

March 5, 1940.

M. DEUTSCH

2,192,183

METHOD OF MAKING CONCRETE SLABS

Filed May 27, 1937

4 Sheets-Sheet 1

Fig. 1.

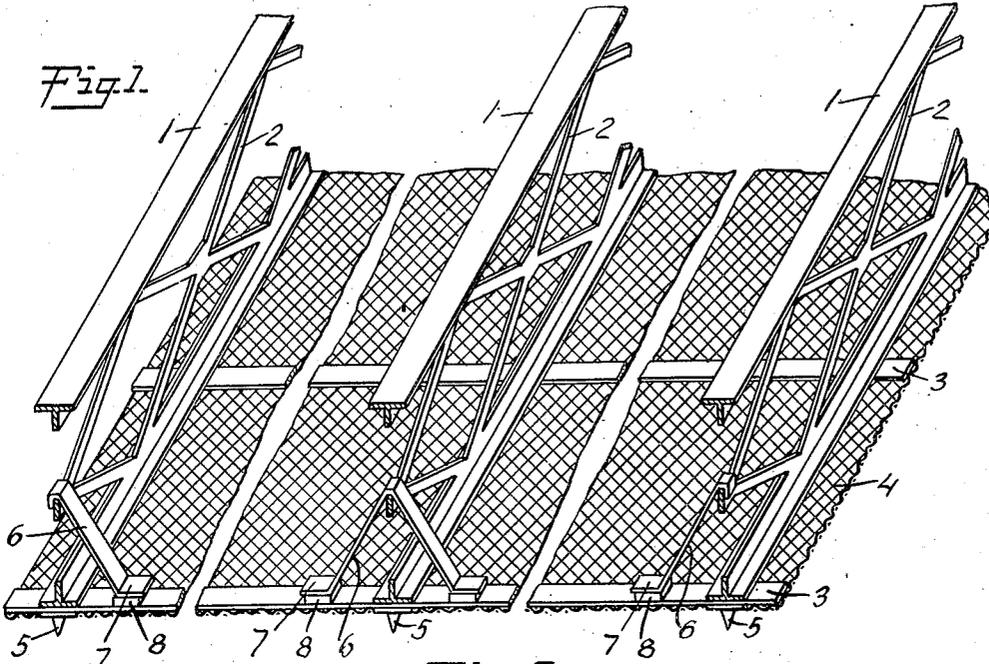


Fig. 2.

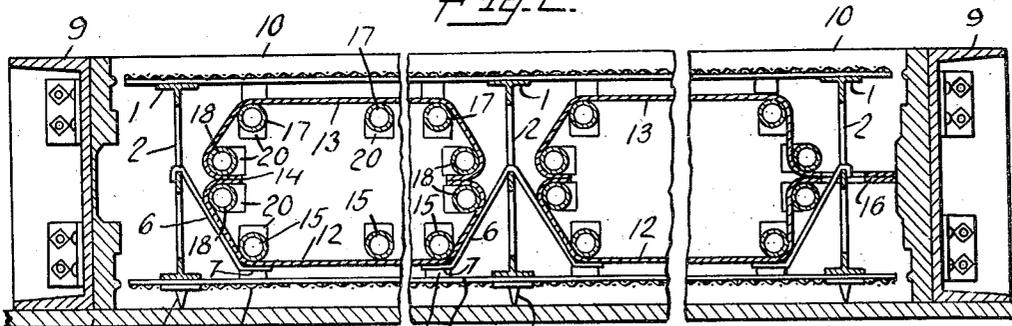


Fig. 3.

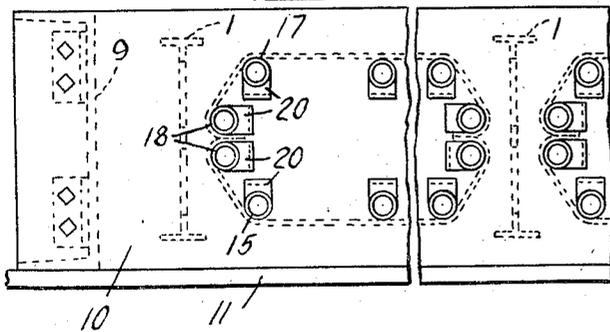
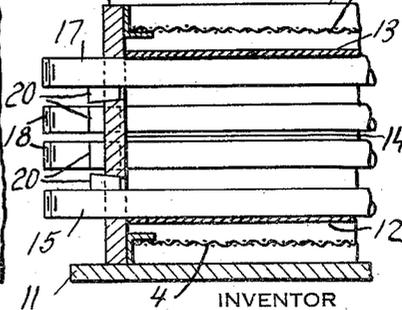


Fig. 4.



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Fig. 5.

