March 16, 1926. 1,576,813

D. C. DAVIES ET AL

CONCRETE STRUCTURE

Filed April 14, 1924 5 Sheets-Sheet 1

Fig. 1.

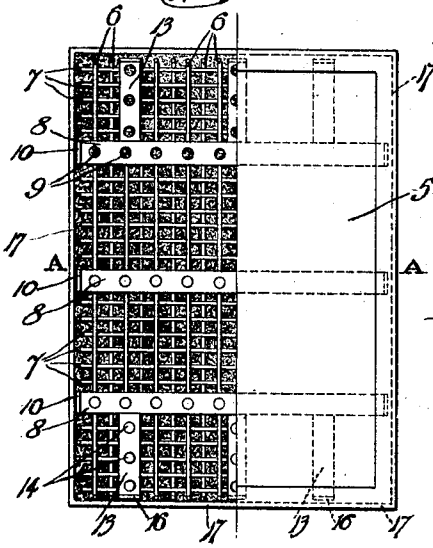
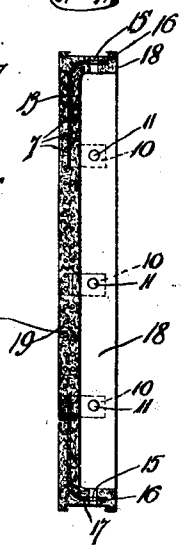


Fig. 2.



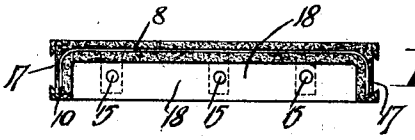


Fig. 3.

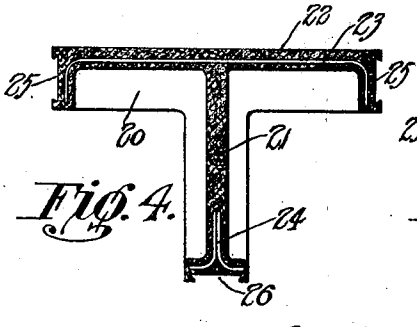


Fig. 4.

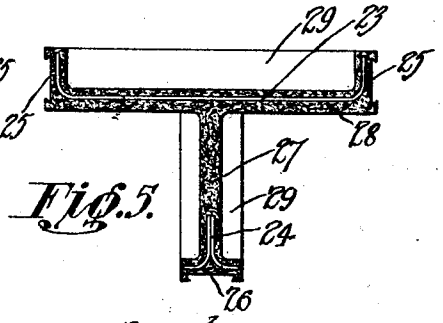


Fig. 5.

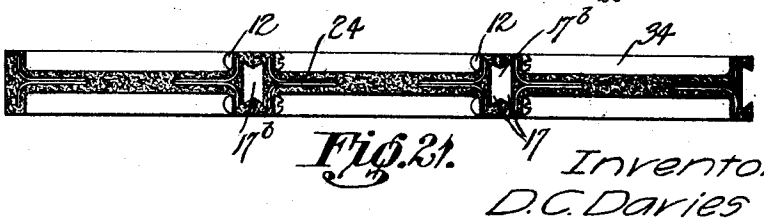


Fig. 21.

