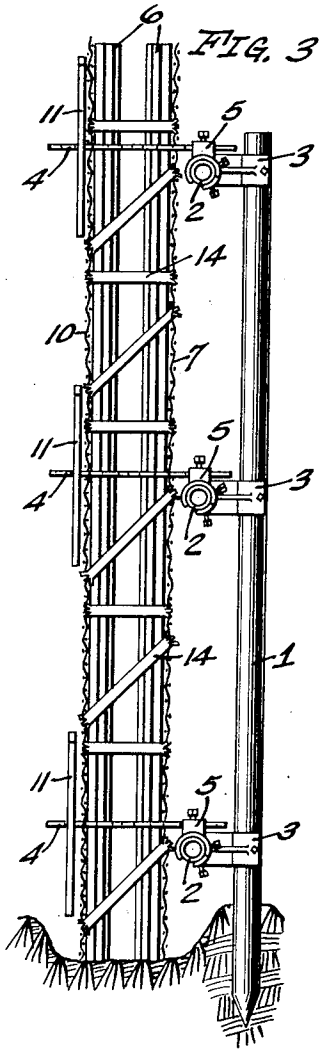


FIG. 4

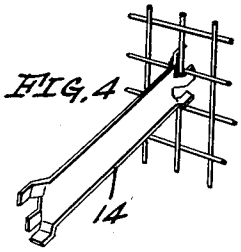


FIG. 6

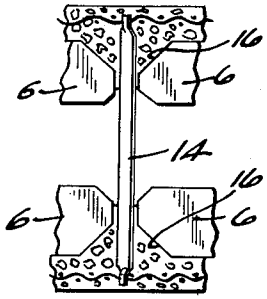


FIG. 5

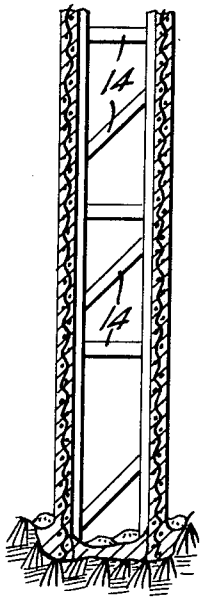
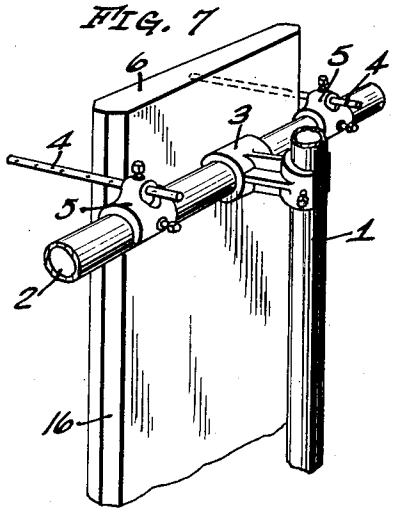


FIG. 7



INVENTOR

Neal Garrett

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1,963,979

METHOD OF MAKING STRUCTURES

Neal Garrett, Glendale, Calif.

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10 Claims. (Cl. 25—131)

This invention relates to methods of making reinforced cementitious structures and more especially to methods of making these characterized by spaced reinforced cementitious slabs joined together at spaced intervals by slab connecting members.

The subject matter of this invention has particular reference to the types of inventions described and claimed in my co-pending applications Serial Nos. 155,699, filed December 18, 1926; 257,357, filed February 27, 1928; 561,392, 561,394 and 561,395, filed September 5, 1931; and 566,958, 566,959, 566,960, 566,961 and 566,963, filed October 5, 1931.

A purpose of my invention is to provide a method for making structures of relatively thin layers of fireproof materials thoroughly reinforced and webbed together to form structures which are very light and yet substantial and possess sufficient elasticity and yieldability to successfully resist earthquake shocks.