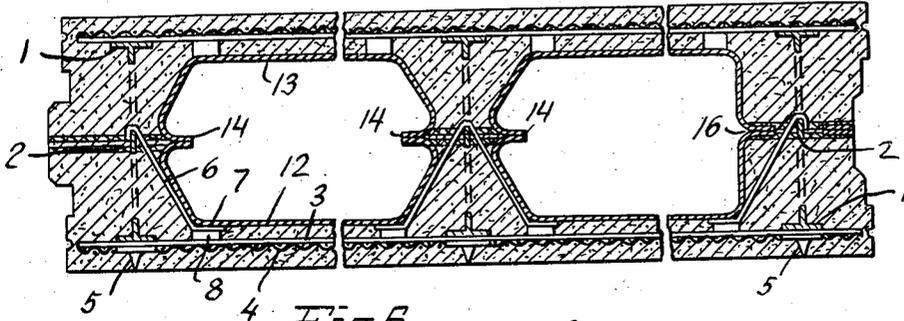


Fig. 6.

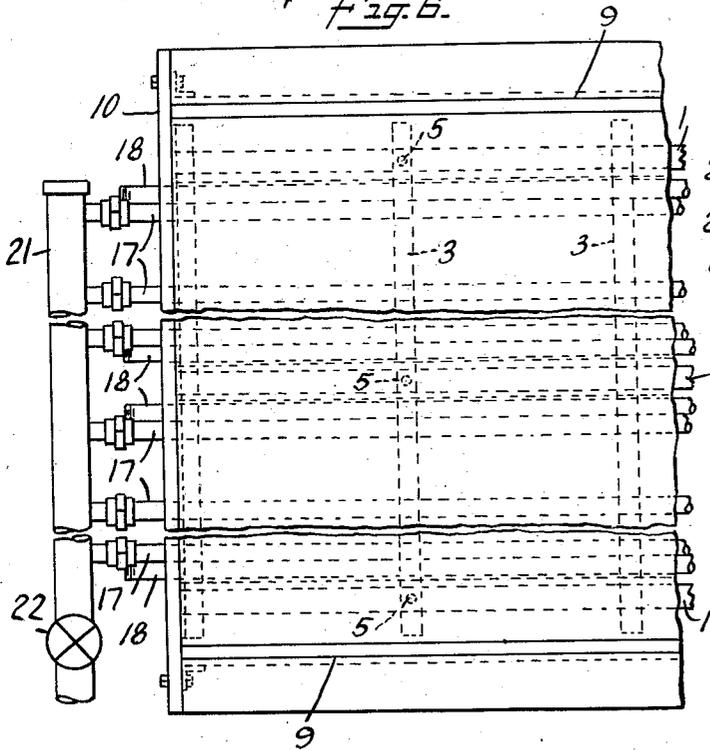
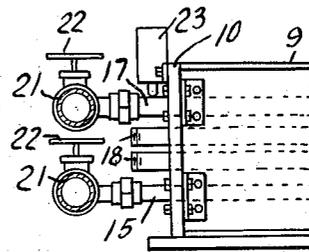


Fig. 7.



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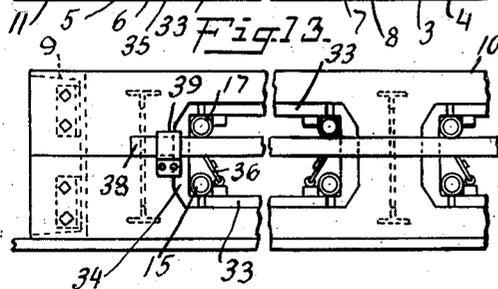
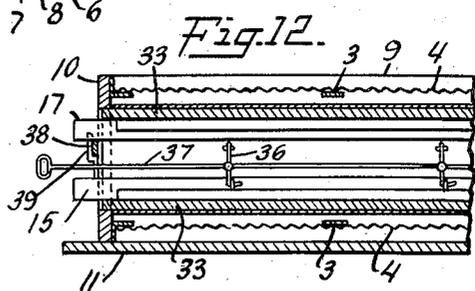
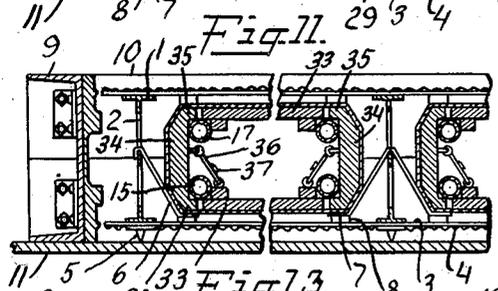
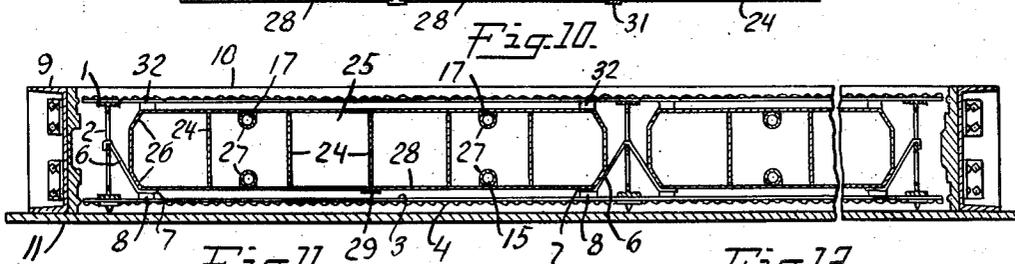
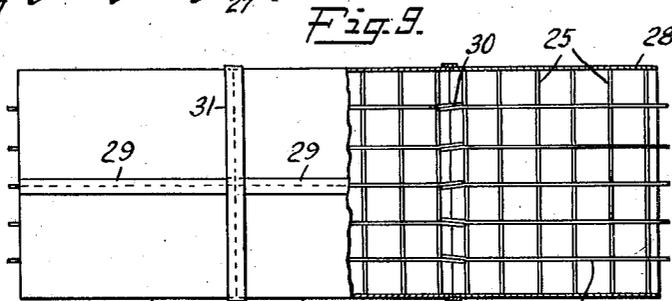
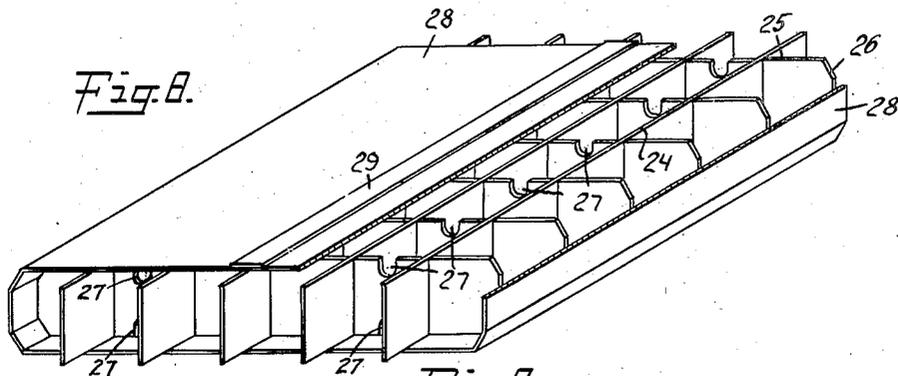
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METHOD OF MAKING CONCRETE SLABS

