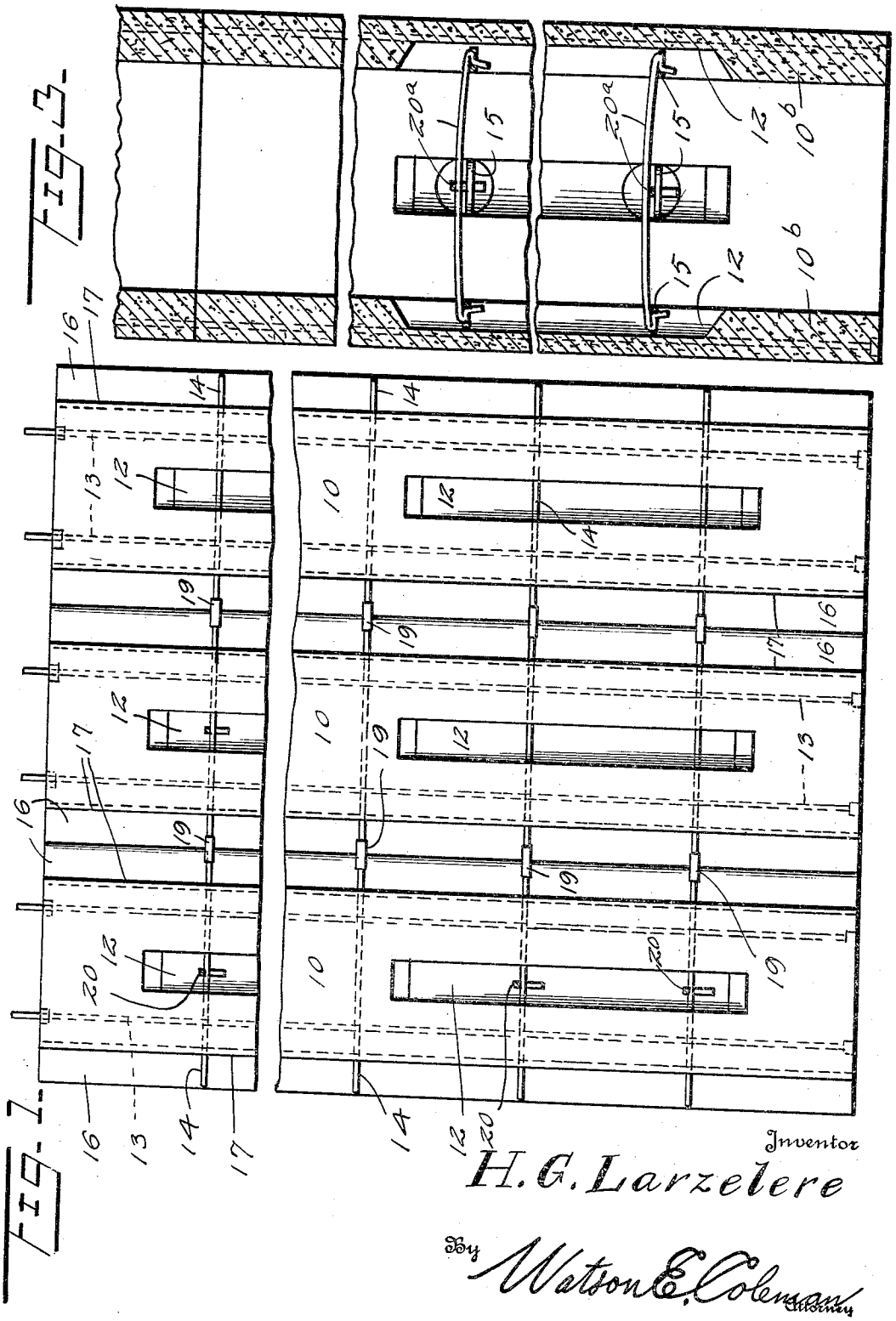
May 30, 1933. H. G. LARZELERE 1,911,626

REENFORCED CONCRETE CONSTRUCTION

Filed March 1, 1930 3 Sheets-Sheet 1



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REENFORCED CONCRETE CONSTRUCTION