An object of my invention is to provide a method for building structures characterized by spaced, relatively thin, cementitious slabs and in which the conventional frame members such as studs, beams, and joists are eliminated by the use of light transversely extending slab connecting members arranged at horizontally spaced intervals to provide superimposed groups thereof integrally joining and bracing the slabs together.

Other objects of my invention are: to provide a method of building floors, walls and roofs by plastering methods; to provide a method by which the apparatus and materials are easily set together with a minimum of tedious operations, such as tying or nailing elements together, and so that the forms may be easily removed; to provide a method that is easily used on irregular ground; and to provide a method of building walls adapted to form the foundation.

In the drawing

Fig. 1 is a plan view of assembled apparatus for building a wall and a portion of a wall formed thereon;

Fig. 2 is a horizontal section of a completed wall;

Fig. 3 is an end elevation of the apparatus of Fig. 1;

Fig. 4 is a perspective view of a slab connecting member;

Fig. 5 is a vertical section of the wall on line 5—5 of Fig. 2;

Fig. 6 is an enlarged fragmentary plan view of the apparatus and wall formed thereon at a gap in the form panels;

Fig. 7 is a fragmentary perspective of a form panel and adjoining apparatus.

Referring to the drawing, vertical pipes 1 are driven in the ground at a definite distance from a predetermined position of a wall. Pipes 2 are provided extending along one side of the predetermined wall position and are supported on pipes 1 by clamps 3. Rods 4 are held in place to extend transversely of the area to be occupied by the wall by clamps 5 on pipes 2. Clamps 5 are spaced to provide the rods 4 arranged in vertical rows at horizontally spaced intervals so that the horizontal space between the rods is the width of a form panel 6. The pipes, clamps and rods erected as described form the alining system.

Reinforcing 7 is placed over and supported by rods 4. Backing is provided behind reinforcing 7 by placing panels 6 between vertical rows of rods 4 and pressing them against the reinforcing 7, thereby forcing the same tightly against clamps 5. Pins 8 are placed through holes in rods 4 and hold the panels against the reinforcing 7.

If just a single slab is to be erected, cementitious material is plastered over the reinforcing 7 and against the form panels. After the cementitious material has hardened the pins 8 are removed, the rods 4 are released in clamps 5 and withdrawn, and the form panels and alining system are removed.

If it is a double wall that is to be built, instead of performing the plastering operations at this time, pins 9 are placed in holes of rods 4 which are suitably spaced from those used for pins 8 so that pins 9 engage the backs of a second row of panels to space and aline the same as desired with respect to the first erected row of panels. Reinforcing 10 is supported on the ends of the rods 4 and held flat against the form faces by strips 11. Each of these strips is narrow so as to form a minimum of obstruction to the plastering operation but is wide enough to include a hole to receive a rod 4. Each of these strips 11 is held in place by a pin 12 passing through a hole in rod 4. These strips are inclined so as not to obstruct the passage of material between the gaps of adjacent form panels while holding a vertical width of reinforcing flat against the forms. Both rows of form panels may be set up prior to the erection of the reinforcing and then the reinforcing may be arranged over both sides of the form.

It is intended that instead of pipes 1 supported as shown, any suitable upright members may be used and supported by any method desired. Pipes

1 or other suitable members are easily set up on the roughest of ground. The rest of the apparatus for supporting the form panels is supported on pipes 1 and is therefore erected easily regardless of the roughness of the ground. Each individual panel is slidably held at its vertical edges so as to be vertically independent of the rest of the apparatus and adapted to rest directly on the ground.

To extend the formwork to a height greater than the length of individual panels the panels are placed on top of each other and held in vertical alinement in the same manner as the panels on the ground.

A slab connecting member, hereinafter referred to as a tie 14, is formed from sheet metal strips into a shape providing a curved cross section to provide rigidity. Tie 14 has deformed ends and is shown engaging a portion of reinforcing in Fig. 4.