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4 Sheets-Sheet 3



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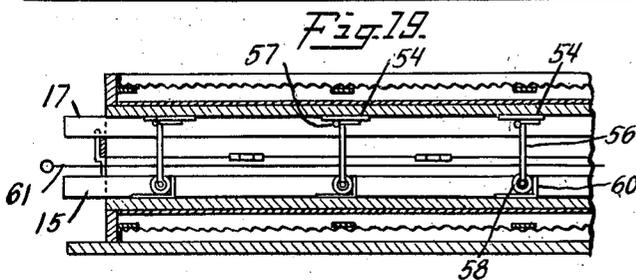
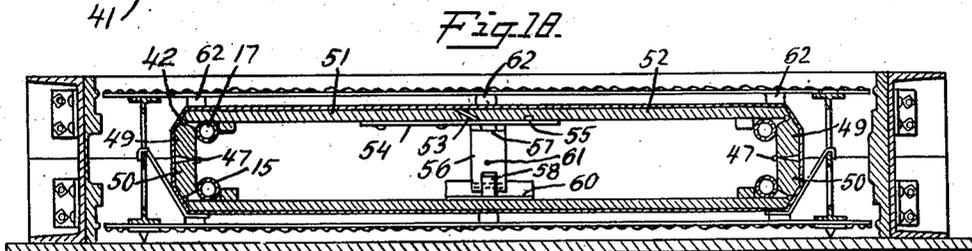
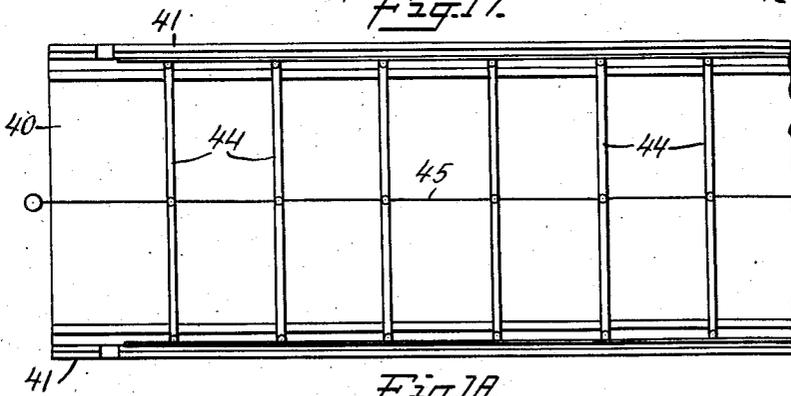
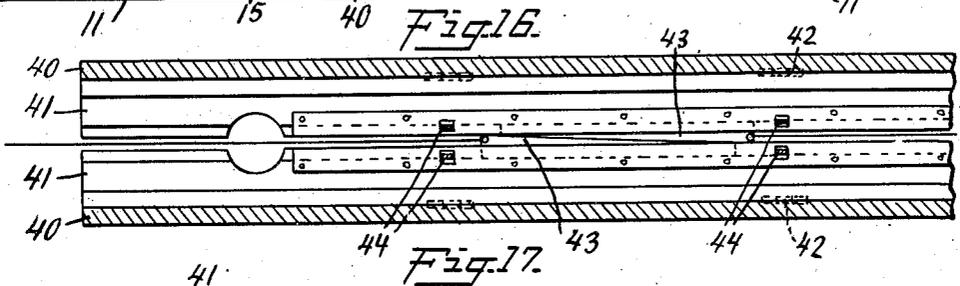
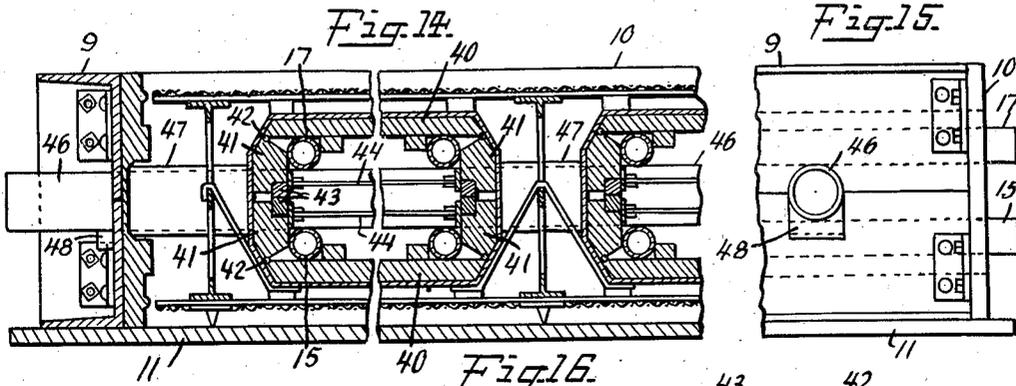
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METHOD OF MAKING CONCRETE SLABS

