

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO	
RAD: 14-112393- -5	FECHA: 2015-07-02 10:37:11
DEP: 2020 DIRECCION DE NUEVAS CREACIONES	EVE: 378 FASE NACIONAL INCLUIDO CAPITULO I
TRA: 11 PCT-PATENTE DE INVENCION CAPITULOS I Y II	FOLIOS: 5
ACT: 430 REQUERSOLICITA	

DIRECCIÓN DE NUEVAS CREACIONES

2020
Bogotá, D.C.,

Abogado(a)/Señor(a)
MARGARITA CASTELLANOS ABONDANO

Asunto: Radicación: 14-112393- -5
Trámite: 11
Evento: 378
Actuación: 430
Oficio: 7451
Folios: 5

Patente de Invención	X			Patente de Modelo de Utilidad	
Vía Nacional					
Vía PCT (Fase Nacional)	X	Capítulo I	X	Capítulo II	
No. Solicitud Internacional	PCT/CA2012/000939				
Fecha de Presentación Internacional	11/10/2012				

Como resultado del examen de fondo realizado, con fundamento en el Artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se comunica:

1. Documentos estudiados

Descripción:	Rad. N° 14-112393-00000-0000	26/Mayo/2014
Reivindicaciones:	Rad. N° 14-112393-00000-0000	26/Mayo/2014
Dibujos:	Rad. N° 14-112393-00000-0000	26/Mayo/2014
Prioridad:	CA 2'756.266	26/Octubre/2011

2. Análisis de la Prioridad

Se acepta la reivindicación de prioridad porque ésta solicitud fue presentada dentro del plazo establecido (Art. 9 D 486) y su contenido técnico corresponde con el de la prioridad reivindicada.

3. Objeto de la invención

De acuerdo con lo establecido en el numeral 1.2.2.2 del Capítulo Primero del Título X de la Circular Única para efectos del examen de patentabilidad, se tendrá en cuenta la tasa pagada por el solicitante al momento de comenzar el examen para las reivindicaciones adicionales; esto es que cuando la solicitud contenga más de diez (10) reivindicaciones y no se haya pagado la tasa complementaria, sólo se estudiarán las cubiertas por la tasa pagada. Por lo tanto, se estudiarán las reivindicaciones 1 a 5.

Título de la solicitud: “Método de excavación socavada con pisos de concreto continuos” (Fl. 1).

El problema planteado en esta solicitud, consiste en lograr una técnica en la excavación socavada, que permite que un piso de concreto reforzado con acero continuo se monte o instale sobre un gran ancho y longitud, y que se instalen pisos de concreto reforzados con acero, continuos, en cualquier colada subsiguiente

Para resolver este problema técnico, la solicitud en estudio propone un método para formar un piso de concreto contigua que comprende instalar un patrón de acero de refuerzo, instalar formas alrededor de un perímetro de piso. Verter o bombear concreto y retirar las formas.

El objeto de la presente solicitud se relaciona con la Clasificación Internacional de Patentes (CIP): E 04 B 5/32; E 02 D29/055; E 21 C41/16; E 21 D11/10.

4. De la solicitud de patente

Reivindicaciones (Art 30 D 486, Art 22 PCT)

El capítulo reivindicatorio no es claro porque:

- Las expresiones: “...para proporcionar la resistencia adecuada a un piso de concreto a ser vertido sobre el acero de refuerzo...”, “...para formar un piso de concreto en la galería, con un espesor suficiente para soportar el relleno de roca cementada o lo equivalente, encima del piso de concreto, cuando la galería se rellena estrechamente...” (reivindicación 1), “...para soportar el relleno de roca cementada o lo equivalente, encima del piso de concreto, cuando la tercera galería se rellena estrechamente (...) continuo en la primera, segunda y tercera galerías.” (reivindicación 3). describen funciones, efectos, ventajas o resultados a alcanzar, los cuales no son aspectos susceptibles de patente. Para mayor claridad, el producto reclamado se debe definir técnicamente mediante sus características estructurales. Se sugiere al solicitante eliminar las expresiones citadas.
- En la reivindicación 4, hay una traducción muy general de la traducción internacional ya que el término “ore” se tradujo como “mineral”¹. Se sugiere al solicitante modificar dicha traducción, de tal manera que se exponga el material al que hace referencia la solicitud internacional.

¹ <https://en.wikipedia.org/?title=Ore>

5. Determinación del Estado de la Técnica

El estado de la técnica se determinó con base en la fecha de presentación de la solicitud de prioridad: Octubre 26 de 2011, y se encontró el siguiente documento que anticipa el objeto de esta solicitud:

Ítem	Documento	Título	Fecha de Publicación
D1	US 2'648.116	'Method of making hollow monolithic concrete slabs'	11/Agosto/1953

El documento D1² divulga la construcción de techos, pisos y otros diafragmas para edificios, puentes, plataformas, paredes y otras estructuras de materiales resistentes al fuego (Col. 1, líneas 1 a 4).

6. Examen de Patentabilidad (Art 14 D486)

Novedad (Art 16 D486)

La reivindicación 1 consiste en: “*Un método para formar un piso de concreto contiguo en una excavación socavada, que comprende, una vez a que se ha excavado una primera galería que tiene un puso y paredes laterales...*” (Ver página 24 del radicado N° 14-112393-00000-0000).

