July 15, 1969 L. MÜLLER 3,455,071

CONCRETE CEILING PLATE

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Fig.1

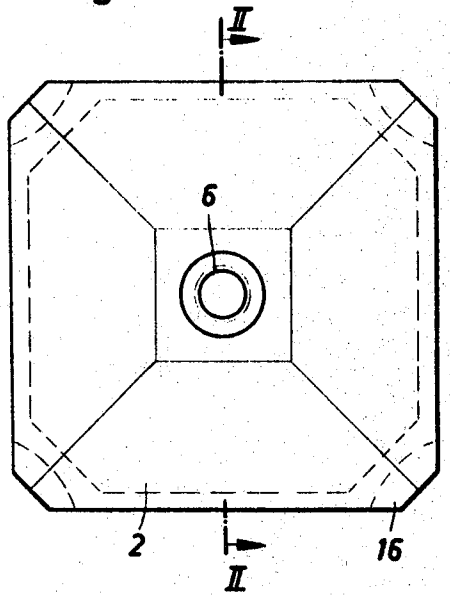


Fig.2

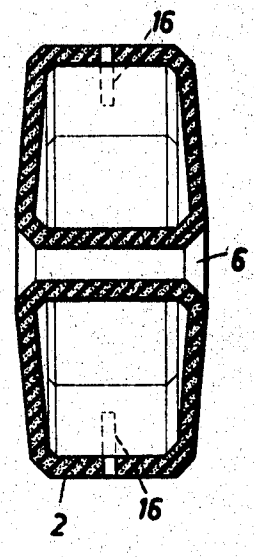
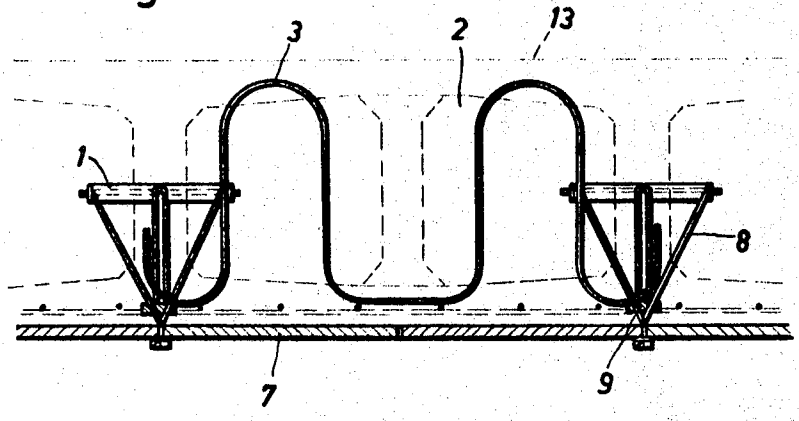


Fig.3



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Fig. 4

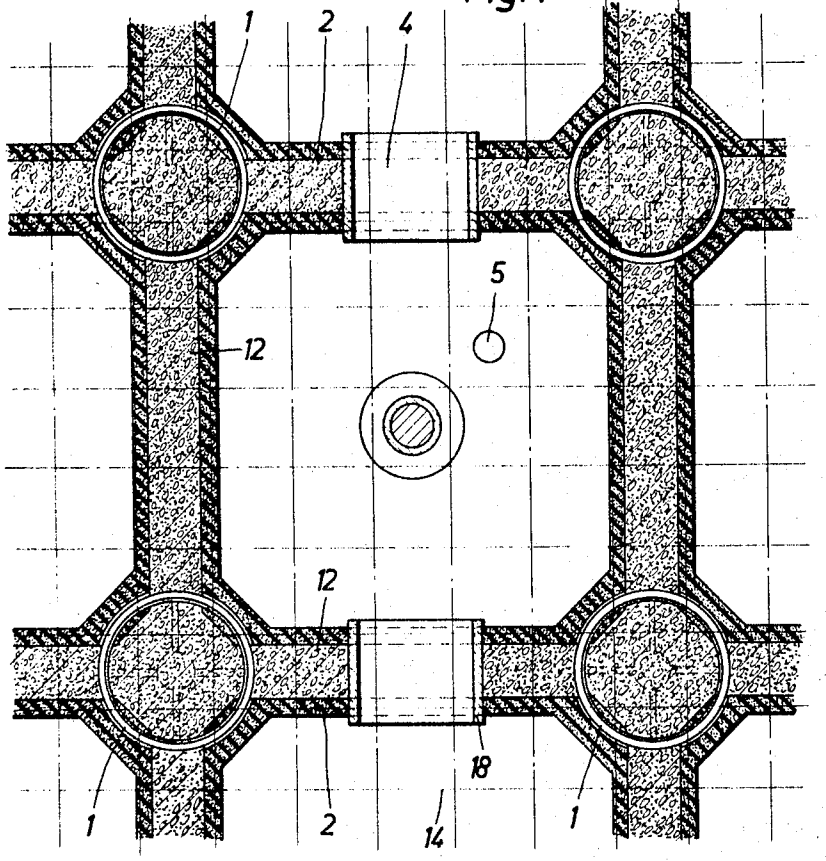
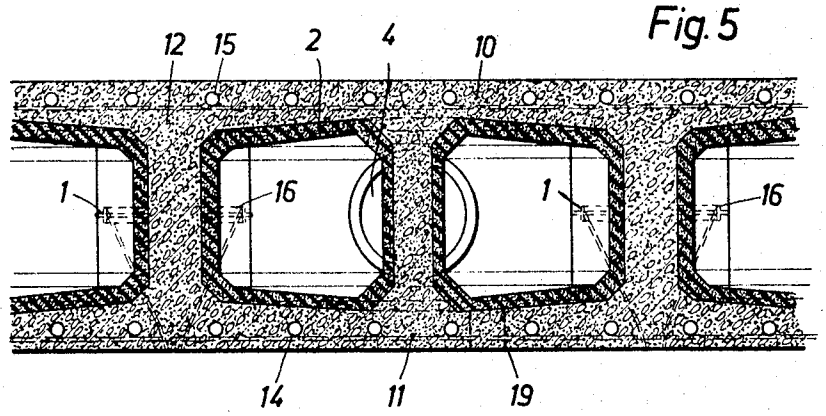