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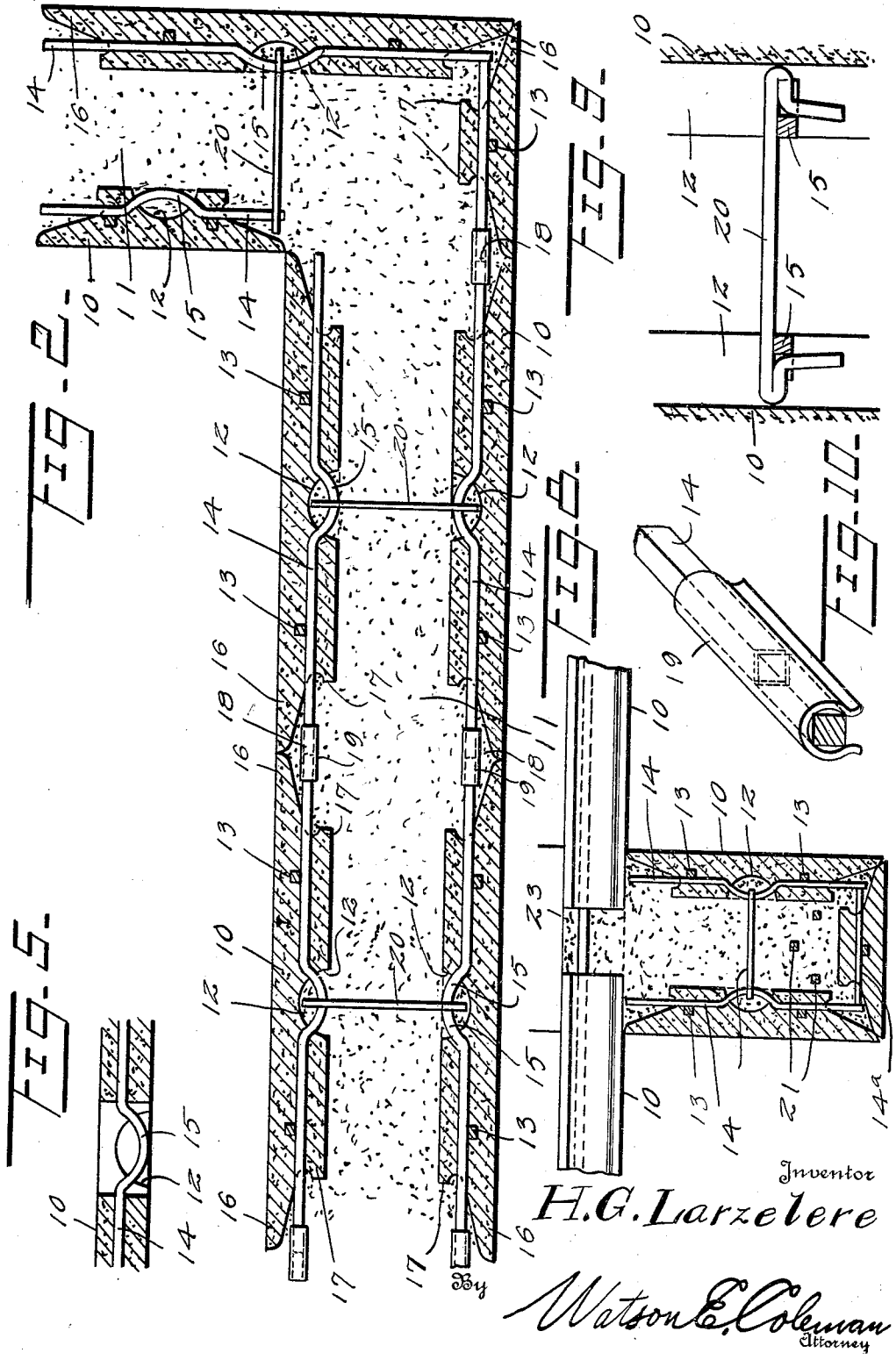

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 10.

