Feb. 16, 1960 L. C. NETTLE 2,924,962

WALL CONSTRUCTION

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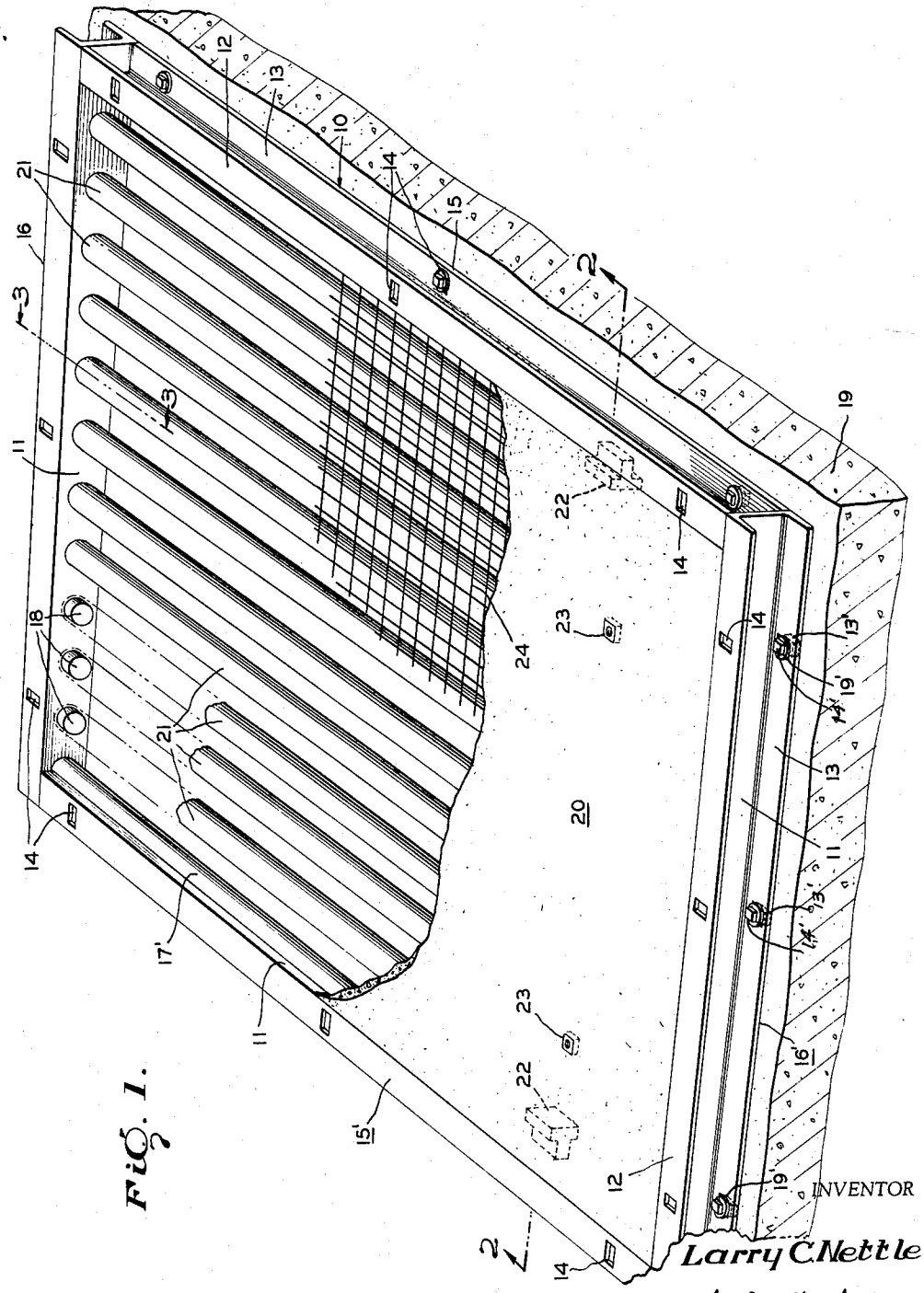

Fig. 1.

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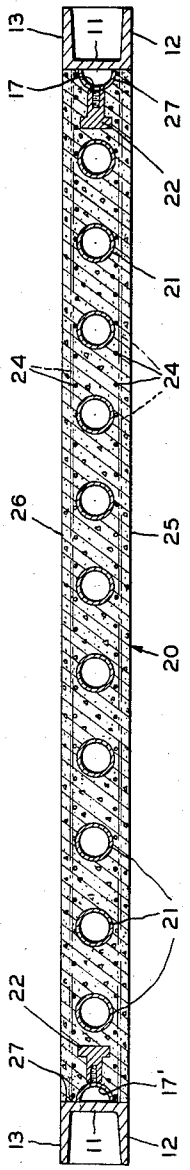

Fig. 2.