Comparación de las características técnicas esenciales, con las del estado de la técnica:

Características esenciales	D1
Un método caracterizado por:	Un método caracterizado por:
Una vez que se ha excavado una primera galería que tiene un piso y paredes laterales, a lo largo de su longitud, instalar un patrón de acero de refuerzo en la forma de malla, barra o pantalla.	Cuando el piso está completo se posicionan las barras de tensión longitudinales (25) de acero de refuerzo. La malla de refuerzo (24) puede disponerse sobre las barras de tensión (Col. 5, líneas 30 a 50).
Instalar formas alrededor de un perímetro del piso de la primera galería, en donde las formas instaladas contra las paredes de la primera galería son de una longitud igual a la longitud de cualquier acero de refuerzo superpuesto, llenando las formas con arena.	Con el refuerzo en su lugar las formas de lámina de metal se disponen sobre el piso, en donde las formas instaladas contra las paredes de la primera galería son de una longitud igual a la longitud de cualquier acero de refuerzo superpuesto. Arena se dispone sobre el suelo. (Fig. 6; Col. 4, líneas 1 a 16; Col. 5, líneas 50 a 75; Col. 6, líneas 1 a 15 y 18 a 25)
Verter o bombear concreto sobre el acero de refuerzo y la arena.	Después de que la formas y la arena o la cal están dispuestas, el concreto puede ser vertido (Col. 6, líneas 36 a 39).
Retirar las formas.	Las formas pueden ser removidas (Col. 7, líneas 45 y 46).

2 <https://docs.google.com/viewer?url=patentimages.storage.googleapis.com/pdfs/US2648116.pdf>

De acuerdo con la tabla anterior, las características esenciales del método de la reivindicación 1 habían sido divulgadas previamente en el documento D1, por lo tanto, la materia reivindicada no es nueva.

Asimismo, el documento D1 divulga las características de las reivindicaciones dependientes así:

- Reivindicaciones 2 y 3: El trabajo puede ser continuado en primer lugar vertiendo concreto sobre la malla, luego posicionando las formas y la arena, luego se vierte concreto de nuevo y se retira la arena de las cavidades (Col. 4, líneas 1 a 23; Col. 9, líneas 12 a 38).
- Reivindicación 5: Roca triturada puede ser dispuesta sobre el suelo. Roca cementada ordinaria puede ser utilizada (Col. 5, líneas 20 a 23; Col. 9, líneas 55 a 53).

7. Conclusión

Los requisitos de Patentabilidad de la presente solicitud están afectados así:

Ítem	Documento	Reivindicaciones afectadas	Requisito que afecta
D1	US 2'648.116	1 a 3 y 5	Novedad/Nivel Inventivo

En cumplimiento del artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le indica que debe dar respuesta dentro del término de sesenta (60) días contados a partir del día siguiente de la fecha de notificación de la presente comunicación. En caso de no dar respuesta al presente requerimiento, o si a pesar de la respuesta subsistieran los impedimentos para la concesión, se denegará la patente.

Se invita al solicitante se sirva indicar, si así lo considera, su renuncia al término faltante de sesenta (60) días para dar respuesta a este requerimiento y presentarla por escrito.

Finalmente, se le recuerda al solicitante que si como respuesta a este requerimiento llegara a modificar el capítulo reivindicatorio y éste contenga más de diez (10) reivindicaciones, no pagará la tasa de modificación voluntaria pero sí la correspondiente al pago por reivindicación adicional.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única No. 10 de 2001.



JOSÉ LUIS SALAZAR LÓPEZ
Director de Nuevas Creaciones (c)

El anterior requerimiento fue notificado por fijación en lista, de fecha 2015-07-07

Elaboró: Monica Andrea Gutierrez Almonacid
Revisó: Rachid Ponce Vergel

Aug. 11, 1953

G. A. MACREADY

2,648,116

METHOD OF MAKING HOLLOW MONOLITHIC CONCRETE SLABS

Filed Feb. 26, 1947

4 Sheets-Sheet 1

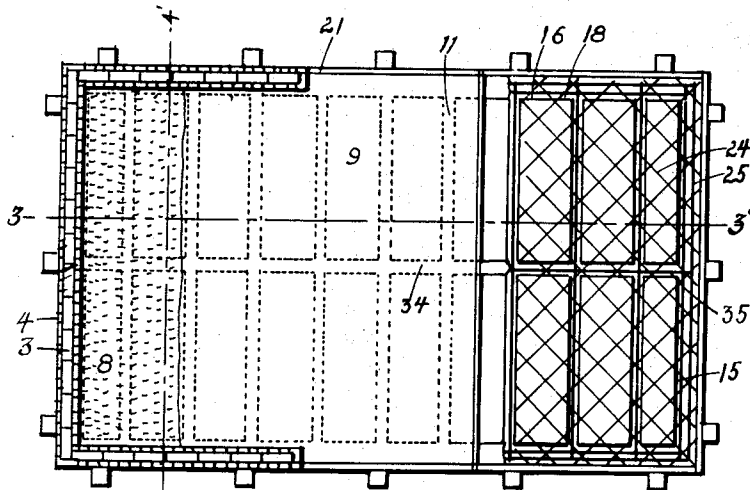


FIG. 2.