Fig. 5



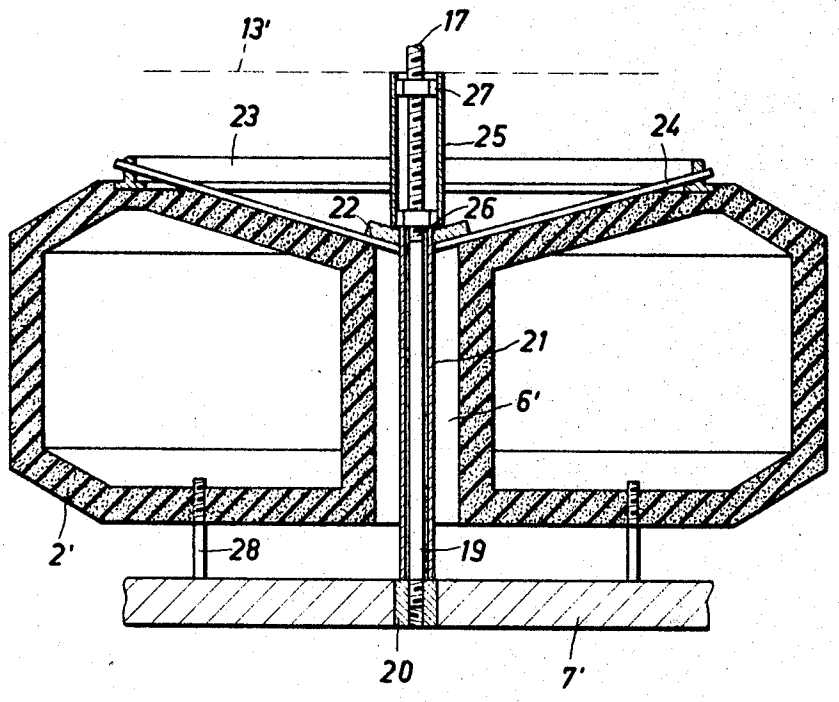
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Fig. 6



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CONCRETE CEILING PLATE

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Continuation-in-part of application Ser. No. 538,253, Mar. 29, 1966. This application May 2, 1968, Ser. No. 734,832

Int. Cl. E02d *35/00;* E04b *1/00*

U.S. Cl. 52—127 6 Claims

ABSTRACT OF THE DISCLOSURE

A light-weight concrete ceiling or floor plate is poured in a mold in which hollow, plastic filler members are individually fastened to the mold bottom to prevent them from moving upward in the concrete mixture which is poured into the mold in a single continuous operation. The filler members are upwardly spaced from the mold bottom and define gaps therebetween, reinforcing steel elements being arranged prior to pouring in the air spaces under the filler members and the gaps between the same.

REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my copending application, Ser. No. 538,253, filed on Mar. 29, 1966, and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to reinforced concrete floor and ceiling plates having voids in the neutral zone between continuous top and bottom sheets, and particularly to a mold arrangement for making the plates.

The mold arrangements used heretofore in the making of ceiling plates of the type described did not permit the fluid concrete mixture to be poured in a single and continuous operation. Typically, a bottom sheet was first formed by pouring a portion of the fluid concrete mixture into a shallow mold, and permitting the mixture to set until it became shape retaining. Light-weight fillers were then placed on the partly set bottom sheet, and pouring was resumed to complete the operation.

An important object of the invention is the provision of a mold arrangement which permits the concrete mixture for a reinforced light-weight floor or ceiling plate to be poured in a single continuous operation so that the entire plate is set uniformly and simultaneously.

SUMMARY OF THE INVENTION

In one of its aspects, this invention resides in a shallow mold in which a plurality of filler members are distributed in a common horizontal plane and define gaps therebetween. The weight of each filler member is substantially smaller than the weight of a body of fluid concrete mixture of the same bulk. Respective fastener assemblies attached to the horizontally extending bottom member of the mold hold the filler members upwardly spaced from the mold bottom and secure them against upward movement with a force sufficient to overcome the buoyancy of the filler members when the filler members are subsequently submersed in the concrete mixture. The filler members and the bottom of the mold vertically bound air spaces prior to pouring.

A first set of steel reinforcing members is spacedly interposed between the filler members and the mold bottom in the aforementioned air spaces. A second set of steel reinforcing members is partly received in the gaps and projects upwardly and downwardly from the gaps beyond the filler members.

Other features, additional objects and many of the attendant advantages of this invention will readily be appreciated as the same becomes better understood by reference to the following detailed description of preferred embodiments when considered in connection with the appended drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows a filler member for a ceiling or floor plate of the invention in plan top view;

FIG. 2 shows the filler member of FIG. 1 in elevational section on the line II—II;

FIG. 3 shows elements of a mold arrangement of the invention in elevation, the filler members being indicated in phantom view;

FIG. 4 shows the finished floor or ceiling plate in plan section on its median plane through the neutral zone;

FIG. 5 shows the plate of FIG. 4 in elevational section; and

FIG. 6 shows a modified mold arrangement of the invention in fragmentary elevational section.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing in detail, and initially to FIGS. 1 and 2, there is shown a filler member **2** of the invention which has the approximate shape of a low, square box having beveled edges, slightly domed top and bottom surfaces and an upright tubular passage **6** through its center between the top and bottom surfaces. The four short vertical edges of the filler member **2** have blind horizontal notches **16**.

The filler member **2** is assembled from two separately molded halves of polyurethane foam by cementing. It encloses an annular air space **5** about the passage **6**, and its weight is only a fraction of the weight of a body of water of the same bulk. The dimensions of the filler member typically are 2 to 3 feet square and 1 to 2 feet thick.

In making a concrete floor of the invention, a wide and shallow mold is first established in a conventional manner. Only the horizontal, practically imperforate sheet metal or plywood bottom **7** of the mold is seen in FIG. 3, and the mold will be understood to have peripheral upright walls extending beyond the top surface **13** of the floor plate which is to be formed in the mold.

The filler members **2** are fixedly fastened to the mold bottom **7** in a common horizontal plane in which the filler members are arranged in rectangularly intersecting, spaced rows and columns, as is better seen in FIG. 4 illustrating the completed floor plate. The filler members are held in position in upwardly spaced relationship to the mold bottom **7** by stiff fastening rings **1** of T-shaped cross section. Each ring **1** is locked to the mold bottom **7** by four narrow wire loops **8** arranged in the surface of an inverted cone coaxial with the ring **1**. The wire loops **8** are fastened to each other near the apex of the cone by a washer **9**, pass through an opening in the mold bottom **7** and are bent over so as to lock them to the underside of the bottom **7**. They cannot be pulled upward from the position shown in FIG. 3.

The gaps between the rows and columns of filler members **2** form a rectangular grid, and the rings **1** and the associated wire loops **8** are attached to the mold bottom **7** at all intersections of the grid. The rings **1** are dimensioned simultaneously to engage the notches **16** in respective edges of the four filler members **2** arranged about the intersection. The rings **1** thus precisely locate the filler members, an air space being bounded vertically between each filler member **2** and the mold bottom **7**.