After the reinforcing is in place over the panels, and before the cementitious material is applied, the ties 14 are inserted through openings of the reinforcing into the position between the form panels illustrated in Fig. 6. Each tie 14 is supported at its ends by engagement with reinforcing 7 and 10. Ties 14 are placed both horizontally and inclined, as illustrated in Figures 3 and 5, to provide a web-like structure to coact with wall slabs in providing a wall adapted to act as a series of vertical trusses.

Reinforcing 7 and 10 is preferably a foraminous sheet material, such as wire mesh or expanded metal of a type adapted to reinforce layers of plastered material.

After the slab connecting members and layers of wire mesh are in place, cementitious material is plastered over the form faces to embed the reinforcing 7 and 10. The cementitious material is forced into the recesses formed by the beveled faces 16 of adjoining panels so as to securely embed the ends of the ties. The shape of faces 16 and the space between adjoining panels forms a ridge that is not so large as to slump when using cement mortar of average stiffness.

The vertical ridges formed on the backs of the slabs provide sufficient bracing for the slabs so that a wall may be made without the use of the slab connecting members. Such a wall is more sound proof and to be desired for some cases where the added strength derived by bracing the slabs together is not necessary.

The nature of the alining system is such that the scratch coat may be completed past the pipe 2 and the clamps 5 at a single application of cementitious material. As soon as the cementitious material has set pins 12 and strips 11 are removed.

The panels are left in place until the plastered material has obtained sufficient strength for the wall to stand alone. Rods 4 are then released in clamps 5 and rotated to drop pins 8 and 9. This releases the panels so that they are free to move away from the wall slabs. The panels are then withdrawn from between the wall slabs.

Outwardly flaring portions of the wall slabs are formed in contact with the ground. After the forms are removed, cementitious material is poured between the slabs to form a transverse portion of cementitious material integrally joining the slabs and closing the space between the slabs at the ground. If desired to form a solid wall, the space between the slabs is filled with cementitious material.

The rod 4 is provided with holes at suitable intervals so that the form panels may be held the desired distance apart to form a wall of any desired thickness. A wall of any height or length may be made by discontinuing the plastering operation where desired.

To build a floor according to this invention the apparatus is set up in a horizontal position instead of in a vertical position as illustrated for the walls. The apparatus is preferably set so that the reinforcing 7 is on the under side. In order to facilitate the formation of the slab on the under side of the forms, it is preferable that reinforcing 7 be an expanded metal or some other type of reinforcing especially adapted to hold the cementitious material from falling. When this structure is used as a floor of a second story, the under slab forms the ceiling of the first story; and when this structure is used to provide the ceiling of the upper story, the upper slab may be inclined to serve as the roof slab.

Many important features of this invention are retained in a variational form of the invention wherein a light and inexpensive backing is provided behind the foraminous materials to take the place of removable form panels and to be left in place.

The slabs are thin enough to be sufficiently yieldable to coact with the systems of webbing to provide a resilience to impact loadings. These slabs do not cause as large dead load stresses in building as thicker walls do. Comparatively low stresses are developed during an earthquake on account of their relatively small inertia. Such slabs require bracing such as is afforded by the arrangement of slab connecting members herein described and are herein referred to as relatively thin slabs.

This construction differs from conventional construction in that, instead of first erecting permanent structural stress bearing frame members and later covering the frame members with plastered slabs, the structure is formed progressively, tying the slabs together as they are plastered, and causing the slabs and the slab connecting members to form a structure that takes the place of the conventional type of construction.

The slab connecting members effect sufficient bracing of the slabs so that a substantial portion of the compressive strength of the slab material is developed before failure from compressive stresses.

The type of vertical systems of webbing used in my invention consists of spaced apart and superimposed slab connecting members. This is a distinction from the prior art in which it was considered necessary to include between plastered slabs in building wall construction some type of pillars or studs which were of a continuous construction coextensive in height with the wall.

The formation of plastered slabs against the exterior faces of removable forms has the distinguishing feature over the forming of walls by pouring against removable cores or molds in that a special type of reinforcing must be provided which is adapted to be incorporated in a layer of plastered material and is adapted to hold the plastered material from slumping.