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4 Sheets-Sheet 4



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2,192,183

METHOD OF MAKING CONCRETE SLABS

Maurice Deutsch, New York, N. Y.

Application May 27, 1937, Serial No. 145,030

5 Claims. (Cl. 25—154)

This invention relates to cellular reinforced concrete slabs and particularly to that type which are cast horizontally and subsequently used as wall, floor, partition or roof elements in the erection of so-called prefabricated buildings. More particularly, the invention embraces novel improvements in the method of forming the cellular openings within such reinforced concrete slabs.

In my copending application Serial No. 127,888, filed February 26, 1937, I have described the method of preparing cellular reinforced concrete slabs of this type having improved permanently positioned hollow core members which form the cellular openings and which cooperate with other elements of the slab to increase its strength, to reduce its weight, and to lessen the cost of its fabrication. While the concrete slabs produced according to this method described in my copending application have all the desirable characteristics which have been attributed to them, difficulty has been encountered under certain conditions in the economic production of these concrete slabs.

The method of casting the concrete slabs, as described in my copending application, involves the use of a casting table having a horizontal surface and side walls of the desired shape and size forming a mold for the exterior of the slab. After a layer of material that is to constitute the interior finish of the slab has been disposed in the bottom of the mold, a small quantity of concrete is deposited on the layer of interior finish material. The entire metallic reinforcing structure is then positioned in the mold and an additional quantity of concrete is deposited to cover the horizontal elements of the metallic reinforcing structure. Sheets of waterproof fibrous material constituting the lower halves of the core members of the cellular slabs are then positioned and held in place while additional concrete is poured into the mold to completely fill the space around the lower half of the cores. After the material suitable for insulation and expansion has been placed on top of the concrete forming the struts separating the hollow cores of the slab as the concrete reaches the top of the lower halves of the core members, the fibrous sheets constituting the upper halves of the core members are positioned and held in place while more concrete is poured into the mold to completely fill the space around the sides of the upper halves of the core members. After the upper horizontal elements of the metallic reinforcing structure have been secured in position, concrete is poured into

the mold substantially to the top thereof and a final layer of suitable material deposited on top of the concrete to form the exterior finish of the slab.

I have found, however, that when the sheets of waterproof fibrous material comprising the core members of the concrete slabs are thin the weight of the concrete around the core members tends to crush these core members. In order to eliminate this distortion of the core members of the concrete slabs, I have devised novel means for supporting the core members. These supporting means may advantageously serve the additional purposes of distributing mechanical vibrations to the concrete so as to render the mass more compact and to eliminate air holes and the like from the interior of the concrete structure as well as for providing heat, vacuum or other means which may be useful in curing the concrete mass.