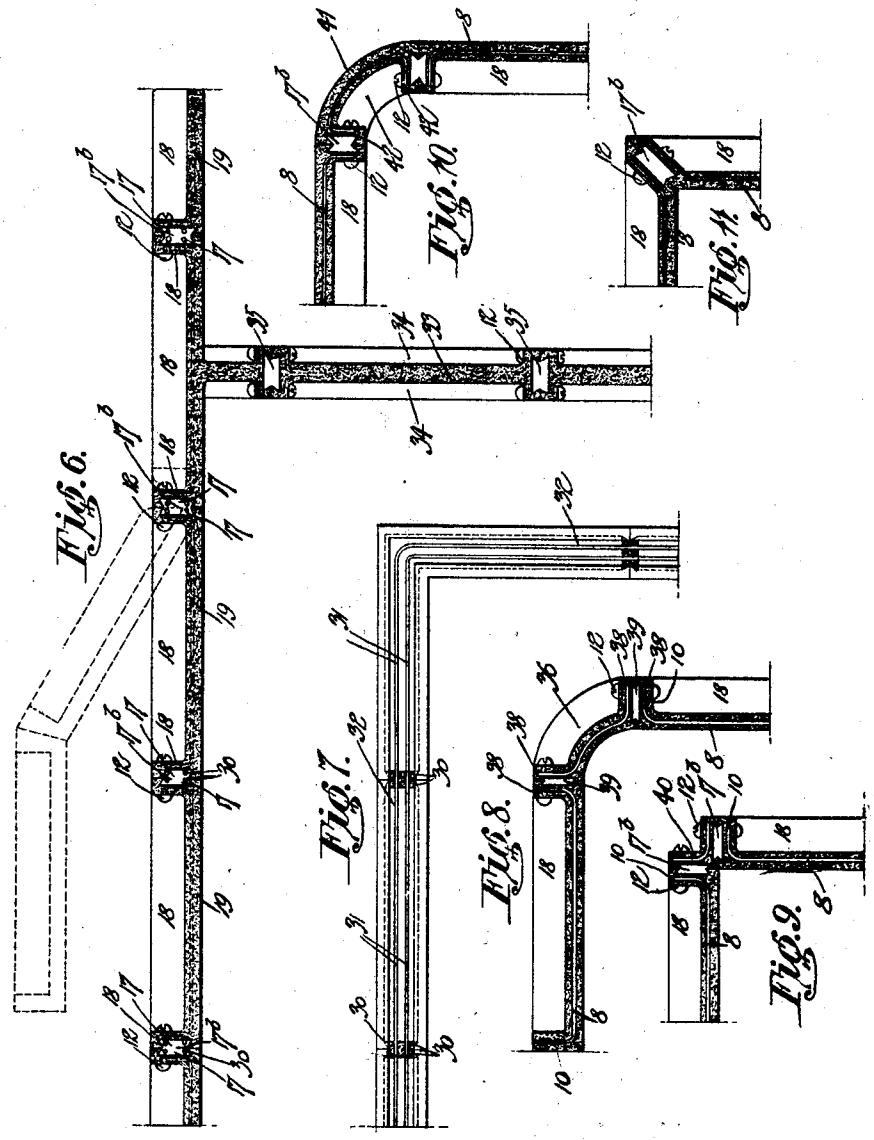
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CONCRETE STRUCTURE