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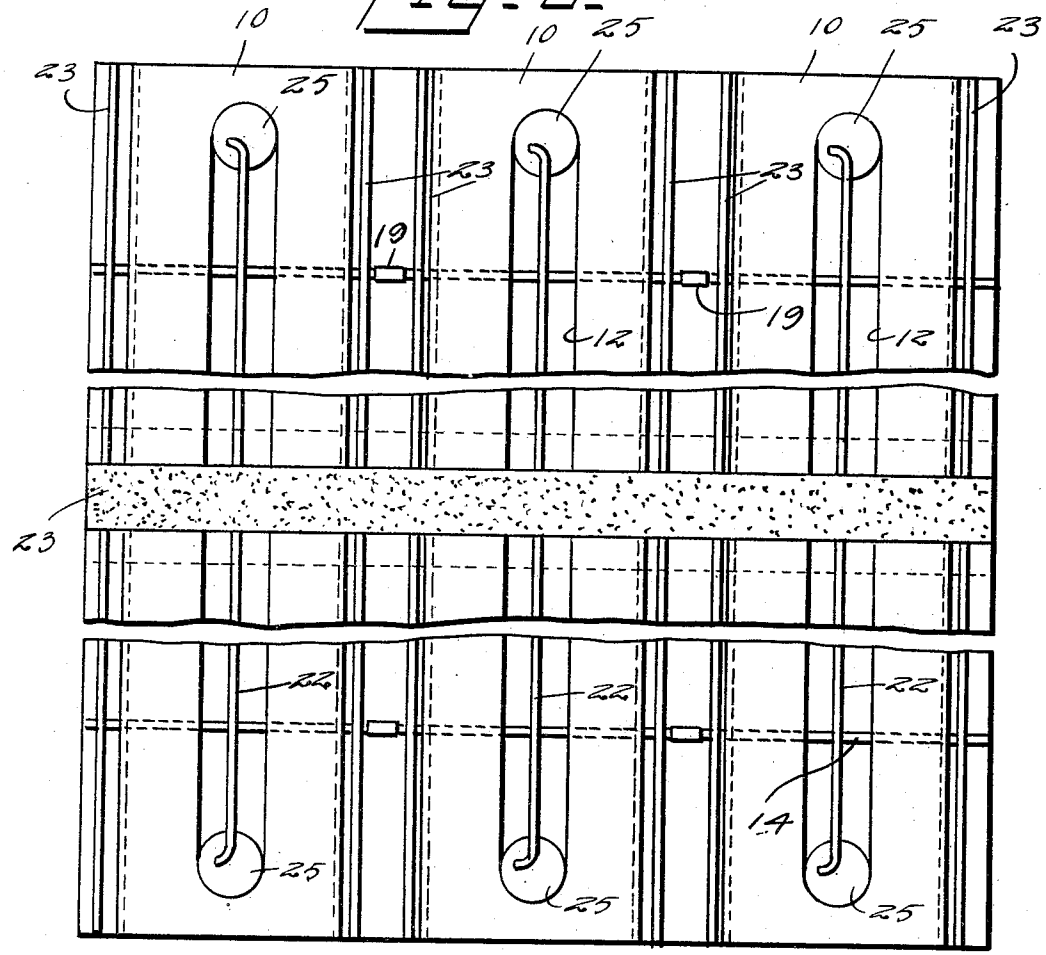
Fig. 6.