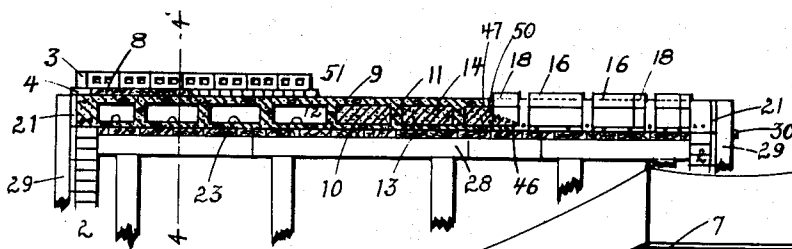


FIG. 3.

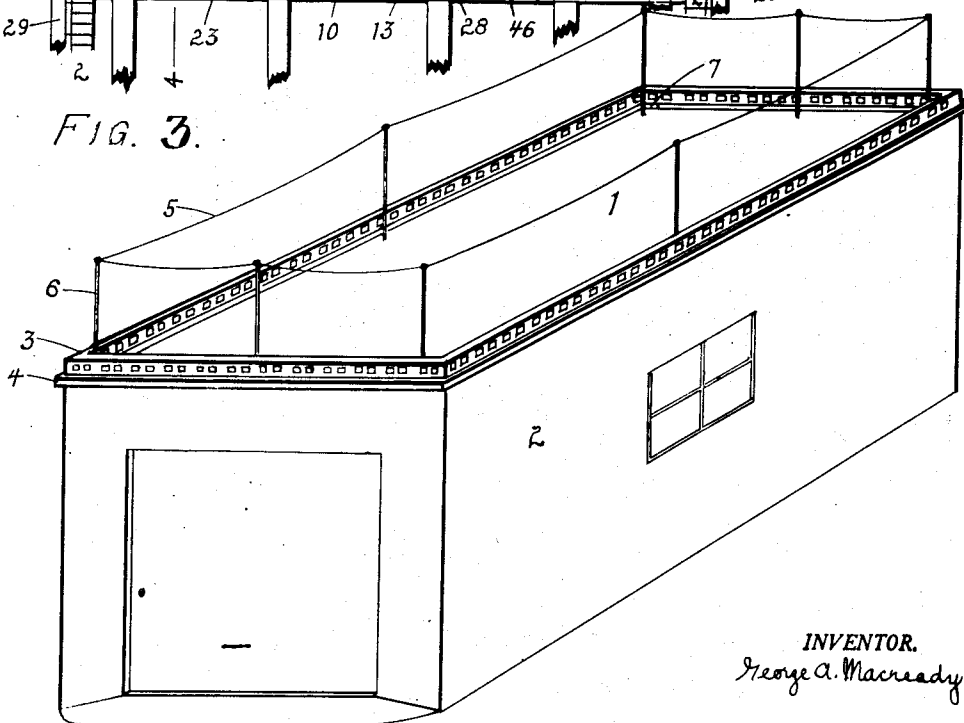


FIG. 1.

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2,648,116

METHOD OF MAKING HOLLOW MONOLITHIC CONCRETE SLABS

Filed Feb. 26, 1947

4 Sheets-Sheet 2

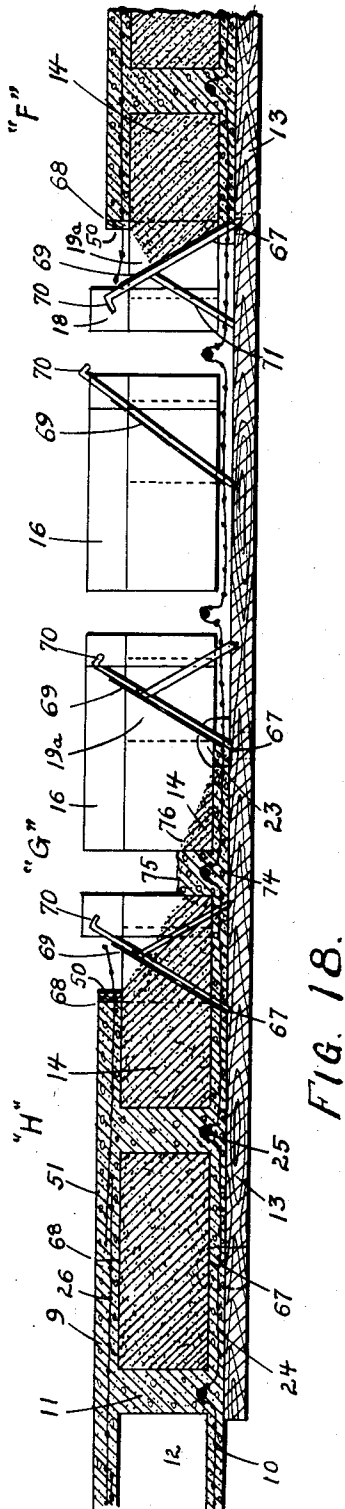


FIG. 18.

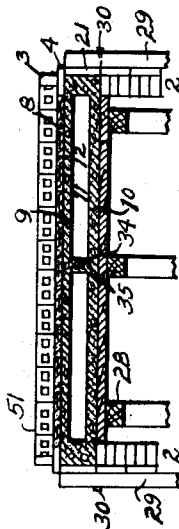


FIG. 4.