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CONCRETE STRUCTURE

Filed April 14, 1924 5 Sheets-Sheet 3

Fig. 12

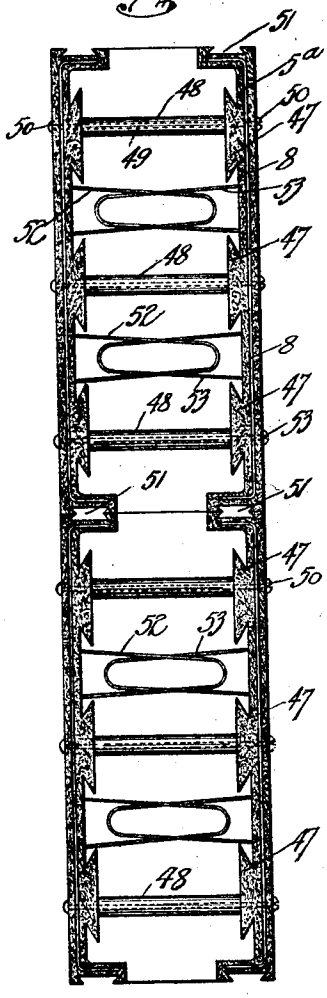


Fig. 13

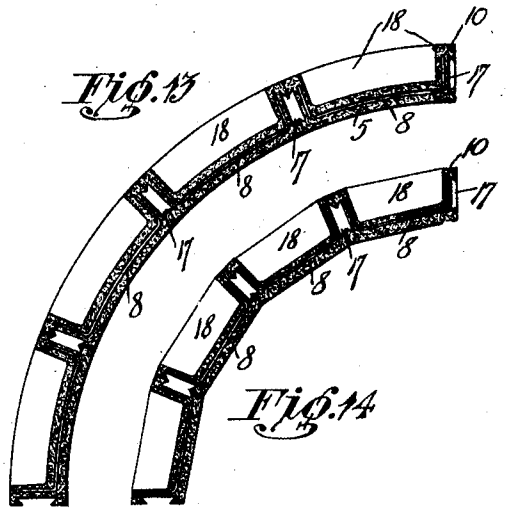


Fig. 14

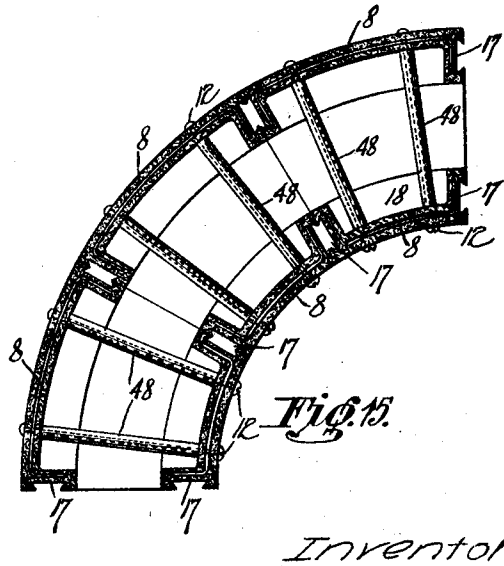


Fig. 15.

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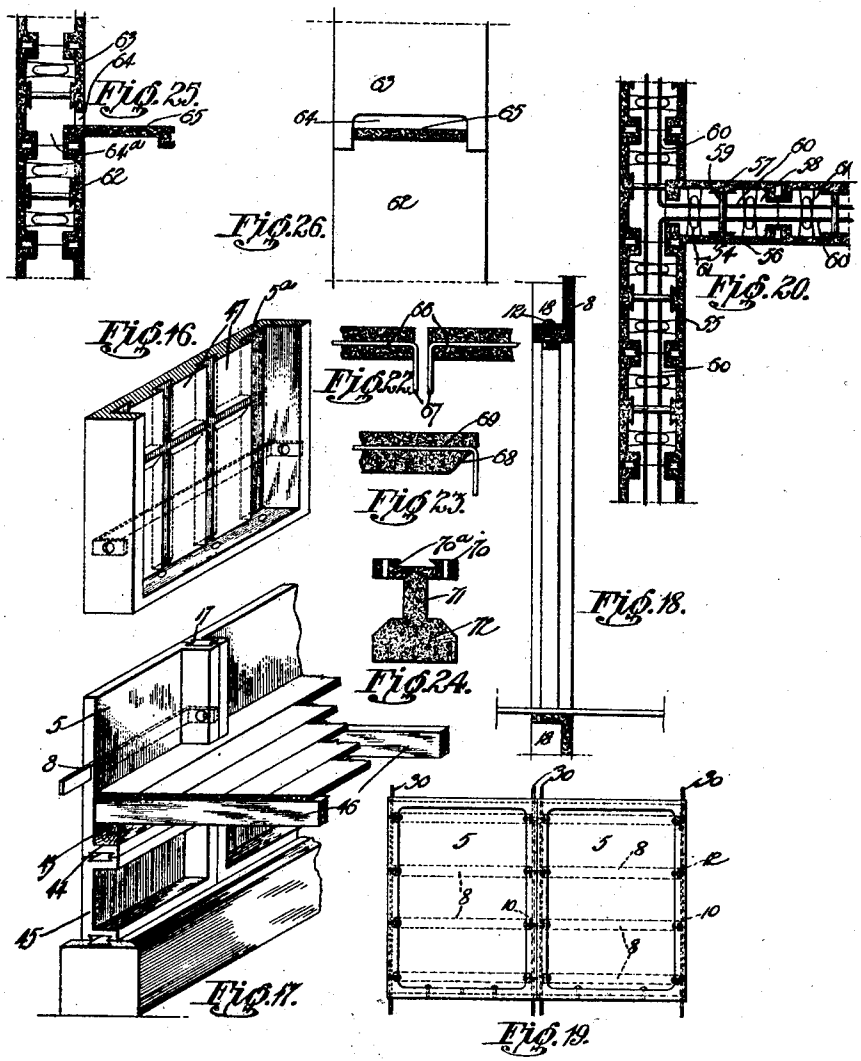
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CONCRETE STRUCTURE