It is considered impossible to form by the pouring method, at one continuous operation, a structure having the proportions of a structure that can be formed at one continuous operation by the method herein described. Poured slabs contain air bubbles and water pockets which are not to be found in slabs formed by troweling cementi-

tious material against vertical form faces. Plastered slabs are generally formed by a plurality of laterally applied layers in which a richer film of cementitious material is brought to the surface of each layer, thereby producing slabs much less brittle and more resistant to shocks than in a wall formed by the pouring method.

It is contemplated that features of this invention will be used in the construction of buildings where cementitious material is plastered on permanent backing.

Although many of the important features of this invention relate to the use of plastering methods, the invention includes features which are to apply to poured concrete work.

The term cementitious material is used to refer to any material in a soft state which is capable of hardening, or to any material which was at one time in a soft state and has hardened.

While I have described preferred forms of my invention, it is to be understood that the drawing and the description thereof are to be considered as illustrative of, rather than limitative upon, the broader claims because it will be apparent to those skilled in the art that changes in method may be made without departing from the scope of my invention.

I claim:

1. The step in the method of making structures characterized by spaced cementitious slabs which consists in erecting two sheets of foraminous material for reinforcing the slabs, maintaining the sheets of foraminous material in a relatively definite spaced-apart relationship, then providing structure for transmitting substantial compressive stresses, shearing stresses and tensile stresses from one of the slabs to the other by extending pre-formed slab-connecting members transversely through the space between the sheets of foraminous material and establishing connection between the ends of said members and the sheets of foraminous material by extending end portions of said members through the sheets of foraminous material.

2. The step in the method of making structures characterized by spaced cementitious slabs which consists in erecting two sheets of foraminous material for reinforcing the slabs, maintaining the sheets of foraminous material in a relatively definite spaced-apart relationship, then providing structure for transmitting substantial compressive stresses, shearing stresses and tensile stresses from one of the slabs to the other by extending pre-formed slab-connecting members transversely through the space between the sheets of foraminous material and into relative positions corresponding to relative positions of web members of a structural truss and establishing connection between the ends of said members and the sheets of foraminous material and exposing end portions of said members from the outer surfaces of the two sheets of foraminous material by extending said end portions of said members through openings in the sheets of foraminous material.

3. The step in the method of making structures characterized by spaced cementitious slabs which consists in erecting two foraminous sheets for reinforcing the slabs, maintaining the sheets in a relatively definite spaced-apart relationship, then, from points exteriorly of the two sheets, inserting pre-formed slab connecting members endwise through the side of one, at least, of the sheets, and establishing connection between the ends of said members and the sheets by extending end portions of said members through the sheets.

4. A method of making walls characterized by two spaced cementitious slabs that includes erecting two sheets of foraminous material to provide one thereof in place to reinforce one of the slabs and the other thereof in place to reinforce the other slab; then, from points exteriorly of the two sheets of foraminous material, inserting slab-connecting members endwise through and transversely with respect to one, at least, of the sheets of foraminous material and extending said members through the space between the sheets of foraminous material and into positions to join the slabs at spaced intervals; establishing connection between the ends of said members and the sheets of foraminous material and exposing end portions of said members from the outer surfaces of said two sheets of foraminous material by extending said end portions through the sheets of foraminous materials; applying cementitious material over the sheets of foraminous material to form spaced wall slabs and embedding therein the end portions of said members as the slabs are formed.