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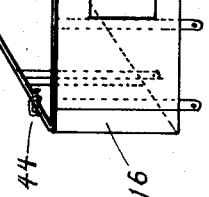
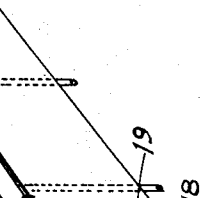
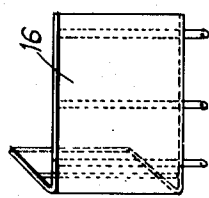
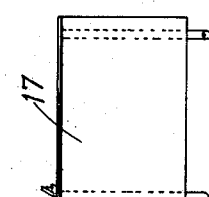
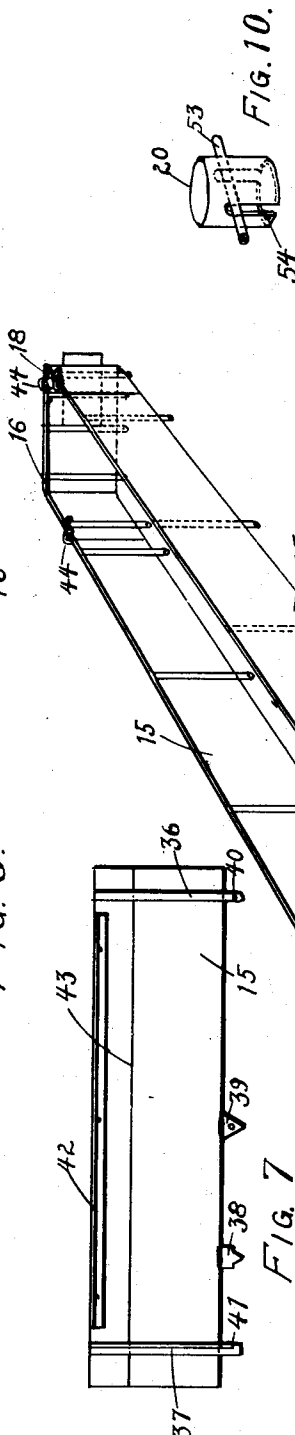
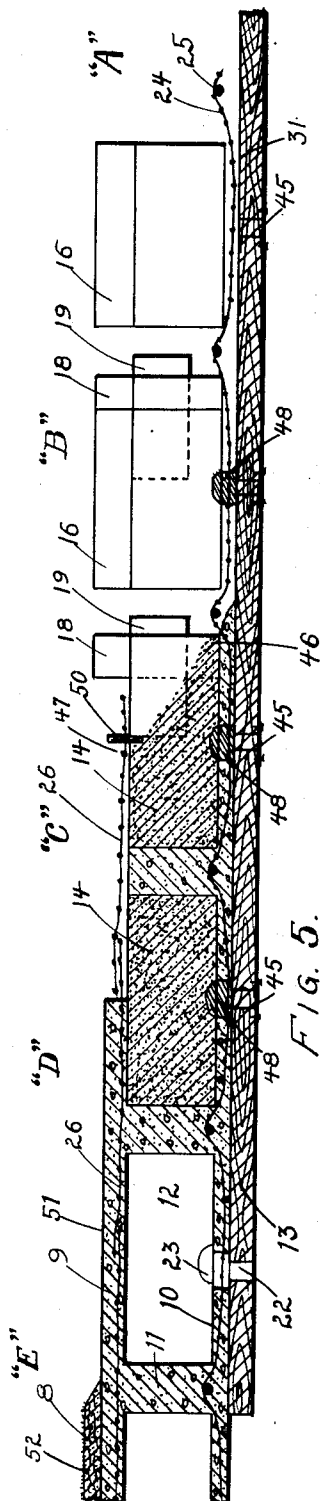
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2,648,116

METHOD OF MAKING HOLLOW MONOLITHIC CONCRETE SLABS

Filed Feb. 26, 1947

4 Sheets-Sheet 3



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2,648,116

METHOD OF MAKING HOLLOW MONOLITHIC CONCRETE SLABS

Filed Feb. 26, 1947

4 Sheets-Sheet 4

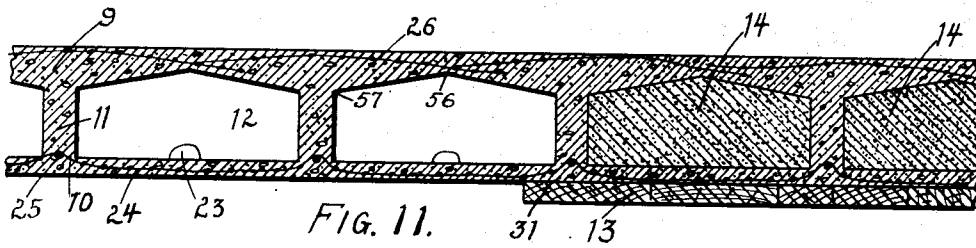


FIG. 12

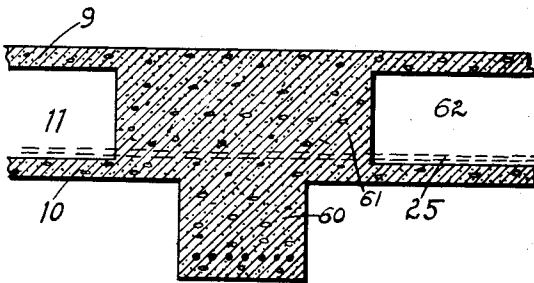
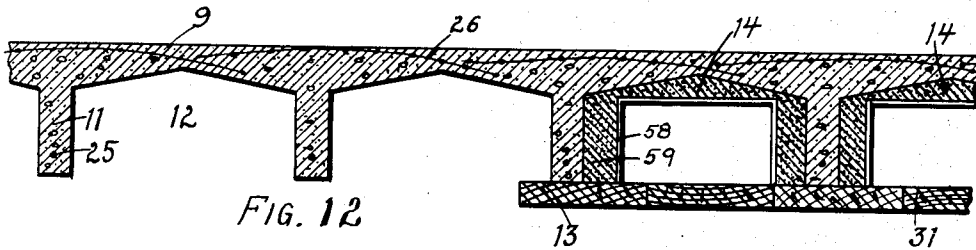


FIG. 13.