Filed April 14, 1924 5 Sheets-Sheet 5

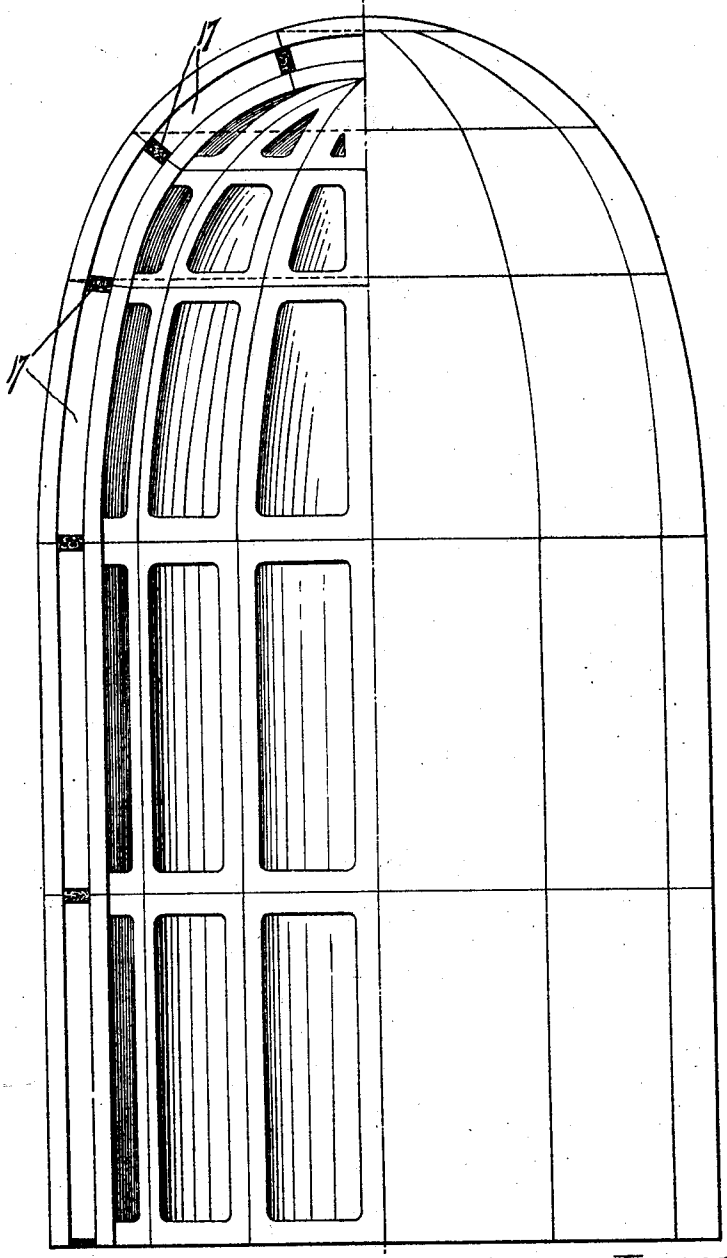


Fig. 27.