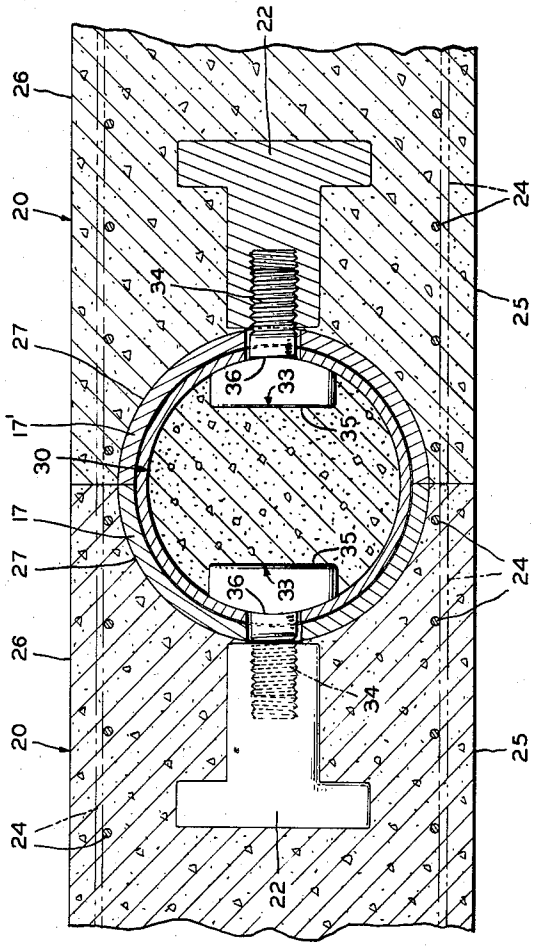

Fig. 4.

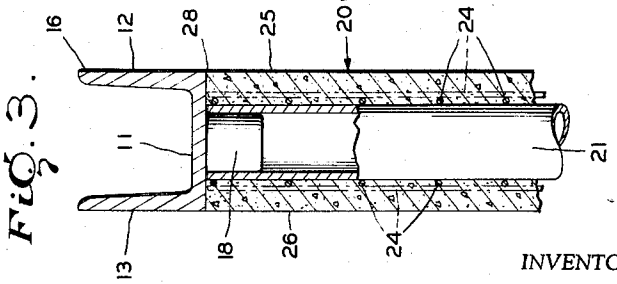

Fig. 3.

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Fig. 8.

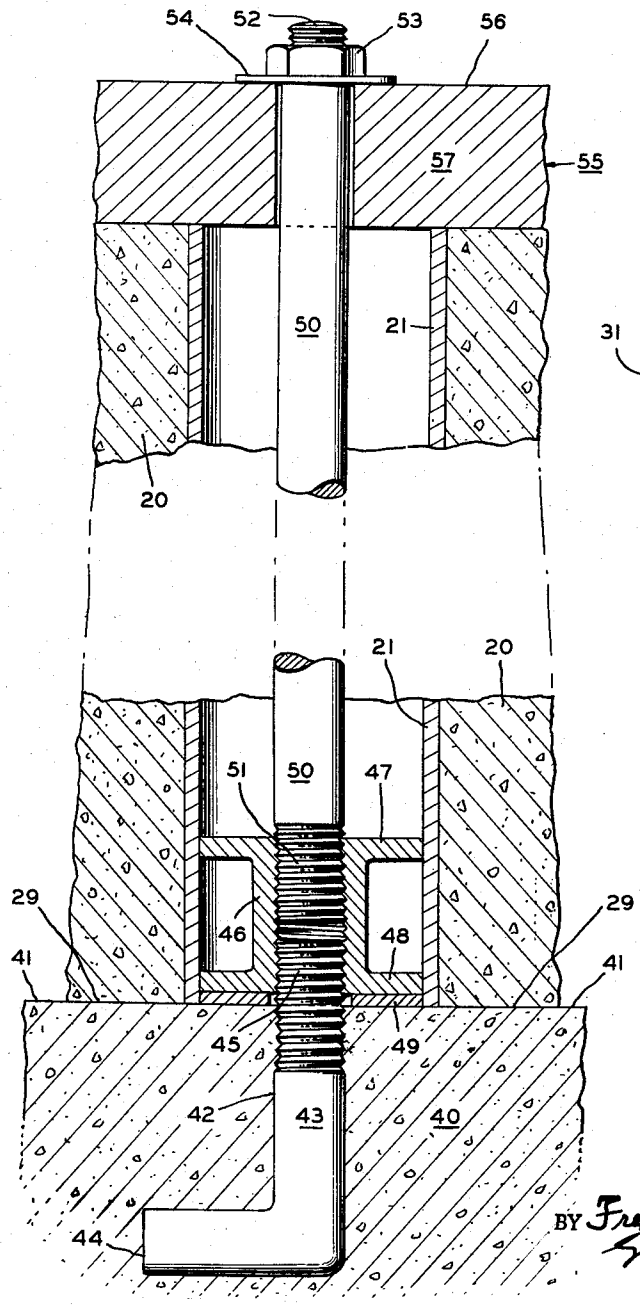
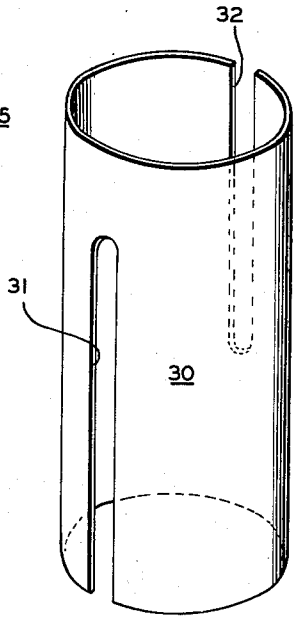