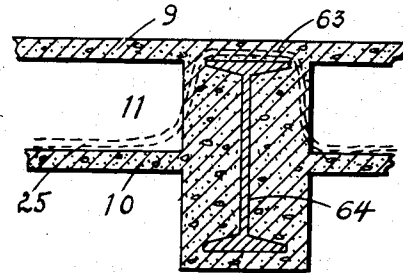


FIG. 14.

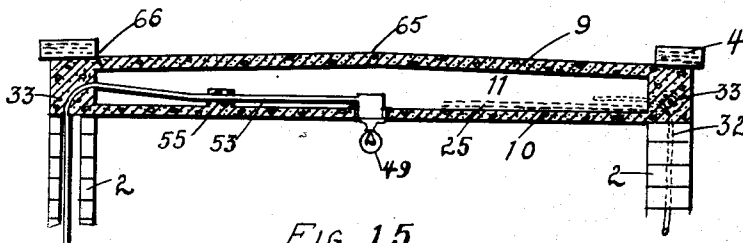


FIG. 15.

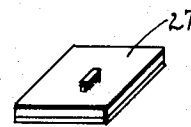


FIG. 16.

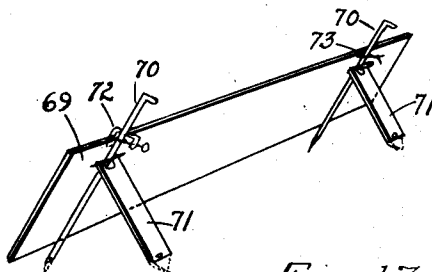


FIG. 17.

INVENTOR.
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UNITED STATES PATENT OFFICE

2,648,116

METHOD OF MAKING HOLLOW MONOLITHIC CONCRETE SLABS

George A. Macready, Los Angeles, Calif.

Application February 26, 1947, Serial No. 730,899

3 Claims. (Cl. 25-154)

1

My invention relates to the construction of roofs, floors and other diaphragms for buildings, bridges, platforms, walls and other structures of fire resistant materials.

My invention relates especially to constructions where a fire resistant monolithic pair of nearly parallel diaphragms is desired, such as the combination of a roof and ceiling.

My invention relates further to the construction of hollow monolithic concrete slabs which heretofore have not been economically practical because of difficulty in removing the forms from the cavities.

An object of my invention is a novel method of constructing hollow reinforced concrete slabs in which a temporary construction form floor is first erected, reinforcing materials then placed on said floor, removable sheet form vanes stood on edge to form pens on the floor to define the solid and cavity portions of the slab, pouring concrete mix on the floor where solids are desired and pouring loose sand or other granular material into the pens where cavities are desired, removing the sheet vanes if desired while the concrete is still soft to leave a sand form, and flushing the sand from the cavities after the concrete has set solid around the sand forms.

Heretofore where the construction of a floor or roof above a ceiling was desired one procedure has been to pour concrete for one diaphragm and the web joists around solid forms, then after the concrete has set to remove the forms and plaster on the second diaphragm, usually the ceiling. Another procedure has been to pour concrete for part of the structure around hollow units and then plaster on the remainder to enclose the units. Still another procedure has been that of cementing together a number of small factory made unit slabs or panels.

In contrast to the older methods applicant's new method makes the entire slab in one monolithic operation with all material left in the slab filling a useful structural function. A saving in weight and labor and material results.

Heretofore solid forms ordinarily used have been rigid and not readily adaptable to changes in size, shape or dimension without changing the entire form. In contrast, applicant's use of removable sheet vanes permits a variety of shapes, sizes and dimensions to be constructed by variations in the grouping and assembly of the individual sheets which in turn can be used over and over again repeatedly. Sheet forms are removed immediately after pouring concrete and are available for repeated use on the same slab.

2

With the foregoing and other objects in view which will be made manifest in the following detailed description and especially pointed out in the appended claims, reference is had to the accompanying drawings for illustrative embodiment of my invention wherein:

Figure 1 is a perspective view of a completed garage building as illustrative of the use of my invention for its roof,

Figure 2 is a plan of the roof of the building shown in Figure 1 in which several stages in the construction are illustrated,

Figure 3 is a cross section of the roof along line 3-3', Fig. 2,

Figure 4 is a cross section of the roof along line 4-4', Figs. 2 and 3,

Figure 5 is a larger scale section similar to Figure 3 but illustrating in larger detail the various details of construction,

Figure 6 is a perspective view of the sheet forms assembled as a pen as they would be to define a cavity in a slab and illustrating details of their construction, assembly and use,

Figure 7 is an elevation of a side sheet form illustrating the supporting legs and other details,

Figure 8 is a perspective view of a corner and end sheet,

Figure 9 is a perspective view of another form of corner and end sheet,

Figure 10 is a perspective view of an auxiliary form used for attaching conduits and pipe to the slab within the cavities,