My invention will be more fully understood by consideration of the accompanying drawings in which—

Fig. 1 is a perspective view of a metallic reinforcing structure open at the top and ready for insertion into a mold for a concrete slab;

Fig. 2 is a broken end view of concrete slab showing the supporting means for the core members and alternative methods of positioning the ends of the fibrous sheets comprising the core members;

Fig. 3 is an end view of the exterior of the mold for a concrete slab showing the position of the supporting means for the core members;

Fig. 4 is a side view in section of the mold showing the method of securing the supporting means in position in the mold;

Fig. 5 is a broken cross-sectional end view of a reinforced concrete slab as a finished product showing continuity of the metallic reinforcing structure and continuity of insulating and expansion material;

Fig. 6 is a partial exterior plan view of the mold showing the supporting pipes connected to a header for supplying heat, for example, to the pipes within the mold;

Fig. 7 is a partial view in elevation of the exterior of the mold showing the pipes connected to headers for supplying curing means to the pipes and showing vibrating means associated with the pipes;

Fig. 8 is a perspective view of a proposed form of reinforced core member which may be inserted into the mold as a single unit;

Fig. 9 is a plan view of the reinforced core member shown in Fig. 8;

Fig. 10 is a broken end view of a concrete slab showing the position within the slab of the reinforced core member shown in Fig. 8;

Fig. 11 is a partial end view in section showing another modification of a core member which may be collapsed and withdrawn from the finished concrete slab;

Fig. 12 is a partial side view in section showing further detail of the modified form of core member shown in Fig. 11;

Fig. 13 is a partial end view of the exterior of the mold showing the position and support of the supporting pipes;

Fig. 14 is a broken end view in section of another modification of collapsible core member construction;

Fig. 15 is a partial side view of the exterior of the mold showing further details of the core member construction shown in Fig. 14;

Fig. 16 is a partial side view in section showing further details of the modified form of core member shown in Fig. 14;

Fig. 17 is a plan view of the interior of the proposed core member shown in Fig. 14;

Fig. 18 is a sectional end view showing another modified form of collapsible core member; and

Fig. 19 is a sectional side view showing further details of the collapsible core member shown in Fig. 18.

The metallic reinforcing structure shown in Fig. 1 is substantially that which is described in my above-identified copending application. The T-shaped bars 1 extending longitudinally through the concrete slabs are interconnected by a metallic web 2. The longitudinal T-shaped bars are held in spaced relationship by transverse metallic bars, or so-called "flats" 3, rigidly secured to the T-shaped bars at spaced intervals. A layer of wire mesh 4 is welded or otherwise secured to the "flats" as indicated at the bottom of the metallic reinforcing structure shown in Fig. 1. A similar construction of "flats" and wire mesh is also secured to the upper portion of the longitudinal T-shaped bars, although this upper structure is omitted from Fig. 1 for the purpose of simplifying the drawings. Spacing elements such, for example, as metallic cones 5, are welded or otherwise secured at spaced intervals to the underneath portion of the metallic reinforcing structure. The height of these spacing elements is such as to support the reinforcing structure above the surface of the casting table so that the layer of wire mesh will lie within the concrete mass of the slab.

The metallic reinforcing structure is further provided with suitable cradles 6 which are supported by the web 2 in any suitable manner, such for example, as that shown in Fig. 1. The cradles preferably slope away from the lower half of the web at such an angle as to conform with the desired slope of the sides of the core members (discussed further herein). The cradles terminate in bent portions 7 which lie in a plane substantially parallel to the wire mesh 4. These bent portions are held at a distance from the "flats" by suitable spacing blocks 8, the thickness of the spacing blocks being such that the bent end portions 7 will support the core member in the proper position within the metallic reinforcing structure. The cradles further serve to hold the metallic reinforcing struts in position within the metallic reinforcing structure thus rigidly reinforcing the entire structure so that the structure may be readily handled as a single unit.

The metallic reinforcing structure is placed within the mold having sides 9 and end walls 10 resting upon the surface of a casting table 11 (Figs. 2-4). A hollow core member of prefabricated sheet material is located between each pair of reinforcing struts comprising the T-shaped bars 1 and the webs 2. Each core member may comprise two independent opposing strips of waterproof fibrous material 12 and 13 which extend longitudinally between the reinforcing struts. The two sheets are inversely arched outwardly and the edge portions lie in close proximity, either extending inwardly to the center of the core as indicated at 14 or extending outwardly from the core and between the upper and lower concrete struts of the slabs as indicated at 16. Each pair of opposing sheets forms a tunnel-like passage or opening extending longitudinally through the slab. The lower half of the core member comprising the lower sheet of waterproof fibrous material is supported from underneath by the bent end portions 7 and on the sides by the sloping cradles 6 as shown in the left-hand half of the drawing in Fig. 2.

The lower portion 12 of the core member is held in place by pipes 15 extending longitudinally through the interior of the core. These pipes are positioned with advantage adjacent the bent end portions 7 of the cradles as well as at appropriately spaced intervals along the inner surface of the core member. The upper portion of the core member comprising fibrous sheet 13 is supported preferably adjacent its corners by suitable pipes 17 and at other advantageous points within the core member. The ends of each of the fibrous sheets comprising the core member may be held in place, for example, by pipes 18 as shown at 14 in the left-hand half of Fig. 2 or as shown at 16 in the right-hand half of Fig. 2.