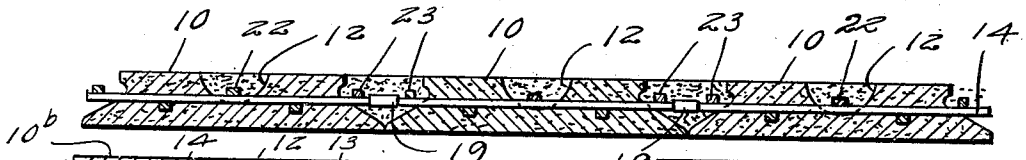


Fig. 7.

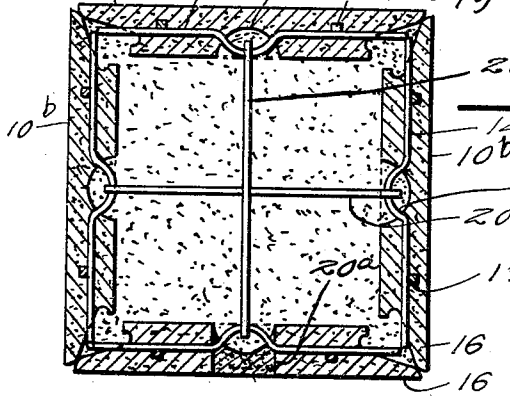


Fig. 4.

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Patented May 30, 1933 1,911,626

UNITED STATES PATENT OFFICE

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REENFORCED CONCRETE CONSTRUCTION

Application filed March 1, 1930. Serial No. 432,488.

This invention relates to structures formed of reenforced concrete and the principal object of the invention is to eliminate the necessity of using removable forms in the field, that is, at the site where the structure is being erected and to provide means whereby monolithic concrete constructions may be rapidly and economically built without the necessity of using these detachable forms.

A further object is to provide a method of building concrete structures which consists in the use of pre-formed concrete slabs thoroughly set and hardened, which may be set up or put in place and which then act as a mold and as part of the wall, floor, pier, or other structure, and a further object in this connection is to provide means whereby the slabs which constitute in effect the mold and also part of the completed structure may be tied to the concrete which is poured or tamped into the mold formed by these slabs so as to tie all parts of the structure thoroughly together and form perfectly a monolithic structure.

Other objects will appear in the course of the following description.

My invention is illustrated in the accompanying drawings, wherein:—

Figure 1 is an inside elevation of a form for concrete walls before the concrete has been poured;

Figure 2 is a horizontal section through a wall constructed in accordance with my invention;

Figure 3 is a vertical section through a column constructed in accordance with my invention;

Figure 4 is a horizontal section through such a column;

Figure 5 is a detailed sectional view through one of the structural elements and its tie;

Figure 6 is a top plan view of a floor;

Figure 7 is a sectional view through the floor shown in Figure 6;

Figure 8 is a sectional view through a beam supporting the floor;

Figure 9 is a fragmentary transverse section through a wall, showing a thrust tie in use;

Figure 10 is a perspective view showing the manner of connecting the tie bars.

In Figure 2, I show one embodiment of my invention, that is, one form in which the invention may be practiced which consists in the use of pre-formed vertically elongated slabs 10, these slabs being formed of concrete either at the place where the building is being erected or the slabs may be preformed in the shop. These slabs are thoroughly dried and hardened before being used. These slabs in order to form a wall are set up on end in parallel relation to each other and in abutting relation and then concrete 11 is poured or tamped between the slabs so as to form the completed wall, these slabs 10 constituting in effect the lateral walls of a form within which the concrete core 11 is designed to be poured.

Each slab may have any desired vertical length and each of these slabs upon its inside face is preferably formed with a longitudinally extending recess 12 which may have any desired length, but which is illustrated as terminating short of the ends of the slabs. If the slab is long, there may be two or more series of these recesses 12.