Fig. 5.



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WALL CONSTRUCTION

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FIG. 7.

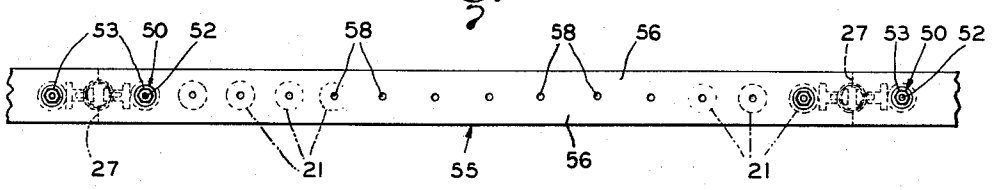
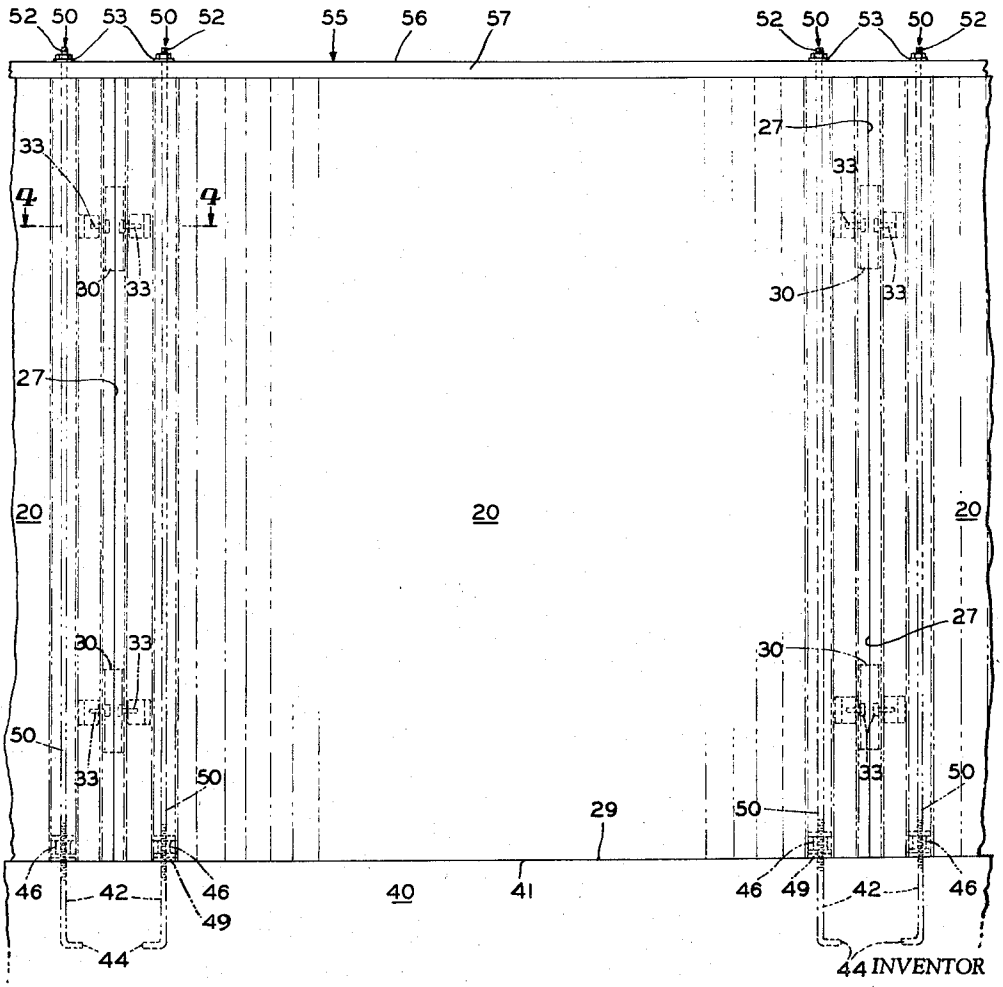