Three sets of reinforcing steel wires or rods are arranged between, below, and above the filler members **2** respectively. The first set consists of a rectangular network of reinforcing members **14** and is horizontally arranged in the mold prior to installation of the filler members **2** so that the reinforcing members **14** are vertically spaced

in the afore-mentioned air spaces from the mold bottom 7 and the filler members 2 when the latter are thereafter fastened to the mold bottom 7 by the rings 1.

The second set consists of steel rods 3 of undulating shape arranged in respective vertical planes in the gaps between adjacent filler members 2. The rods have upper and lower bight portions which project upwardly and downwardly beyond the filler members 2. The free ends of each rod 3 are hooked through the wire loops 8 and the rings 1 of two fastener assemblies, and are thereby held in position between the filler members 2 on either side of the rod 3. When all rods 3 are installed, another set of reinforcing members, not seen in FIG. 3, but forming a network substantially identical with that of the members 14, may be placed over the upwardly projecting bight portions of the rods 3 and fastened thereto in any desired manner, as by wiring.

Fluid concrete mixture is thereafter poured into the mold to a level 13 well above the top surfaces of the filler members 2 and the upper bight portions of the rods 3. It may be rammed in a conventional manner to improve the appearance of the exposed bottom face of the ceiling plate, and ramming is facilitated by the unobstructed passages 6. After the concrete mixture has been permitted to set, the mold proper may be removed. The floor or ceiling so formed is seen in FIGS. 3 and 4.

It has a top sheet or layer 10 of concrete reinforced by a rectangular network of steel rods or wires 15, and a bottom sheet 11 of concrete similarly reinforced by the steel rods or wires 14. The gaps between the rows and columns of filler members 2 are filled with rectangularly intersecting concrete ribs 12. The neutral zone of the floor or ceiling has voids formed by the annular air spaces 5 of the filler members. The voids reduce the weight of the floor or ceiling without significantly reducing its carrying capacity. The top and bottom sheets 10, 11 are locked to each other by concrete in the ribs 12 and by short concrete columns filling the passages 6. The ribs are reinforced by the steel rods 3, not shown in FIGS. 4 and 5, which project into the top and bottom sheets 10, 11.

If so desired, the air spaces 5 in the filler members 2 may be connected to provide a duct for the flow of air or for electrical or plumbing conduits. Openings are made in opposite vertical walls of selected filler members 2, and the openings of adjacent filler members are connected by a tubular former 18 which bridges the gap between the filler members and encloses a connecting duct 4 in the finished ceiling structure, as is seen in FIGS. 4 and 5.

If the several floors and ceilings of a multiple-floor building are to be cast one on top of the other, and thereafter hoisted into position by the construction method commonly referred to as "lift-slab method," modified fastener assemblies of the type shown in FIG. 6 are preferred, and cooperate with modified filler members 2'.

The bottom end of a partly threaded upright spindle 19 is received in an interally threaded tubular insert 20 fixedly fastened in the bottom 7' of the floor or ceiling mold. The spindle 19 is partly enveloped by a thin walled tube 21 which rests on the insert 20 and whose top carries a conically dished, fixedly attached washer 22. A fastening ring 23 is fixedly attached to the washer 22 by four rods 24 which extend obliquely upward from the washer 22 at angles of 90°. The washer is held in position by a short tube 25 in the ends of which nuts 26, 27 are fixedly fastened in coaxial alignment of their threads. The top end of the spindle 19 engages the threads of the nuts 26, 27.

The rods 24 and the ring 23 abut from above against the top face of the filler member 2' which is approximately conical, thereby preventing upward movement of the filler member 2' when buoyed by concrete mixture poured into the mold, as described above. Legs 28 threadedly inserted into the bottom face of the filler member 2' maintain the desired spacing between the filler member 2' and the mold bottom 7'.

When the lowermost member of a stack of reinforced floor or ceiling plates is to be cast, the several filler members 2' are placed on the mold bottom 7' in the desired pattern, the central passage 6' of each filler member being vertically aligned with an insert 20. A spindle 19 is thereafter installed in each insert 20 by means of a screwdriver engaging a slot 17 in the top end of the spindle. The ring 23, rods 24, washer 22 and tube 21, which are fixedly fastened to each other by solder joints, not seen in the drawing, are then slipped over the spindle 19 until the ring 23 rests on the top face of the filler member 2'. The tube 25 with its nuts 26, 27 is next threaded on the spindle 19 until it engages the washer 22 and firmly presses the ring 23 against the filler member 2'.