Extending vertically through each slab are a plurality of reenforcing bars 13 and extending transversely through each slab are a plurality of horizontal reenforcing bars 14 which are disposed against the reenforcing bars 13 and may be tied thereto. The bars 14 are outwardly bowed at 15, each at its middle so as to project outward into the corresponding recess 12. The side faces of each slab 10 extend, broadly speaking, outward and longitudinally at an angle to a transverse face of the slab and preferably this beveled face 16 is so formed as to provide an overhanging lip 17 adjacent the inner face of the slab and the inner end of the beveled portion 16. Thus when the concrete 11 is poured in to fill the space between the outer and inner walls formed of the slabs 10, this concrete will fill the spaces between the faces 16 and will fill the under-cut portions behind the lip 17 so as to effectually tie the slabs to the concrete core 11. The longitudinal rods 14 project out past the faces 16 and these rods are preferably connected to each other by

means of a spring ferrule shown in Figure 10 and designated 19. This ferrule is, of course, embedded in the concrete core as are the projecting ends of the tie rods. The outwardly bowed or looped portions 15 of the tie rods 14 are connected by transversely extending thrust wall ties 20, one of which is shown in Figure 9, these being so formed as to engage around the loops or outwardly bowed portions 15 of the transverse tie rods and preferably so formed as to bear at their ends against the inner faces of the confronting slabs so as to hold these slabs in spaced relation to each other.

This is secured by extending the wall tie 20 outward beyond the longitudinal tie 14, then bending the wall tie inward and downward so as to engage against the bowed portion 15 of the tie rods 14. The downwardly extending ends of the thrust wall tie 20 being embedded in the concrete within the forms act to prevent any turning movement of the thrust wall tie. These wall ties hold the slabs in proper spaced relation to each other, preventing any inward movement of the slabs and any outward movement due to the pressure of the concrete as it is poured in.

At the corners of the building, a special relatively narrow slab 10^a may be used, as shown in Figure 2, which will form an approximately heart-shaped recess 18 at the exterior corner of the building and an obtusely angled undercut recess 18^a into which recesses the tie rods 14 on the two walls of the building will project, these permitting the tie rods to be tied together or engaged with each other in any suitable manner and then these recesses filled with concrete as will be obvious from Figure 2.

After one tier or course of slabs 10 have been disposed to form the outside elements of the wall and after the concrete has been poured in or tamped into the space between these two mould walls, as they may be termed, then if a very high wall is desired a second course or tier of slabs may be erected upon the first tier and a second load of concrete poured in and so on until the walls have been completed. It is obvious that these outer slabs 10 may be so formed as to provide for window and door openings and for any ornamental finish upon the exterior of the building or ornamental elements such as beading, cornices, ornamental lintles or jambs, etc.

Figures 3 and 4 show how slabs 10^b of the same construction as slabs 10 may be used to form a pier or column. In this case, however, one of the slabs is pre-formed with an opening 20^a, to permit the last tie to be put in place after the slabs have been set up to define the pier. This opening is to be filled with concrete and then concrete poured into the interior of the mold formed by the slabs.

In Figure 8, I have illustrated a concrete floor beam. Three of the slabs 10 are disposed with two of the slabs in parallel spaced relation to the third slab and at right angles thereto forming the sides and bottom of the beam. Each lateral slab is provided with tie bars 14 outwardly bowed at 15 to receive the ties 20. Each slab has reenforcing members 13. The lowermost slab, which constitutes the bottom of the beam is provided with transverse reenforcing bars 14^a projecting beyond the recessed ends of the slab and engaged with rods 14 of the lateral slabs. These three slabs when combined constitute a mold within which the concrete core 11 may be poured. Reenforcing bars 21 will be disposed below the neutral axis of the beam. A floor which may be formed in any suitable manner is disposed upon this beam. Preferably, the floor is formed as shown in Figures 6, 7 and 8 of slabs 10 disposed in alinement with their beveled faces upward. Reenforcing bars 14 are connected to each other by spring clips 19 as previously described.

Preferably, the beam shown in Figure 8 will be filled with concrete 23 filled into the beam through openings such as the openings 25 in the floor slabs as shown in Figure 6, thus bonding the floor slabs fully to the beam and providing means whereby the beam may be filled with concrete.