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Patented Mar. 16, 1926. 1,576,813

UNITED STATES PATENT OFFICE.

DANIEL CHARLES DAVIES AND ARTHUR HAROLD THOMAS, OF MELBOURNE, VICTORIA, AUSTRALIA.

CONCRETE STRUCTURE.

Application filed April 14, 1924. Serial No. 706,531.

To all whom it may concern:

Be it known that DANIEL CHARLES DAVIES and ARTHUR HAROLD THOMAS, citizens of the Commonwealth of Australia, and residents of Melbourne, in the State of Victoria, Commonwealth of Australia, have invented certain new and useful Improvements in Concrete Structures, of which the following is a specification.

This invention has reference to concrete structures and is particularly directed to the erection of structures from integers constructed apart from the selected site.

The invention refers to that class of concrete structure formed of a pluraliy of precast slabs suitably reinforced and adapted to be placed one on the other and abutting in order to obtain the desired length and height of structure.

Further, the invention allows of obtaining great heights in structures such in the case of a building of more than one story and further the walls of such high structures may be perfectly plumb from top to bottom which is not possible with the existing methods which consist essentially of building up forms generally of wood and filling in between them with concrete.

This latter method, however, results in a very rough exterior and interior which generally requires covering with some material in order to render such a wall presentable, the cause of such unevenness being due to the boards used in the form structure warping and twisting through absorption of water used in the mixing of the agglomerate, and further it is submitted that wooden forms are unsatisfactory for the reason that by their use it is not possible to obtain a thorough settlement of the concrete when poured between the forms so constructed and further such a method is wasteful on account of the material used and unfit for further use owing to the condition thereof after absorbing a quantity of moisture.

The basic principle underlying this invention and especially when building more than one story consists in using pre-cast slabs as the forms for receiving the agglomerate which when set becomes part of the slabs and thus forms sections of the wall or other building structure which when completed comprises inner and outer oppositely disposed pre-cast slabs with an agglomerate core, the slabs also acting as the forms at present employed in building structures the need for removing such forms being obviated in this invention as the slabs become the inner and outer surface of the structure.

But in order that the invention be more readily understood reference will now be made to the accompanying drawings in which:—

Figure 1 is a plan view partly in section of a pre-cast slab constructed according to our invention.

Figure 2 is a side sectional elevation thereof.

Figure 3 is a sectional view on the line A. A. of Figure 1.

Figure 4 is a sectional view of a slab formed with a right-angled extension for use when forming extensions to a building or in forming intermediate walls.

Figure 5 is an alternative construction of the member shown in Figure 4.

Figure 6 is a sectional plan view of part of a wall and intermediate wall and showing the formation of a bay in dotted lines.

Figure 7 is a plan view of one course of slabs showing grouting and reinforcing rods in position.

Figure 8 is a sectional plan view showing method of forming a curved corner.

Figure 9 is a view of means for constructing a corner.

Figure 10 is an alternative method of forming a corner.

Figure 11 is a further alternative method.

Figure 12 is a sectional plan view showing opposed slabs, spacing pieces and reinforcing means for use when erecting structures requiring great strength.

Figure 13 is a plan sectional view showing method of forming circular work as in silos, chimney stacks, water tanks, towers and the like.

Figure 14 is a sectional plan view showing the use of flat pre-cast slabs with angular faces for obtaining a hexagon, octagon or dodecagon as desired.

Figure 15 is a sectional plan view show-

ing the formation of a cavity in circular work.

Figure 16 is a part perspective view of a slab for use in structures requiring great strength.

Figure 17 is a perspective view showing method of laying a floor.

Figure 18 is a sectional elevation showing method of affixing door jambs.

Figure 19 is a view showing method of affixing panelling or lining dadoes to a wall constructed according to our invention.