FIG. 6.



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United States Patent Office 2,924,962 Patented Feb. 16, 1960

2,924,962

WALL CONSTRUCTION

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Application December 2, 1954, Serial No. 472,730

7 Claims. (Cl. 72—16)

This invention relates to improved hollow and solid concrete wall construction, particularly adapted for one-story buildings, of lighter types of construction, such as homes, stores, motels, courts, light industrial buildings, barracks, school buildings, grain storage bins, hangars, home garages, and similar types of buildings.

The invention also relates to light-weight building wall panels, and to special casting forms and method of forming and assembling the panels into building walls. More particularly, the invention relates to cast wall panels of light-weight mineral aggregates, such as pozzuolana, pumice, trass, vermiculite, and like materials of volcanic origin, compounded with suitable cementitious materials, with or without gas-forming additions to form expanded aggregate masses.

The present invention makes possible the elaboration of mineral aggregates, of the character described, which are in abundant and relatively cheap supply in the western sections of the United States. In these sections there is an unsatisfied demand for low-cost, one-story housing units, garages, and small manufacturing units.

Cinder block construction is relatively costly, due to the fact that its use is restricted to relatively high-cost labor areas, in the vicinity of large coal-burning power plants, which are the main source of the raw material. Additionally, cinder block construction involves the handling and erecting of a multiplicity of relatively heavy blocks into any building, which blocks must be cemented in place in the usual manner, by high-priced skilled labor. Furthermore, because of the weight and bulk of cinder blocks, the use of stagings and other construction impedimenta is required, greatly increasing the cost of erection.

The difficulties attendant upon the use of cinder blocks for the construction of building walls for one-story units are obviated by the use of the building units of the present invention, which are comprised of light-weight, pre-cast slabs of building wall height, incorporating interlocking and securing means, and adapted to be mounted on and fixedly secured to the usual concrete footings. The units can be handled most easily, and are readily assembled into completed structures by unskilled labor, and with a minimum of supervision.

It is an object of the present invention to provide light-weight building constructions formed of preformed, wall-height panels of special construction, interlocked by novel interlocking means, and secured to the foundations in a simple and efficient manner.

It is another object of the present invention to provide novel building wall panels of light-weight material, severally embodying a plurality of parallel, uniformly spaced, full-length tubular core members, whereby the internal structure of the panels is physically enhanced and their weight is greatly reduced, all without sacrificing any desired and necessary load-bearing strength.

A further object of this invention is the provision of special interlocking means for wall panel assemblies.

Another object of the present invention is the provision

of special, break-away casting frames, comprised of frame members mutually abutted and secured to form a casting frame, the said members incorporating means for demountably holding core tubes and metal inserts in place during the casting operation.

An additional object of the present invention is the provision of casting frame elements of square channel shape, and incorporating means for securing the assembled frame elements in interlocked, casting postion, the said elements incorporating special forming members for imparting desired surfaces to the case wall members.

Other objects of the present invention include novel methods of both forming and erecting the novel building panels herein, and the special compositions used for forming the light-weight casting material.

With these and other objects in view, which may be incident to my improvements, the invention consists in the parts and combinations to be hereinafter set forth and claimed, with the understanding that the several necessary elements, comprising my invention, may be varied in construction, proportions and arrangement, without departing from the spirit and scope of the appended claims.