Figure 11 is a cross section of a modified type of floor slab differing from the slabs illustrated in Figures 3 and 5 by arching the upper diaphragm for use in longer spans,

Figure 12 is a cross section of a slab similar to that of Figure 11 but without the lower diaphragm or ceiling,

Figure 13 is a cross section of another modification in which my form of hollow slab is supported on main reinforced concrete joists at right angles to the joist webs within the hollow slab,

Figure 14 is a cross section of a similar modification in which a structural steel beam is used for the main cross joist,

Figure 15 is a section similar to that shown in Figure 4 but illustrating a cambered deck surface of the roof for drainage, a way of attaching conduits for electricity and fluids, and a wall anchorage by bending the vertical wall reinforcement down to splice with the horizontal tension bars of the joist webs,

Figure 16 illustrates an auxiliary foot pad for supporting the legs of the sheet forms on ordinary

3

ground or rock fill where my hollow slab is to be used as a floor resting directly on the ground.

Figure 17 illustrates an inclined form sheet for use where it is desired to have construction joints occur midway between and parallel to joist webs, and

Figure 18 is a large scale section similar to Figure 5 but illustrating the use of inclined form sheets to cause construction joints to occur midway between and parallel to joist webs.

Similar numerals refer to similar parts throughout the several views.

Referring to the drawing, Figure 1 illustrates a completed garage type building including the roof 1, embodying my invention, supported on walls 2 which should be of masonry or other strong construction such as brick, grouted brick, concrete blocks, reinforced concrete.

For trim and appearances the building is shown finished with a band of hollow concrete block 3 set on edge above flat red brick 4 round the edge of the roof and a chain 5 supported on upright pipe 6 as a safety guard. Upper surface of the roof may slope gently for drainage which can escape through outlets 7. In addition, the roof can be completely covered by a layer of grass sod 8, Figures 2 and 3, a few inches thick to serve as decoration, weather insulation, and recreation space.

Briefly, the monolithic concrete slab embodying my invention consists of:

First, a reinforced concrete diaphragm 9 serving as a roof, floor,

Second, another reinforced concrete diaphragm 10 serving as a ceiling and approximately parallel the first, but which may optionally be dispensed with when no ceiling is desired,

Third, reinforced concrete joist webs 11 functioning with one or both diaphragms as supporting beams, and

Fourth, cavities 12 enclosed between diaphragms and webs to function as ventilation space, heat insulation, weight lightening, and for installation of conduits.

Optionally, the upper surface of a roof slab can be covered with grass sod or lawn to function as previously described.

Other features of less importance will be described later among the details.

From an engineering analysis the roof or floor slab consists of a series of parallel reinforced T beams supporting a suspended ceiling.

Briefly, the apparatus used for construction of my hollow concrete slab consists of:

First, a substantial temporary floor 13 upon which the forms and resulting slab are supported until the concrete has set,

Second, a plurality of pen like forms made of removable sheets 15, 16, 17, 18, 19, 19a, 20, 69 and 87 on floor 13 as illustrated in Figure 6 and other figures to retain the granular material such as sand 14 for the cavities 12 of the resulting slab,

Third, granular material such as sand 14 which is placed in the pens to serve as a form after the sheets of the pens are withdrawn and which is removed or flushed out after the concrete has set to leave cavities 12 in the slab,

Fourth, a retaining form or fence 21, 81 or 82 around the outside of the slab to limit lateral extent of concrete work.

Additional details appear later in the description.

Briefly, the method of constructing my slabs is as follows:

First, after completion of the exterior or foundation wall 2, 78 or 79 the floor 13 is constructed

4

on trestles for a roof slab, the ground surface is cleared for a ground floor slab, and outside forms 21, 81 or 82 installed,

Second, reinforcing metal is then placed and anchored,

Third, sheet metal pens such as illustrated in Figure 6 are then erected on the floor to outline the cavities of the slab,

Fourth, concrete aggregate is poured in the forms and granular material such as sand 14 into the cavities spaces simultaneously to the same levels on both sides of each sheet,

Fifth, the sheets of the pens are withdrawn from the green cement and soft granular material or sand to leave a sand form or mould around which the concrete may harden,

Sixth, after the concrete has set the flushout holes 22, 23 are opened and the granular material flushed or otherwise removed from the cavities,

Seventh, after the concrete has attained sufficient strength the floor forms and outside forms may be removed and the grass sod or floor covering installed where desired.

Additional details appear later in the description.

For the sake of brevity throughout the following specification the granular material such as sand is frequently referred to simply as sand. My use of the term sand is not to be restricted to its strict geological definition as an aggregation of sorted small sized mineral grains. My use of the term includes such granular materials as mineral sand, loam, clay, earth soil, sawdust, shavings, crushed rock, salt or soluble material that will satisfy my requirements. My requirements are that the granular material shall be sufficiently granular and incoherent to be poured into the cavity spaces, that it shall pack sufficiently to make a fairly rigid form for the concrete to set around, and that it can easily be disintegrated after the concrete has hardened to be flushed out or removed from the cavities through the small flushout holes provided for that purpose.

My hollow monolithic reinforced slabs can be used for roofs, floors above ground, and floors resting directly on the ground.

My hollow monolithic reinforced concrete slabs provide novel and economical fire resistant roofs and floors suitable for dwellings and other small units which heretofore have not been practical in small units because of excessive form costs and other construction costs.