Figure 20 is a view showing method of erecting floors to buildings of more than one story in height.

Figure 21 is a view showing the formation of intermediate walls.

Figure 22 is a view showing a modified joint.

Figure 23 is a view showing a further modification of joint.

Figure 24 is a sectional view showing one form of foundation piece.

Figure 25 is a view showing an alternative construction of floor for buildings of more than one story.

Figure 26 is an elevation thereof, and

Figure 27 is a view showing the application of pre-cast slabs to a dome or tower.

The essential feature embodied in this invention consists in forming pre-cast slabs 5 of concrete or other material, such slabs being suitably reinforced by means of longitudinal and transverse rods or wires 6—7 which are suitably embedded in the material, during the manufacture of the slab.

Positioned in the mass is a plurality of transverse bars 8 provided with holes or openings 9 to allow the concrete to percolate therethrough so as to securely bind said bars in the mass, whilst the ends 10 of said bars are turned outwardly and formed with holes or openings 11 adapted to receive rods or bolts 12 for holding two or more slabs as 5 together.

A number of short bars 13 are positioned on the upper and lower portions of each slab, these bars being also provided with holes or openings 14 to allow of the concrete or other material to percolate therethrough and hold said bars rigidly in the mass when set, holes 15 being provided in the outturned ends 16 of said bars to receive bolts for holding upper and/or lower slabs together.

Disposed completely around the sides, top and bottom of each slab is a dove-tailed recess or rebate 17, which is adapted when two slabs are abutting or one above the other to form a complete dove-tail space 17^b which is filled with cement or other grouting thus forming a positive lock between the slabs and also makes a weather-proof joint, and to further strengthen the grouting, reinforcing wires or rods are positioned in the openings prior to filling in with said grouting, and in order to ascertain when the recess or rebate 17 is filled with cement grouting, and when same has percolated throughout the entire length and system of recesses, grouting holes 17^a are provided in each slab which would allow the grouting to rise therein when the recesses were filled.

Disposed around one surface or face of each slab is a rib 18 which is adapted to form a substantially wide face where two slabs abut and allowing of easy fitting of the slabs one to the other whilst the veil 19 of concrete may be substantially thinner in cross section than the ribs 18 as no strain is taken on the surface of the slabs either during the stages of manufacture or when erected.

The bars 8 and 13 are bent outwardly at the ends which pass into the ribs 18 described, the holes 11 and 15 in said bars being also through the rib 18 so that when pressure is applied to the bolts or other fastening devices the concrete or other rib 18 is prevented from breaking away as the strain is taken on the bars 8 and 13 which are provided for this purpose.

When it is desired to form a projection or internal or external corner, slabs as illustrated in Figure 4 may be used which consist essentially of a T-shaped member with a rib 20 internally arranged, according to whether the ribs throughout the structure are internally arranged, whilst a right-angled extension 21 is formed on the inner surface or veil 22, bolt receiving bars 23 and 24 being disposed in the mass as has already been described, whilst dove-tailed recesses 25 and 26 are formed around the interior abutting surface of the member for the purposes herein set out.

In Figure 5 it will be noticed that the extension piece 27 joins or connects the slab 28 on the inside, such construction being used when it is desired to have the internal face of the slabs smooth and with bolting ribs 29 externally arranged.

When two or more slabs are abutting as shown in Figure 6, dove-tailed recesses 17 are together with reinforcing members 30 disposed therein and when the slabs are bolted together these recesses are filled up with cement or other grouting which is poured in thus forming a key between the slabs, whilst the reinforcing members 30 prevent such grouting from breaking up.

Reinforcing rods 31 are also arranged along the horizontal face of the recess 32 so that the grouting in all positions about and between the slabs is securely reinforced and ultimately becomes part of the slabs in which these recesses are formed.

Figure 6 also shows the application of the extension or projection member shown in Figure 5 wherein such extensions or projections are carried out with the veil or web 33 of concrete centrally disposed and with ribs

34 each side thereof, dove-tailed recesses 35 being arranged on the abutting edges and side of the slabs in the same manner as the slabs for external purposes.