In order to make my invention more clearly understood, I have shown in the accompanying drawings means for carrying the same into practical effect, without limiting the improvements in their useful applications to the particular constructions, which for the purpose of explanation, have been made the subject of illustration.

In the drawings, like numerals refer to similar parts throughout the several views, of which

Figure 1 is a perspective view of an assembled casting frame, as mounted on a casting platform, and showing tubular cores held in parallel, spaced relation, one portion of the frame including a portion of the cast embedment forming a wall panel;

Fig. 2 is a transverse cross-section taken on line 2—2 of Fig. 1, and showing the embedment of the tubular cores and the locking and securing inserts in the cast wall panel;

Fig. 3 is a fragmentary longitudinal section taken on line 3—3 of Fig. 1, and showing the method of mounting the tubular cores in the casting frame;

Fig. 4 is an enlarged horizontal cross-section on line 4—4 of Fig. 6, of an inter-panel joint showing tapped locking inserts with locking studs in place, and engaged in and by a special tubular locking key;

Fig. 5 is a perspective view of the locking key of Fig. 4;

Fig. 6 is a front elevation of a wall panel assembly mounted on its foundation, the panel interlocking means and wall tie-down means being shown in phantom view;

Fig. 7 is a top plan view of the assembly of Fig. 6, showing the cap fittings of the wall assembly; and

Fig. 8 is a detail, in broken section, of a tie-down rod and the method of securing it in place on the foundation and in the cap channel.

Turning now to the drawings, and with particular reference to the showings of Figs. 1–4, the fabrication or casting of the novel wall panels will be described.

Casting frame

A special feature of primary importance with respect to the economical elaboration of cast wall panels is the casting frame. The novel casting frame **10**, is formed of channels of square cross-section having bottoms **11**, and sides **12**, **13**. The sides **12**, **13**, are formed with a suitable number of pairs of aligned slots, the slots being designated generally by the numeral **14**. The channels are cut into matching lengths to form pairs of side frame members **15**, **15'**, the end frame members **16**, **16'**. For casting a wall panel 8'6" long by 8' wide, the members

15, 15' will be 9'6" long, while the members 16, 16' will be 9' long. The outer faces or bottoms 11 of side frame members 15, 15' will severally incorporate full-length semi-cylindrical forming elements 17, 17', welded or otherwise secured thereto. The end frame members will severally incorporate uniformly spaced studs or spacing lugs 18, secured to the bottoms by welding, or in any other suitable manner. The lugs 18 on members 16, 16', will line on common centers, so that the core tubes 21, of a cast panel 20, are rigidly maintained in their desired parallel, spaced relation.

The casting frame members, as shown in Fig. 1, are secured in their desired cooperative relation, on any suitable casting platform 19, by securing means 19' passed through the aligned slots 14 and into the platform. The securing means, as shown, may comprise bolts 14' adapted to thread into nuts 13' embedded in the casting platform 19. The elongated openings 14 in the top sides of the frame members are used when another form is poured on top of the bottom one. Thus, a number of units having no apertures and of the same size, can be set up and poured one on top of the other. Similarly, units having the same aperture arrangement can be bolted together and poured in like fashion, thus saving ground space. As will be described more in detail hereinafter, the semicylindrical forming elements 17, 17', of the side casting frame members may incorporate mounting means, not shown, for detachably securing tapped panel locking lug-receiving inserts 22, at least two such inserts being provided for each side of the panel. For mounting indoor or outdoor wall trim, base-boards, picture molding, and the like, flanged nuts 23 will be suitably secured in the frame, and will be fixedly embedded in the cast wall. The nuts 23 may also receive threaded eye bolts, not shown, used to lift the unit in place. After the bolts are removed, the openings in the nuts are filled with concrete, to provide a smooth surface. Where a maximum of internal reinforcement is desired, reinforcing members 24, of wire mesh, may be secured on and over the core tubes 21, before the wall is cast therearound.

Cast panels and locking details

The panels 20 will comprise front and back wall surfaces 25, 26, with semicylindrical end grooves 27, formed by the side framing members of the casting frame, and top and bottom surfaces 28, 29, respectively. The top and bottom surfaces are pierced by the core tubes, and it will be noted that the inter-core spaces, when filled with the cast embedment, will form spaced, parallel, vertical supporting sections, or stanchion elements of full panel length and thickness, with their width being determined by the inter-tube spacing. These elements will be transversely joined and cross-braced by the outer or surface coatings of the panels. Thus, in a panel six inches thick, cored by tube 4 inches in diameter, the stanchions or vertical load-supporting sections will be six inches thick, while the integral surface skins will be one inch thick. Any transverse cracks developing in a cast wall panel will not be propagated through the width of the panel, but will be diverted longitudinally on extending to a relatively thin (1") skin section overlying a core tube.