The pipes 15, 17, and 18 which support the core member preferably extend through the end walls 10 of the mold as shown in Figs. 3 and 4. The holes in the sides of the mold through which these pipes extend are substantially larger than the outside diameter of the pipes so as to permit the insertion of wedges 20 into the holes in the sides of the mold to hold the pipes securely in position. These holes may advantageously be rectangular in form having a width sufficient to admit one of the pipes and a length substantially greater than its width. As shown in Fig. 3, the wedges holding pipes 15 in place are preferably driven into the hole above the pipes, while those holding pipes 17 in position are preferably forced into the holes beneath the pipes. The wedges holding pipes 18 in position are preferably forced into the holes through which pipes 18 extend either on one side or the other of these pipes as clearly shown in Fig. 3.

In casting one of the improved concrete slabs in accordance with my present invention, the metallic reinforcing structure shown in Fig. 1 is placed on the surface of the casting table within the mold as shown in Fig. 2. After the waterproof fibrous core members have been placed in position between the adjacent reinforcing struts of the metallic reinforcing structure and the core member held in position by the pipes 15, 17, and 18, the wedges are driven into the holes at the ends of the mold through which these pipes extend, thus securely holding the core member in position. The upper horizontal portion of the metallic reinforcing structure may then be ap-

appropriately secured to the upper T-shaped bars. Concrete or other suitable self-hardening material is then poured into the mold, provisions being made for the interior and exterior finish of the slab as described above. After the concrete or other self-hardening material has set, the wedges may be withdrawn from the holes in the sides of the mold and the pipes 15, 17, and 18 withdrawn from the mold leaving a finished product such as that shown in cross-section in Fig. 5.

The pipes which extend longitudinally through the interior of the core member may be connected to headers 21, as shown in Figs. 6 and 7. Suitable valves 22 are provided in the headers for supplying heat, by means of steam, for example, or for providing other medium which may be used in curing the mass of concrete or other self-hardening material in the mold. As shown in Fig. 7, means 23 are advantageously provided for imparting vibration to the pipes whereby the vibrations may be transmitted to the concrete within the mold for rendering the mass more compact and eliminating air pockets therein.

A modification of a core member is shown in Fig. 8. This core member comprises a grid-like construction having interlocking vertical longitudinal and transverse strips 24 and 25, respectively, intersecting substantially at right angles to one another. The ends of the transverse strips 25 are appropriately cut as at 26 so as to provide the side walls of the core member with a slope conforming with the slope of the cradles 6 and to provide support for the sloping side portions of the core member. Slots 27 are provided adjacent the top and bottom of the transverse strips in order to accommodate the longitudinal pipes which extend through the mold. The grid-like structure is covered with a sheet of waterproof fibrous material 28 or other suitable sheet material which extends over the top, sides and bottom of this structure. The ends of the sheet material may be joined together by a strip of tape 29 or other suitable material around the outside of the core member. In order to build up the grid-like structure to a sufficient length so as to extend throughout the entire length of a single slab, a plurality of the longitudinal vertical strips may be fastened together adjacent their ends as shown at 30 in Fig. 9 and the joints between sections of waterproof fibrous or other suitable covering material joined by tape 31 or other suitable material. The reinforced core members each may be completely covered and a plurality of the covered core members laid end-wise within the slab. The core members may be completely covered by cutting off the ends of the longitudinal strips 24 and covering the ends of the core members with paper or the like.

In using the internally reinforced core member shown in Figs. 8 and 9 the pre-assembled core member is placed upon the cradles 6 and resting upon the bent end portions 7. The core member is held from moving transversely within the metallic reinforcing structure by the sloping ends 26 of the core member which rest against the cradles 6. After the core member has been placed within the metallic reinforcing structure, the upper horizontal portion of the metallic reinforcing structure is fastened in place. On the other hand, the upper horizontal portion of the metallic reinforcing structure may be securely fastened in position and the core member subsequently inserted into the metallic reinforcing

structure through the open end thereof. The underneath surface of this upper portion of the metallic reinforcing structure is provided with advantage with spacing elements 32 which bear down firmly upon the upper surface of the core member. Thus, the core member is rigidly held in position and can not be raised or otherwise moved as concrete or other self-hardening material is poured or forced into the mold around and underneath the core member. Pipes 15 and 17 may then be inserted through the slots in the transverse vertical strips of reinforced core member, and, upon being appropriately wedged in the holes within the end walls of the mold, the pipes will be in contact with the inner surface of the sheet material which forms the core member so that vibration or curing means supplied through the pipes may be imparted to the concrete mass. After the concrete has been poured into the mold and has set, the core member may be left in the slab if desired or may be withdrawn.

In the modification of core member shown in Fig. 11, the waterproof fibrous core lining is supported by a collapsible core member. The core member comprises solid portions 33 which form the top and bottom of the mold and solid side members 34 provided with projecting portions 35 at the top and bottom of the side members. The upper solid portion of the core 33 is of sufficient width to span the distance between the pipes 17 yet insufficient to reach completely between the upper and lower projections 35 of the side members. Thus, when pipes 17 are inserted through the mold the upper solid portion of the mold 33 is supported by these pipes. The pipes 17 also further provide support for the solid side members 34. Suitable means such as hooks 36 attached at spaced intervals to the side members 34 are provided for supporting the lower solid portion of the mold 33. The lower solid portion of the mold and the lower portion of the side walls are held in position by pipes 15. The hooks 36 on each side member are interconnected by means of longitudinal rods 37, one end of the rod extending through the end of the mold. The pipes 17 may be supported at the exterior of the end of the mold as, for example, by the bar 38 which in turn may be supported by a cleat 39 (Figs. 12 and 13).