Circular corners may be formed by providing a member as 36, Figure 8, in which the smooth surface of the wall is internally arranged and the bolting ribs 38 externally arranged, recesses 39 being formed as already described between the abutting surface of the corner member 36 and the slabs arranged on each side and above and below.

Figure 9 shows a corner formed by the use of an angle piece 40 which also allows of obtaining a smooth surface on the interior of the structure.

In Figure 10 it will be noticed that the corner member 41 is the reverse to that shown in Figure 8 in which case the smooth surface is on the interior of the structure whereas in Figure 10 the corner piece 41 is formed with bolting ribs 42 internally arranged so that the exterior of the structure is a smooth surface with each corner wherever occurring having a pleasantly arranged finish but this of course would depend upon the taste of the builder.

Figure 11 shows corner members which may be formed on the ends of slabs without the use of a separate integer as 36 or 41 and in this instance the interior face of the structure is smooth and the bolting ribs externally arranged.

The essential characteristic of the invention consists in forming pre-cast slabs as described, each slab being provided with longitudinal and transverse reinforcing rods embedded in the mass and transverse bars 8, the ends of which are formed to pass into the ribs on one face of the slab and short bars adapted to receive the bolts or other fastening means for holding upper and lower slabs together.

The provision of the dove-tailed recesses about the whole peripheral length of each slab so that when two or more slabs are abutting and in line the dove-tailed recess of one slab meets the dove-tailed recess of the abutting slab which forms a completed dove-tailed recess or passage to receive grouting which is poured into said recess after the slabs have been bolted together.

Door and window openings may be provided by leaving out slabs at selected intervals, the bolts used for holding two or more slabs together being used for securing the frames of the windows or door openings in position in the structure.

Floors are provided for by placing a bearer 43 on the lower rib 44 of the commencing row of slabs 5 and if desired these slabs 5 may rest upon a member 45 formed similarly to the slabs but much narrower in width.

Floor joists 46 rest upon the bearer 43 which is bolted to the ribs 44 by the bolts for holding said ribs together.

The description given refers mainly to the erection of structures of not more than one story in height, the means for erecting buildings of more than one story being substantially as follows:—

In building structures of more than one story in height it is preferred to use slabs as illustrated in Figure 16 wherein on the inner surface of the veil 5^a longitudinal and transverse ribs 47 are formed and it is preferred to space slabs so formed some distance apart as illustrated, such spacing being maintained by the use of distance pieces 48 consisting preferably of tubes through which stay rods 49 pass, the heads 50 of said stay rods being external and adapted to hold the slabs rigidly together.

Dove-tailed recesses 51 are used in this structure whilst reinforcing wires 52—53 are arranged in the manner of loops, said reinforcing wires being arranged in each slab so that when the slabs are oppositely disposed, said wires substantially overlap so that when the concrete is poured in the reinforcing wires hold such fitting together and by the filling passing in and about the dove-tailed ribs 47 such filling becomes part of the slabs forming the inner and outer face of the completed structure.

In this construction we dispense with the use of wooden or other forms for the building of the walls or other parts of a building, the slabs which ultimately form the inner and outer face being used as the forms to receive the agglomerate, thus resulting in a smooth external and internal face and dispensing with the necessity of further treatment once the concrete filling between the slabs is set, and further by erecting lofty structures by this method the walls, however high, will be perfectly plumb and free from undulations which is particularly noticeable with the present structures of this class which are erected by the use of wooden or metal forms which allow of irregular surfaces when the forms are removed, resulting in the necessity of facing up the whole surface with cement or plaster.