As shown more particularly in Figs. 4 and 5, abutted wall panels are expeditiously joined together and interlocked in the following manner:

The semicylindrical end grooves 27 of the wall panels 20 incorporate tapped inserts 22, embedded therein, with the tapped socket portion lying along the central vertical or longitudinal plane of the panel. Access to the tapped socket is had through the end grooves, as shown in Fig. 4. The end grooves are adapted to receive special keying members 30 (Fig. 5), comprising short lengths of metal tubing having diametrically opposed, and mutually inverted keying slots 31, 32, extending from the top and bottom edges of the members, inwardly of the tubes for at least a major portion of their length. Locking studs 33, are provided with threaded shanks 34 adapted to threadedly engage the tapped inserts 22. The shanks 34 are adapted for slip-fit engagement with and in the keying slots 31, 32. The keying members are provided further with special flat-sided and ended head portions 35, having curviform rear surfaces 36, conformed to the curvature of the inner surfaces of the keying members, and adapted for drive-fit engagement therewith.

With a wall panel in place, on its foundation, and the locking lugs 33 screwed into the tapped inserts 22, keying members 30 are fitted on and over the lugs by slipping the slots 31 over the shanks 34 of the lugs, whereby the curviform rear surfaces 36 are engaged by the inner surface of the keying member, and the surface of an end groove 27 is engaged by the outer surface of the key. To insure positive locking engagement of the keys in place, slight tapping of the upper edge with a mallet or hammer will do. Because of the ease of attachment of the keys 30 to a panel, they may be attached to one end of a panel, before erection into a wall structure, the apposing ends of juxtaposed panels being slid downwardly thereagainst, so that the lugs 33 will be received by and in the upturned keying slots 32 of the keying members. In this case, the top of the panel can be tapped to secure its drive fit in the keys, and assure positive bilateral joining of the aligned and apposed wall panels.

The wall panels are assembled to form a wall structure in a simple manner, as is clearly illustrated by the showings of Figs. 6–8, inclusive. Turning now to these figures, and more particularly to Figs. 6 and 8, the wall foundation and associated elements will be described.

Wall foundation

When a wall is to be erected, the usual concrete or masonry base or foundation 40, is laid in place. Such bases will be of any suitable dimensions, and laid on the ground, or in trenches, as the particular design calls for. The top surface 41, of the foundation should be truly flat, a spirit level being the usual instrument used to check on the surface. Whether the foundation be fabricated of concrete, brick, or masonry, anchor rods 42 must be embedded therein. These members comprise a shank section 43 having an angular hook or offset 44 at the bottom, and adapted for locking engagement in and by the embedment forming the foundation 40. The upper end 45 of the shank is threaded, and extends a sufficient distance above the level of surface 41 to insure positive locking engagement with a threaded hollow coupling 46. This coupling is a doubly flanged, internally threaded cylinder having concentric top and bottom flanges 47, 48, of equal diameter, and adapted to receive cores 21 of panel 20 in slip fit thereover. The bushings or couplings 46 are of a sufficient height to provide a positive vertical support for the cores 21, and thereby for the wall panel of which they form a part.

The bushings 46 are adapted to threadedly receive the threaded bottom ends 51 of the tie rods 50, whose upper threaded ends 52 receive nuts 53 and associated washers 54. The tie rods are somewhat longer than the height of the wall panels, and form vertical extensions of anchors 42. As shown in the drawings, two anchors and associated tie rods are provided for tying down each wall panel, and are preferably spaced apart to register with and be fitted in the end cores of a wall panel. It will, of course, be understood, that any desired number of anchors may be used, as the type of construction dictates. In assembling the panels in place, the foundation crew will first secure the bushings 46 in place, suitable gaskets 49 being placed thereunder and over anchors 42 to provide a suitable yieldable bearing surface for the bottom flange 48 of the bushing.

Mounting of the wall panels

Turning now to the showing of Figs. 6 and 7, the preferred method of erecting the improved wall panels herein into a self-sustaining wall will be described.