After the concrete or other self-hardening material has set in the mold, the collapsible core member shown in Figs. 11, 12, and 13 supporting the waterproof fibrous core lining may be removed by first removing bar 38 from its supports 15 and then removing pipes 15 and 17 from the exterior of the core. The spaces provided between the ends of the upper and lower solid portions 33 of the core member and the projections 35 of the side members 34 permit the entire core member to be loosened when pipes 15 and 17 are withdrawn. When pipes 17 are withdrawn the upper solid portion 33 of the core member will fall to the bottom of the core. By withdrawing rods 37 through an open end of the mold, hooks 36 which are attached to side members 34 and the lower solid portion 33 of the core member are moved toward the open end of the core thus withdrawing the entire core assembly from the mold. There is left within the hollow portion of the slab a permanent continuous lining of insulating waterproof fibrous material.

Another modification of a collapsible core is shown in Fig. 14 wherein the waterproof fibrous

core lining is supported at the top and bottom of the core by solid members 40 at the ends of which are hinged side-wall portions 41. The side-wall portions 41 are each provided with suitable clearance so that they may be swung inwardly into the core about the hinges 42. Means are provided in the side wall portions which are hinged to the top and bottom solid members, respectively, so that the adjacent side wall portions on each side of the core member may be wedged apart as by tapered wedges 43. The upper and lower side wall portions are connected together by rods 44 having hinged or similar joints intermediate the ends of the rods. The hinged portions of these rods are interconnected by a longitudinal rod 45 (Fig. 17) which may project with advantage through the end of the mold. The walls of the collapsible mold are firmly held in place by pipes 15 and 17 as shown in Fig. 14. Means such as a pipe 46 may be provided transversely through the mold and through the interior of the slab whereby a space will be left in the finished concrete slab through which electrical conduits, water and steam pipes, and the like may be passed. The pipe 46 is appropriately provided with sleeves 47 at those points at which the pipe passes through a concrete strut in the slab structure whereby the pipe may be readily withdrawn, if desired, from the slab when the mass within the slab has firmly set. The pipe 46 may also be used to lift the entire mold assembly from the casting table so that the casting table may be used in the production of another concrete slab and if left within the finished slab the pipes may be used to facilitate the loading and shipment of the slabs. A plurality of these pipes 46 may be inserted with advantage through the mold at spaced intervals. The pipes are preferably held in position in the side walls of the mold by wedges 48 and may serve the additional purpose of supporting the upper longitudinal pipes 17.

The collapsible core member shown in Fig. 14, and in further detail in Figs. 15, 16, and 17, may be withdrawn from the finished slab by removing pipes 15, 17, and 46 and then withdrawing the longitudinal rod 45. As the longitudinal rod 45 is drawn toward one another by the folding action provided by the hinged means intermediate the ends of the transverse rods. The contraction of the ends of the transverse rods draws together the upper and lower side wall portions, respectively, within the core member. The core member thus collapsed may be completely withdrawn from the slab as a single unit attached to longitudinal rod 45.

The modification of collapsible core member shown in Figs. 18 and 19 comprises solid top and bottom pieces which support the waterproof fibrous core lining. The side walls, besides being connected by hinges 42 as in the modification shown in Fig. 14, are further interconnected by hinges 47. The sections 49 and 50 of the side wall portions are appropriately shaped to provide clearance between the hinged portions thereof so that the hinges 47 may be withdrawn inwardly toward the center of the core. The upper solid portion of the core member is preferably formed of two separate sections 51 and 52 having beveled edges at their point of contact, as at 53. Interconnecting means such as the strip 54 are provided at spaced intervals within the upper portion of the core member for hold-

ing the sections 51 and 52 in place. Each of the strips 54 is preferably secured to the inner surface of section 51 and extends beyond the beveled edge thereon to a point well under the section 52. The end of strip 54 which makes contact with section 52 is provided with a suitable projection 55 adapted to engage a recess in the interior surface of section 52.

Each of the interconnecting strips 54 are provided with a brace 56 made of metal or other rigid material. The brace 56 is securely attached to the interconnecting strips 54 by a hinging means 57 in such a manner that the brace may be swung about the hinging means in a plane substantially perpendicular to the longitudinal axis of the interconnecting strip 54. The free or unhinged end of the brace 56 is provided with a roller 58 which is adapted to roll along the interior surface of the bottom portion of the core member. L-shaped members such, for example, as angle irons 60, are secured to the inner surface of the bottom portion of the core member in such a position that each roller 58, when resting upon the horizontal leg of the angle iron and against the vertical leg of the angle iron, is substantially directly below the hinged end of the brace 56. The plurality of braces which are spaced at appropriate distances throughout the length of the core member are interconnected by suitable means such as the rod 61 which preferably extends out of the open end of the mold.