Where floors occur in a building similar slabs as the wall slabs are used, and may be arranged as shown in Figure 20 in which case the lower slab 54 is seated upon the wall slab 55 at the required height, the ribs 56 being uppermost, whilst a slab 57 is disposed above the slab 54 a suitable space 58 being provided and maintained by spacing tubes 59, reinforcing rods 60 passing between the slabs 54—57 and downwardly and upwardly to pass between the wall slabs and to further strengthen the floor slabs looped wires 61 are provided so that when the filling is poured in between the wall slabs and floor slabs the wires 61 and rods 60 rein-

force the mass and convert the slabs and filling into one homogeneous mass.

Figures 25 and 26 show an alternative method of construction for floors in which case the wall slabs 62 may be carried up to any desired height the slabs at the selected floor height being formed as 63 with an arched opening 64 through which the end of the floor slab is adapted to pass, only one slab being used in this arrangement, and after the slabs have been secured in position cement is then poured into the cavity 64 and after filling same the cement is then carried to the floor surface 65 which may be reinforced with rods or expanded metal prior to receiving the coating.

In forming circular work as illustrated in Figure 13 the abutting face of the slabs is constructed to give the required angle, such angle being obtained according to the diameter of the finished structure.

In the application of the slabs for this purpose dovetailed recesses will also be provided as already described in regard to the slabs for walling purposes and this method may be found advantageous when erecting chimney stacks, tanks, towers, silos and like structures.

Figure 14 is a similar arrangement to that illustrated in Figure 13 with the exception that the slabs are formed with straight sides and slabs constructed according to this arrangement may be used for a similar purpose to that described in Figure 13.

In some circular structures particularly for the storing of grain it is preferred to form a cavity between inner and outer walls owing to the combustible nature of some grain when under pressure and in this instance it is preferred to form a silo or similar structure as shown in Figure 15 wherein spacing tubes 48 form the means for maintaining the cavity throughout the whole height of the structure, and if desired ventilating means may be provided in communication from the interior of the structure to the cavity at the bottom and from the cavity to the exterior wall at the top so that gases forming in the silo may be drawn into the cavity and allowed free access to atmosphere at the top of the external wall.

Figure 22 shows an alternative joint between slabs in which the bars 66 pass externally of the slabs, the object being that when the grouting is poured in between the slabs, it completely envelopes the ends 67 of the bars.

Fig. 23 is a further alternative joint between the slabs wherein the ends are formed with a taper 68, the bolt receiving rods 69 passing beyond the face of the slab in the same manner as shown in Figure 22 and in both these constructions the rib 18 is dispensed with.

Figure 24 shows a form of foot piece for foundations, the upper flange 70 provided with a recess 70^a for receiving the first row of slabs, which are bolted thereto in any suitable manner, a substantial web 71 being disposed between said flange 70 and a base 72 which may be either directly embedded in the earth or rest upon a concrete foundation disposed in an excavation as in the established practice of construction.

Figure 27 shows the application of the slabs to a dome or tower in which case the slabs, at the uppermost portion, would be specially formed so as to close in correctly at the apex of the dome or tower, but we would still use the dove-tailed recesses as 17 adapted to receive grouting, and ribs 18 would also be formed on each slab for affixing the slabs together.

It will be obvious that any form of structure may be erected by the use of slabs constructed according to this invention, the particular shape and configuration of each slab depending upon the structure to be erected, moulds being provided to cast the slabs for whatever purpose they are to be used for.

What we claim as our invention and desire to secure by Letters Patent is:—

1. In improvements in concrete structures means for holding two or more slabs together, said means consisting in forming ribs on one face of each slab, embedding bars in the mass during the manufacture of the slab, turning the ends of each bar outwardly to enter said rib, forming holes in said bar and said rib and passing bolts or other holding devices therethrough.

2. Improvements in concrete structures characterized by the provision on each rib face of a pre-cast slab, of a dovetailed or other shaped recess or channel for the purposes specified.

Signed at Melbourne, Victoria, Australia, this 29th day of February, 1924.

DANIEL CHARLES DAVIES.
ARTHUR HAROLD THOMAS.