As noted above, the anchor rods **42** are first capped by the bushings **46**. The starting panel is fitted on and over its aligning and anchoring bushings, and secured to a corner post, or other vertical structural element, not shown. The free end **27** of the panel may previously have been fitted with its locking keys **30**, and the next panel is lifted in place, care being taken that the locking lugs **33** engage their locking slots **32** in keys **30** simultaneously with the engagement of the appropriate cores **21** on and over the bushings **46**. When a sufficient number of panels have been set up to form a wall, or any desired section thereof, a cap channel or channels **55**, is fitted on and over the tops **28** of the assembled panels. In this operation, and especially in case a number of channel sections are used, it is important to make sure that continuous channel bearing members are applied on and over the abutted sides **27** of juxtaposed and interlocked panels **20**.

The channels **55** have a foraminous top **56**, and depending sides, designated generally by the numeral **57**. The top **56** is provided with aligned apertures **58**, on equal centers with the cores **21** of the panels **20**, and adapted to be fitted in register therewith. With the channel or channels **55** in place on and over the top of the panel assembly, a requisite number of tie rods **50** are passed through apertures **58** and registering, bushing-mounted cores **21**, and are threadedly engaged with the bushings **46**, the threaded lower ends being engaged therein and thereby. Washers **54** and nuts **53** are then fitted on and over the threaded upper ends **52** of the tie rods **50**. The nuts **53** are taken up and tightened enough to impose a positive locking tension on the tie rods, whereby the cap channels **55** are brought into positive bearing engagement on and over the tops of the wall panels to secure them in place in mutual supporting position, and properly aligned to form a wall. To secure uniform tension of the tie rods, conventional tension wrenches may be used to tighten up the nuts **53**. These wrenches are well-known on the market, and can be set to apply any desired pressure, which can be regulated by the job foreman or superintendent, so that even the huskiest, but unskilled laborer can use them with impunity.

The cap channels can also serve for the mounting of roof structures, not shown, and which form no part of the present invention. Additionally, the flanged nut inserts **23**, as noted above, can serve to mount any and all kinds of inside and outside trim, as may be desired. The foundation-wall joint may be sealed in any suitable manner, as by means of cementitious or plastic grouts, applied by pressure guns, or laid in place before the panels are mounted in place. The bottoms of the panels may be open to the air, and a circulation of air up through the hollow cores to the top will make for a cool wall structure. Of course, forced draft flow of cold or hot air through the walls will serve to provide radiant cooling or heating from the walls, and without requiring any alteration of the wall structures.

Wall openings

A special feature of this invention is the casting of standard light-weight panels of uniform dimensions, and the forming of wall openings in place, on the job. This feature makes for highly economical operation, as it does away with the necessity for special casting frames and fitments for the special casting of door panels and window panels.

The inter-panel joints can be filled as shown on Fig. 4, with a suitable filler, for example, a mixture comprising three parts rock fragments (¼"), two parts sand, and one part Portland cement, or the casting mixture may be used as a filler, and continuous inner and outer wall surfaces formed without any breaks therein.

The units are set in place on a conventional foundation with anchor bolts placed in a conventional manner. A dowel is screwed onto the anchor bolt which serves as a pilot extending up three inches into the hollow unit and a tye rod made of three-quarter pipe equal to the height of the unit plus the top plate thickness, installed through the top plate and the hollow aperture and screwed into the dowel on the foundation and set with a nut and washer installed on the top of the plate, thus firmly holding the unit to the foundation as shown in Figure 8. At least two of these tie rods shall be placed in a unit depending on the width of the unit.

After ten days the units can be taken to the job and set up by hoisting the unit in place, plumbed and braced and locked in place with each joint filled with concrete, thus making a six inch by twelve inch column every eight feet or the width of the unit, thus making a complete one piece wall regardless of lines, straight or off-set. After the walls are securely fastened to the foundation from the plate above and the joints locked and filled, you have wall construction that is fireproof, earthquake proof, termite proof, moisture proof, sound proof, and insulated, which will insure extra long life with class A construction, at a cost much less than frame construction.

Labor costs are at a minimum as very little skilled labor is needed, as a unit can be poured and trowled to a high finish in about thirty minutes. The windows, sash and doors, if of metal construction, are cast in and are ready to be glazed when set up. If frame windows and doors are used, the apertures are cast in to size and ready to install. The conduits and other items can also be cast in and ready to hook up. The surfaces are highly finished and are treated so as to make them waterproof and ready to take paint as you would paint wood. Aluminum silica gel with color can also be used which gives a permanent glaze that will become a part of the unit. No plastering is needed in either the inside or the outside, but can be plastered on the inside if wanted. An eight foot by eight foot unit can be set and anchored in thirty minutes, thus making a sixty-four foot square wall in less time than it would take to saw a few rafters. This is one hundred and twenty-eight square feet of wall per hour.