Having briefly described the principal features of the invention I now proceed to describe the invention in more minute detail. The invention as applied to horizontal slabs such as floors, roofs and ceilings will first be described.

For supporting a horizontal hollow slab the foundation should preferably be of masonry such as brick, concrete, or steel reinforced and fire protected. For floors and roofs above ground the building walls function as the foundation for my slab. For floors or platforms laid directly on the ground the foundation supports need barely clear the ground but should carry the load instead of depending on the ground surface of the entire slab area.

With the foundation complete the next procedure is to provide a substantial floor upon which to construct the slab. If the slab is to be directly on the ground all that is necessary is to level off the space and perhaps place a layer of crushed rock on the ground surface. Small pads 27 illustrated in Figure 16 are provided as bearing supports for the legs of the sheet pens and should be of cheap material as they may not be

5

salvaged. If the slab is above ground then a substantial temporary floor 13 is constructed preferably of heavy plank supported on trestles 28. Preferably the caps of the trestles should be short and the legs provided with wedges or screw jacks so that portions of the floor may be removed in units without disturbing the entire floor.

In addition to the temporary floor the side forms 21 may be attached as by timbers 29 and bolts 30 to the side of the building or by stakes driven into the ground to provide lateral limits for the slab. The upper edge of the side boards may be leveled or shaped to function as a strike board for the top of the slab. The side forms may be similar to those used in conventional concrete practice for construction of the bond beams of buildings.

It may be advisable to cover the temporary floor with building paper 31 to prevent material leaking through. If it is desired to add a finish coat of plaster to the ceiling then sand or fine crushed rock may be scattered over the floor to form a rough surface for the plaster to adhere to.

Flushout holes 22 plugged and covered as by plate 45 should be made below the center of each cavity for subsequent removal or flushing of sand 14.

This stage of the proceedings is illustrated at A on Figure 5.

After the floor is completed and prepared the next step is to mark out the positions of the joist webs and place the longitudinal tension bars 25 of deformed reinforcing steel securely on chairs along the joist lines in proper positions. Vertical reinforcing bars 32 from the building wall may be bent down parallel to the joist to provide a splice as illustrated in Figure 15. The tension bars 25 may also be hooked around the longitudinal sidewall reinforcement 33 for additional anchorage and may be elevated or doubled for shear and negative stresses.

If the span of the slab is great bridges 34 reinforced by tension bars 35, should be provided between joist webs for stiffness.

Reinforcing mesh 24 for the ceiling such as stucco net, welded mesh or wire lath may next be spread over the tension bars and allowed to sag nearly to the floor but preferably be furred up a little clear of the floor to become fire protected within the concrete.

With the reinforcement in place the removable sheet metal pens such as illustrated in Figure 6 are next set upon the temporary floor to define the cavities of the hollow slab. The cavities may be narrow and elongated parallel to the joist. Width is limited by safe span of the diaphragms and length by positions of the cross bridges.

Figure 7 illustrates a simple form of side sheet for a pen. It consists of sheet material 15 such as metal, plastic, paper or wood but preferably steel or aluminum about one sixteenth inch thick, and provided with legs such as 36, 37, 38 or 39 to support the sheet erect and slightly above the floor. Leg 36 illustrates the simplest form as a metal strip riveted to the sheet and extending below the bottom edge of the sheet. Leg 36 may be pointed and provided with a hole for a pin 40 so that when driven into the floor as a spike the pin 40 provides a depth stop. Leg 37 is of angle iron with a sharp point and shoulder 41 to function as a depth stop. Legs 36 and 37 also function to stiffen sheet 15. Legs 38 and 39 are small pieces of sheet projecting below the main sheet 15 and provided with a point and depth stop.

For long sheets a stiffener angle 42 can be riv-

6

eted or otherwise attached along the upper edge of the sheet 15 for stiffness. Marks 43 may be painted on the sheets for each job to indicate the depth to which sand and concrete are to be poured.

Figures 8 and 9 illustrate end sheets for the pens. Sheet 16 is bent to form curved corner and is provided with legs similar to those on side sheet 15. Sheet 17 is provided with a metal angle for the corner.

The pens are assembled as illustrated on Figure 6 by driving the spike like legs into the temporary floor and clamping the upper edges together as by small C clamps 44 or by bolts.

Additional features of the pen assembly will be described later in connection with concrete pouring.

To provide holes in the cement for subsequent removal of sand forms from the cavities, wads of clay or bags of sand 48 are placed on the temporary floor above outlets 45 of sufficient height to extend above the top to the ceiling diaphragm. In addition wads of clay or bags of sand may be placed at convenient places 23 in the bridges or joists.

After the concrete has been poured and set the clay and sand remain soft and can be poked out easily to leave holes 23 through which the sand within the cavities can be removed or flushed out. In addition these holes provide access and ventilation holes for miscellaneous uses. Those holes which are not to be used can be filled with plaster to hide them from view. Some holes can be used for plumbing and electric outlets 49 as illustrated in Figure 15.

After the pens, reinforcements and clay wads are in place pouring of concrete can be commenced. The stage of progress described to here is illustrated at B on Figure 5.

Concrete can be poured one or more beams at a time so that construction joints of the upper diaphragm occur midway between each joist. In large slabs these joints make a good place for expansion joints. Because of the slope of the sand and concrete the joints in the lower diaphragm or ceiling naturally occur at the toe of the sand slope beside the bottom of the next joist.