5. A method of making walls characterized by two spaced plastered slabs that includes erecting two sheets of foraminous material to provide one thereof in place to reinforce one of the slabs and the other thereof in place to reinforce the other slab; providing backings on the sides of the sheets of foraminous material facing each other and establishing transversely alined vertical gaps in the backings; then, from points exteriorly of the two sheets of foraminous material and at points in alinement with said gaps, inserting both tension and compression slab-connecting members endwise through and transversely with respect to one, at least, of the sheets of foraminous material and extending said members through the space between the sheets of foraminous material and into relative positions corresponding to relative positions of web members of a vertical truss; establishing connection between the ends of said members and the sheets of foraminous material by extending end portions of said members through the sheets of foraminous material; plastering cementitious material over the sheets of foraminous material to form spaced wall slabs and embedding therein the end portions of said members as the slabs are formed.

6. A method of making walls characterized by two spaced plastered slabs that includes erecting two sheets of foraminous material to provide one thereof in place to reinforce one of the slabs and the other thereof in place to reinforce the other slab; providing removable backings on the sides of the sheets of foraminous material facing each other and establishing transversely alined vertical gaps in the backings; then, from points exteriorly of the two sheets of foraminous material and at points in alinement with said gaps, inserting relatively long, thin, stiff slab-connecting members endwise through the side of one, at least, of the sheets of foraminous material and extending said members through the space between the sheets of foraminous material and into positions to join the slabs at spaced intervals; establishing connection between said members and the sheets of foraminous material by extending pre-formed, finger-like, projections of each of the respective ends of each of said members through respectively different openings in an adjacent one of the sheets of foraminous material; troweling cementitious material against the outer sides of

the two sheets of foraminous material while exerting pressure against the cementitious material with the trowel to cause portions thereof to pass through the foraminous material and to be firmly and evenly pressed against the faces of the backings to form relatively thin and uniformly constructed wall slabs having the foraminous material thoroughly incorporated therein and embedding the end portions of said members in the slabs as the slabs are formed; allowing the cementitious material to harden; and then removing the backings.

7. A method of making walls that includes positioning the lower extremities of two sheets of foraminous material in a pre-formed-ground trench while maintaining the sheets of foraminous material substantially vertical and in a relatively definite spaced-apart relationship; then, from points exteriorly of the two sheets of foraminous material, plastering cementitious material over the sheets of foraminous material to form spaced portions of walls and flowing portions of cementitious material into the trench exteriorly of the two sheets of foraminous material to form outwardly flaring portions of cementitious material integral with the aforestated portions of walls at the lower extremities of the latter; and applying cementitious material in the trench between and into bonding engagement with the aforestated portions of walls to establish a monolithic joinder between the latter.

8. A method of making walls that includes erecting a removable form in a pre-formed-ground trench to provide substantially vertical and parallel, outwardly disposed form faces; positioning plaster-slab reinforcing over said faces with lower extremities thereof in the trench; plastering cementitious material over the reinforcing to form spaced portions of walls against said faces and flowing portions of cementitious material into the trench exteriorly of the form to form outwardly flaring portions of walls at the lower extremities thereof; removing said form; and applying cementitious material in the trench between and into bonding engagement with the aforestated portions of walls to establish a monolithic joinder between the latter.

9. The steps in the method of connecting together two spaced-apart pre-erected sheets of foraminous reinforcing material preparatory to embedding said sheets in separate spaced-apart slabs of cementitious material, comprising progressively extending metallic connecting members through one of the sheets in a direction toward the other of the sheets so as to dispose the respective ends of the members in positions coincident with the respective sheets, and effecting an applied connection of said members with the sheets so as to expose the extremities thereof exteriorly of the sheets, as and for the purpose set forth.

10. The steps in the method of making structures characterized by spaced cementitious slabs which consists in erecting a sheet of foraminous material in place for reinforcing one of the slabs, erecting forms to provide two outwardly disposed form faces with one thereof arranged against one of said sheets, erecting a second sheet of foraminous material against the other of said faces, joining both of the aforementioned sheets by extending slab-connecting members of lengths approximately equal to the thickness of the wall to be formed through one of the sheets in a direction toward the other of the sheets so as to dispose the respective ends of the members in positions adjacent to the respective sheets, and establishing connection between each end of each of said members and an adjacent one of said sheets.

NEAL GARRETT.