Any type of wall construction can be used, as to design, and any type of roof can be used, as well as a second story frame can be used. In the case of home garages, and like buildings, the roof can be prefabricated and bolted on as soon as walls are set up.

While I have shown and described the preferred embodiment of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention or exceeding the scope of the appended claims.

What is claimed:

1. A building wall construction comprising a plurality of abutted and interlocked cast wall panels, severally incorporating semi-cylindrical end grooves and parallel longitudinal ducts, said end grooves embodying locking studs; locking means engaging locking studs of adjacent panels whereby the panels are held in interlocked relation; a structural footing subjacent the panels; threaded anchor bolts spacedly embedded in the footing, and so constituted and arranged as to provide at least two such bolts for the end ducts of each of the panels; threaded bushings threadedly engaging the threaded anchor bolts, said bushings being generally conformed to the ducts fitted thereon and thereover; tie rods in the ducts fitted over the said bushings, said tie rods being threadedly engaged in and held by said bushings, whereby to form vertical extensions of the anchor bolts; and channel cap

members fitted on and over the tops of adjacent wall panels, said cap members being apertured to receive the threaded upper ends of the tie rods; nuts threadedly engaging the tie rods, whereby to force the cap members in biasing bearing engagement on and over the wall panels, and the wall panels are forced into positive seating engagement with the footing wall, the openings defined by adjacent end grooves of the panels being filled with a settable plastic mass.

2. Building wall construction according to claim 1, characterized by the fact that the openings defined by adjacent end grooves of the panels are filled with a settable plastic mass, and the surface of the mass is flush with the surfaces of the bilaterally adjacent wall panels.

3. Building wall construction according to claim 2, characterized by the fact that the plastic mass filler is comprised of material having the characteristics of the wall panel material.

4. A building wall construction comprising a plurality of abutted and interlocked cast wall panels, severally incorporating semi-cylindrical end grooves and parallel longitudinal ducts, said end grooves embodying locking studs; locking means engaging locking studs of adjacent panels whereby the panels are held in interlocked relation; a structural footing subjacent the panels; threaded anchor bolts spacedly embedded in the footing; threaded bushings threadedly engaging the threaded anchor bolts, said bushings being generally conformed to the ducts fitted thereon and thereover; tie rods in the ducts fitted over the said bushings, said tie rods being threadedly engaged in and held by said bushings; and channel cap members fitted on and over the tops of adjacent wall panels, said cap members being apertured to receive the threaded upper ends of the tie rods; nuts threadedly engaging the tie rods, whereby to force the cap members in biasing bearing engagement on and over the wall panels, and the wall panels are forced into posiitve seating engagement with the footing wall.

5. A building wall construction comprising a plurality of abutted and interlocked cast wall panels, severally incorporating semi-cylindrical end grooves and parallel longitudinal ducts, said end grooves embodying locking studs; locking means engaging locking studs of adjacent panels whereby the panels are held in interlocked relation, said locking means comprising cylindrical tubulatures adapted for close fit in the cylindrical grooves formed by and between abutted wall panels, said tubulatures incorporating diametrically opposed keying slots extending a major portion of the length of the tubulatures, said slots being mutually reversed, and severally adapted to receive said locking lugs of abutted panels, a structural footing subjacent the panels; threaded anchor bolts spacedly embedded in the footing, and so constituted and arranged as to provide at least two such bolts for the end ducts of each of the panels; threaded bushings threadedly engaging the threaded anchor bolts, said bushings being generally conformed to the ducts fitted thereon and thereover; tie rods in the ducts fitted over the said bushings, said tie rods being threadedly engaged in and held by said bushings, whereby to form vertical extensions of the anchor bolts; channel cap members fitted on and over the tops of adjacent wall panels, said cap members being apertured to receive the threaded upper ends of the tie rods; and nuts threadedly engaging the tie rods, whereby to force the cap members in biasing bearing engagement on and over the wall panels, and the wall panels are forced into positive seating engagement with the footing wall, and the openings defined by adjacent end grooves of the panels being filled with a settable plastic mass.

6. Building wall construction according to claim 5, characterized by the fact that the openings defined by adjacent end grooves of the panels are filled with a settable plastic mass, and the surface of the mass is flush with the surfaces of the bilaterally adjacent wall panels.

7. Building wall construction according to claim 5, characterized by the fact that the plastic mass filler is comprised of material having the characteristics of the wall panel material.

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