The reenforcing rods 14, Figure 6, are not outwardly bowed as are the reenforcing rods in Figures 2 and 4 but extend straight across the recesses 12 and continuous reenforcing bars 22 are disposed transversely across the floor in these recesses and resting upon or tied to the transverse reenforcing bars. In the space between two slabs, a pair of continuous reenforcing bars are disposed designated 2^a. Instead of using a spring ferrule 19 for the purpose of connecting the transverse bars 14 at their joints, I may weld the bars together at their joints. In either case, the space between the beveled ends of adjacent slabs is filled with concrete 24. These slabs are preferably formed as shown in Figure 6 with openings 25 extending downward through each slab which openings will be disposed in alinement with the space between the two lines of the slabs 10 of the wall so that concrete may be poured through these openings to interlock with the core of the wall so as to form a wall bond or to bond with the concrete beam formed as shown in Figure 8.

It will be seen that with this construction, I can erect monolithic concrete buildings without the use of ordinary detachable wall forms which in themselves constitute a considerable item of expense, both as regards their structure and also because these wall forms constitute so much false work which must be put up and then taken down. With my invention all high priced skilled labor is done away with. The slabs are easily set

in place and after being tied cannot move and then the core or center is filled with concrete. When the slabs are set for an eight inch wall, fifty per cent of the wall is completed. If a twelve inch wall, when the slabs are set, thirty-three and one-third per cent is completed. For a twenty inch wall, twenty per cent of the wall is completed and for a twenty-four inch wall, sixteen and two-thirds per cent of the wall is completed when the slabs are set.

After the core of concrete has been poured, the wall is complete and there is no expense due to removing the forms therefrom as is the case where removable forms are used. Furthermore work on the superstructure may be carried along without any loss of time due to the waiting for concrete to set as the lateral slabs being of concrete, will be a full support to the superstructure without waiting for the poured concrete core to be completely hardened. Walls and piers may be completed in less time than it takes for the carpenter to build wood forms in the usual manner. Floors may be built in freezing weather and no waiting for them to harden is necessary before going ahead with construction.

The floor slabs may be placed on steel, brick, wood, stone or other walls or beams. It will be seen that sidewalks and roadways may also be built without forms in the manner shown and will involve the least possible damage to lawns or to grading. By using pre-formed slabs, it will be possible to insure that these slabs are all of a perfectly uniform mix, well cured before erection so that the structure erected will be thoroughly strong and relatively perfect. This method of construction may also be used for marine work or work under water as the slabs after being put in place will remain in their exact position under water until the concrete core is put in place, ensuring a great saving in both labor and material. The same means may be used for erecting structures in mud holes, quick sands and all places requiring rapid and accurate construction. Circular work is normally very expensive where forms have to be built to be used. Slabs for circular work may be as readily cast as slabs for flat work and these slabs will cost very little more than for straight slabs and there will be no extra cost involved in erecting the building.

By forming the wall with pre-formed slabs constituting a mold or form and afterwards filling the interior with concrete, the slabs may be set exactly against lot lines and thus avoid trespassing on other property whereas where forms are used, the building must be either set inward from the road line or else the false work will have to trespass upon the other property. For thin walls, a single thickness of slab may be used in the same manner as illustrated for making a floor. These slabs may be used for fences or walls against embankments and because of the fact that there are no forms to be removed, the slabs may be set close against the embankment. These slabs may be used to enclose structure-work steel columns, etc., so as to render these columns thoroughly fireproof. The space between the slabs and the columns may be then filled with concrete.

Obviously the slabs may be made up in various sizes and carried in stock ready for immediate delivery at any time.

I claim:—

1. A concrete structure including a beam formed of three pre-formed reenforced concrete elements, there being a bottom element and two side elements, the side elements being spaced from each other, a floor formed of preformed reenforced concrete slabs having longitudinally extending recesses, said slabs being disposed to extend over the upper edges of the side elements of the beam, the slabs having openings above the beam, reenforcing elements disposed in the recesses of the slabs and across the space between the slabs, and concrete filling the space defined by the elements of the beam and the openings in slabs.