In using the collapsible core member shown in Figs. 18 and 19, a layer of waterproof fibrous or other suitable material is laid in position and then held in this position by the bottom portion and side wall portions of the collapsible core member. The bottom portion and hinged side wall portions of the core member may be vibrated and heated by pipes 15 and 17. By not securing the upper horizontal portion of the metallic reinforcing structure in place until after the core has been completely assembled, it will be noted that the sections 51 and 52 comprising the upper portion of the core member may be swung upwardly and outwardly thus giving access to the interior of the core for the installation of any desired electrical conduit or steam pipe system, or the like. After the desired installations have been made within the interior of the core member, sections 51 and 52 may be swung down into position so that the projection 55 securely engages the recess in section 52. By controlling the longitudinal position of the rod 61 as section 51 of the core member is lowered into position, the rollers 58 may be placed on the angle irons adjacent the vertical legs thereof. After sections 51 and 52 have been placed in position and the waterproof material placed over the outer surface thereof in order to completely encase the core member, the upper horizontal portion of the metallic reinforcing structure may be securely fastened to the upper surface of the T-shaped bars 1. Suitable spacing elements 62 are secured to the underside of the upper horizontal portion of the metallic reinforcing structure so that the spacing elements, when the metallic reinforcing structure has been completely assembled, will press against the upper portion of the core member. Thus, the core member is supported in position on its exterior by the cradles 6 and the bent end portions 7 thereof as well as by the spacing elements 62, while the interior of the collapsible core member is supported by the braces 56. Vibration or suitable curing means may be transmitted to the concrete mass 76

through pipes 15 and 17. After the concrete or other self-hardening material has been poured into the mold and the mass has set, the core member may be collapsed by withdrawing pipes 15 and 17 and by withdrawing the longitudinal rod 61 so that the rollers 58 are moved away from the vertical legs of the angle irons 60. As the braces are swung on their hinged ends they no longer support the upper portion of the core member but actually pull the section 51 downwardly into the interior of the core. Section 52 being thus deprived of its interior support also falls downwardly into the interior of the core. The removal of pipes 15 and 17 permits the side walls to fold inwardly into the interior of the core after the internal support provided by braces 56 has been removed. The core member being thus entirely collapsed may be readily withdrawn from the interior of the core formed by the waterproof fibrous material.

By the use of the supporting pipes in accordance with my invention, a core comprising merely a suitable sheet material or such material internally supported by permanent or collapsible reinforcement may be supported and held in position during the casting of cellular slabs of concrete or other self-hardening material ordinarily used in the construction of buildings. The pipes may not only support the core but may be used with advantage to transmit mechanical vibrations to the concrete mass as well as to provide heat, or other means which may be desired for curing the mass.

While I have described the fabrication of my improved slab by the horizontal table method, which produces a slab suitable for use in the erection of so-called "prefabricated" buildings, it will be understood that the invention is not limited to that particular method or to a slab made by that method. The slab might be fabricated in situ as the construction of the building progresses in accordance with the usual building methods or other appropriate ones. This is particularly true when a core of the kind shown in Figure 8 is employed especially when no supporting pipes are used.

The term "concrete" as used through the specification and claims is intended to include any similar or equivalent self-hardening plastic material such as gypsum and similar materials which may be used in the construction of buildings.

I claim:

1. In the method of fabricating a cellular concrete slab by casting concrete about a hollow core, the improvement which comprises supporting the hollow core from within during casting of the slab and removing the support thus furnished after the concrete has substantially completely set while permitting the hollow core to remain in the slab.

2. In the method of fabricating a cellular concrete slab by casting concrete about a hollow core which is inherently incapable of withstanding the pressure of the concrete before it has set, the improvement which comprises reinforcing the interior of the hollow core to prevent it from collapsing when the slab is being cast, and removing the reinforcement thus furnished after the concrete has substantially completely set while permitting the hollow core to remain in the slab.

3. In the method of fabricating a cellular concrete slab by casting concrete about a hollow core which is inherently incapable of withstanding the pressure of the concrete before it has set, the improvement which comprises reinforcing the interior of the hollow core to prevent it from collapsing when the slab is being cast, supporting the hollow core thus reinforced, and removing both the reinforcement and the support thus furnished after the concrete has substantially completely set while permitting the hollow core to remain in the slab.

4. In the method of fabricating a cellular concrete slab by casting concrete about a hollow core, the improvement which comprises supporting and reinforcing the hollow core from within during the casting of the slab, curing the concrete and utilizing the supporting and reinforcing means as an instrumentality in the curing procedure, and removing the support and reinforcement thus furnished after the concrete has substantially completely set while permitting the hollow core to remain in the slab.

5. In the method of fabricating a cellular concrete slab by casting concrete about a hollow core, the improvement which comprises reinforcing and supporting the hollow core from within during the casting of the slab, and collapsing and removing the supporting and reinforcing means after the concrete has substantially completely set while permitting the hollow core to remain in the slab.

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