Reinforcing steel elements are arranged in the mold before and after installation of the filler members 2' in a manner obvious from the preceding description of FIGS. 1 to 5, but not shown in FIG. 6, and fluid concrete mixture is poured into the mold to the level 13' at or slightly below the top edge of the tube 25. When the concrete is set, the spindle 19 is removed by turning its upwardly projecting end, and the mold bottom 7' is thereby released. The openings in the ceiling surface within the permanently installed tubes 21, 25 may be used for mounting the hangers of a false ceiling or for similar purposes, or they may be plugged at the ends.

When another floor of the same type is to be cast on the first-formed floor, the top of the latter is covered with a plastic sheet as a separator, and spindles 19 are threadedly inserted in the nuts 27 through small openings pierced in the plastic sheet. Filler members 2' are slipped over the spindles, and another mold arrangement substantially identical with that described in the preceding paragraphs is assembled, the top sheet of the previously cast floor serving as a mold bottom for the second concrete floor. The procedure may be repeated as often as is needed to produce the desired number of floor plates or slabs.

The fastening assembly 1, 8, 9 described hereinabove, may obviously be modified to include a central upright spindle analogous to the spindle 19, and may similarly be utilized in the sequential casting of initially superimposed multiple floor plates. Conversely, the fastening assembly shown in FIG. 6 is not limited in its application to floors intended for use in the lift-slab method, but may be employed in the pouring of an individual floor plate. In that event, the tube 25 and nut 27 may be omitted. The spindle is removed from the underside of the mold bottom 7', and its bottom end may be provided for this purpose with a slot for insertion of a screw driver.

Other modifications are contemplated, and may obviously be resorted to by those skilled in the art without departing from the spirit and scope of the invention since only preferred embodiments thereof have been disclosed.

The mold arrangements of the invention are completely assembled prior to the pouring of the fluid concrete mixture, and may be assembled in a workshop remote from the construction site and thereafter transferred if so desired, and if their size and weight permits. The light and very strong floor or ceiling plates of the invention, however, may be built to span wide areas between supporting walls, and are normally assembled on the spot from prefabricated units.

Because the spatial relationship of all members of the mold assembly is fixed in advance, the entire amount of concrete mixture required for forming the floor or ceiling plate may be poured in a single continuous operation so that the portion of the mixture occupying the initial air spaces between the filler members 2, 2' and the mold bottoms 7, 7' is still as fluid as the last-poured concrete portion covering the filler members as a top sheet when pouring is terminated.

What is claimed is:

1. In a shallow mold arrangement for pouring a concrete floor plate, in combination:

(a) a horizontally extending bottom member;

(b) a plurality of filler members distributed in a common horizontal plane and defining gaps therebetween,

(1) the weight of each filler member being substantially smaller than the weight of a body of fluid concrete mixture of the same bulk,

(2) each filler member having horizontally extending top and bottom faces and being formed with a passage vertically extending therethrough between said faces;

(c) a plurality of fastening means attached to said bottom member and respectively holding said filler members upwardly spaced from said bottom member and securing the filler members against upward movement with a force sufficient to overcome the buoyancy of said members when the filler members are submerged in said concrete mixture,

(1) each filler member and said bottom member vertically bounding an air space therebetween

(2) each fastening means including

(i) an elongated fastening member extending through the passage of the associated filler member and having a lower terminal portion threadedly received in a corresponding threaded opening of said bottom member and an upper terminal portion upwardly projecting from the associated filler member,

(ii) abutment means on said fastener member abuttingly engaging the top face of the associated filler member,

(iii) nut means on said upper terminal portion for retaining said abutment means in engagement with said top face, and

(iv) protecting tube means enveloping said fastener member substantially from said bottom member to said nut means;

(d) a first set of steel reinforcing members spacedly interposed between said filler members and said bottom member in said air spaces; and

(e) a second set of steel reinforcing members partly received in said gaps and upwardly and downwardly projecting from said gaps beyond said filler members.

2. In an arrangement as set forth in claim 1, said upper terminal portion being threaded, and said nut means including a nut member threadedly engaging the threads on said upper terminal portion.

3. In an arrangement as set forth in claim 1, each filler member having a vertically extending edge and being formed with a transverse notch in said edge, a portion of said fastening means horizontally extending into said notch.

4. In an arrangement as set forth in claim 1 said second set of steel reinforcing members including a plurality of rod members of undulating shape, each rod member having a plurality of bight portions projecting above said filler members and a plurality of bight portions projecting below said filler members.

5. In an arrangement as set forth in claim 1, said bottom member having an upwardly directed substantially planar face.

6. In an arrangement as set forth in claim 1, said filler member sealingly enclosing a body of air.

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U.S. Cl. X.R.

52—220, 303, 337, 382, 577; 249—177; 264—35