2. A structure of the character described, including two opposed rows of preformed facing slabs, the rows being spaced from each other and the slabs of each row being disposed in edge-abutting relation, the lateral edges of each slab being beveled and reentrantly recessed on their inside faces whereby to define inwardly opening vertically extending undercut recesses, reenforcing wires extending vertically through the slabs, and transverse reenforcing wires extending beyond the beveled faces, the transverse wires of the several slabs being connected to each other within said recesses, and concrete filling the spaces between opposed rows of slabs and in the undercut recesses between adjacent slabs, thus bonding the alined slabs to each other and to the concrete.

3. A structure of the character described, including two opposed rows of preformed slabs, the rows being spaced from each other and the slabs of each row being disposed in edge-abutting relation, the lateral edges of each slab being beveled and reentrantly recessed on their inside faces whereby to define inwardly opening vertically extending undercut recesses, reenforcing wires extending vertically through the slabs, and transverse wires extending transversely through the slabs and beyond the beveled faces, the transverse wires being connected to each other within said recesses, the transverse wires having inwardly projecting portions intermediate their ends, said portions projecting beyond the adjacent face of the slab, tie members connecting said inwardly bent portions of the transverse reenforcing wires of oppo-

site slabs, and concrete filling the spaces between opposed rows of slabs and extending into the undercut recesses between adjacent alined slabs, thus bonding alined slabs to each other and to the filling of concrete.

4. A structure of the character described, including two opposed rows of vertically elongated preformed slabs of artificial stone, the slabs of each row being set on end and being disposed with their lateral edges abutting the adjacent slabs of the same row, the lateral edges of each slab being beveled outward laterally on their inside faces, the beveled portions being reentrant, reenforcing rods extending transversely through each slab at a plurality of points and extending beyond the beveled lateral margins of each slab, the reenforcing rods of one slab being engaged with the reenforcing rods of adjacent slabs, the wires connecting said rods at intervals, and concrete filling the space between said rows of slabs and filling the said recesses and having interlocking engagement therewith.

5. As an article of manufacture, a structural element for use in forming concrete structures and having the form of a slab, the side edges of the element being beveled longitudinally and outward, the element having embedded therein longitudinal reenforcing members and transverse reenforcing members, the latter members extending beyond the beveled ends of the element, each element being formed with an elongated recess, each transverse member having an integral outwardly bowed portion disposed at the intersection of the transverse member with said recess whereby ties may be connected between opposed elements.

6. In a building, a slab having a longitudinally extending recess in one face thereof, there being an opening extending from the recess through to the other face of the slab, an element disposed in a plane at right angles to the plane of the slab and in alinement with said opening, initially plastic material forming part of said element filling said recess and said opening, and a reenforcing rod disposed longitudinally in said recess and extending over said opening whereby the rod is embedded in the initially plastic material.

7. The combination with a line of slabs having inwardly beveled margins, of a reenforcing element extending through each slab, the reenforcing element of one slab being alined with the reenforcing element of the next adjacent slab, a split resilient sleeve engaging over the adjacent ends of the reenforcing elements and disposed in the space defined by the beveled margins of the slabs and plastic material filling the spaces defined by said beveled margins and enclosing the sleeves of the adjacent ends of the reenforcing elements.

8. In a building, an angular wall formed by slabs disposed at right angles to each other, the adjacent margins of the slabs being beveled inward and laterally from the intersections of the slabs, said beveled faces being reentrantly recessed adjacent the inner faces of the slabs, and concrete disposed between the outer and inner slabs and filling the space therebetween and anchored thereto, said concrete filling the space defined by said deflected reentrant faces and being interlocked therewith to hold the exterior corner slabs in right angular relation to each other.

In testimony whereof I hereunto affix my signature.

HERMAN G. LARZELERE.