Some building codes arbitrarily require that all construction joints in flat slabs shall occur midway between supporting joists. To meet such requirements a modified method of construction will be described later in connection with Figures 17 and 18.

Referring to the simplest condition first mentioned and illustrated by Figures 2 to 5, the ceiling or lower diaphragm 10 is poured first with a rather fine grained or even light weight aggregate until it covers the area between construction joints to its proper thickness. The portion within the cavity pens may then be covered by paper such as building paper to make a clean separation between sand and concrete.

Next the webs 11 of one or more joists are poured and as they build up the cavity pens on each side of the concrete are filled with granular material such as sand to the same height to keep pressure equalized on both sides of each sheet. When the concrete and sand reach the marks 43 on the sheets the top surfaces of each are leveled off as far as the brow 47 at half a span length beyond the last web poured. From the brow 47 the surfaces are sloped to toe 46 at the bottom of the next web to be poured.

All of the pen sheets up to brow 47 are then withdrawn straight up out of the sand and green concrete to leave the sand 14 as a form about which the concrete may set. Sheets are only pulled as far as brow 47 because the slope 47 to 46 is to be built up as construction proceeds.

Reinforcement 26 for the upper diaphragm such as conventional welded mesh is then laid above the sand and fresh concrete to extend from the last completed concrete to sufficient distance beyond brow 47 to provide a space for the next installment of mesh. A strike board 50 provided with notches to straddle the mesh wires is placed parallel to the webs along brow 47. The upper edge of strike board 50 should be placed at proper elevation for the finished top surface of the slab and may be arched upward at its middle or elsewhere if a roof is to be arched for drainage as illustrated in Figure 15.

This stage of progress is illustrated at C, Figure 5.

The next procedure is to pour concrete for upper diaphragm 9 and strike off excess by using strike board 50 and either the last strike board 50 or the last hardened concrete. All strike boards are removed except the last and the top surface 51 of the slab is trowel finished smooth. After concrete has set flushout holes 22, 23 are opened by removing caps 45 and clay plugs 48. All the granular material such as sand within the cavities is then removed through the holes by means of hydraulic jet or hand tools.

The stage of progress described to here is illustrated at D in Figure 5.

After the concrete has set and attained strength the upper surface, if a roof slab, may be coated with hot asphalt or tar as a waterproofing 52. Optionally, a layer of grass sod may be planted on top to function as weather insulation, roof garden or decoration. If the hollow slab is to be used as a floor some other finish such as paint, tile, linoleum or hardwood may be applied.

The stage of progress described to here is illustrated at E in Figure 5.

After the concrete has attained more strength all of the forms may be removed, conduits and ventilators installed, and the unused flushout holes plastered over to conceal and close them. The structure may then be decorated and finished for use.

The following miscellaneous details may be explained.

In removing the end sheets of a cavity pen they can only be removed as far as brow 47 because as work progresses additional sand and concrete are to be added to slope 47 to 46. The cavity end cannot be divided into two equal sheets because the last of the two sheets to be withdrawn comes under mesh 26 which prevents its withdrawal. Therefore, referring to Figures 5 and 6, a wide end sheet 16 and a narrow one 18 are provided so that the narrow sheet 18 does not come under the mesh 26. An auxiliary sheet 19 is provided to fill the gap above the slope that would be left when sheet 16 is pulled. Sheet 19 may be withdrawn from under mesh 26 by pulling it out slantwise when the sheets are withdrawn from the next web.

Conduits for electric wiring 53 or for gas and water may be laid in cavities of the walls and slab as shown in Figure 15. Flexible electric conduit can be used to advantage under this condition.

Figure 10 illustrates a device for anchoring a

conduit in a cavity. A cylindrical sheet 20 is provided with notches 54 and set astride a conduit. Concrete is poured in the cylinder around the conduit and sand filled around outside the cylinder. The cylindrical sheet is pulled to leave the concrete set surrounded by sand. Where conduits are passed through webs of joints the pen sheets can be notched similar to notch 54 or a clay wad can be laid in the concrete across the web to be poked out and leave a transverse hole for the conduit to be installed in later.

Where it is not desired to salvage the sheet metal pens for re-use then non-metallic sheets such as stiff building paper with wire legs may be substituted and left in the cavities after removing the sand. Such sheets are cheap and need be waterproofed only sufficient for them to remain stiff while sand and concrete are poured around them.

Figures 11, 12, 13, 14 and 15 illustrate optional forms of horizontal slabs which vary in detail from the form just described but also embody my invention.

Figure 11 illustrates a construction suitable for longer spans in which the compression area of the concrete of the T beam units is thick near the joist webs but arches 56 to thin midway between webs. This form provides more concrete above the neutral axis 57 than is required for fire safety alone.

Figure 12 illustrates a construction with a single upper diaphragm but no lower ceiling diaphragm and is a simple series of parallel T beams. This construction is adaptable to the conventional method of inverted trough forms. However, my use of a box 58 surrounded by sand 59 permits variations in dimensions without changing troughs and there is less time lost in dropping the troughs away from the set concrete. My construction offers these two advantages over older methods.

Figures 13 and 14 illustrate my construction of a hollow monolithic slab supported upon beams instead of building walls. In Figure 13 use is made of a reinforced concrete T beam with its web 60 projecting below the slab and its flange 61 incorporated as part of the slab with the joist webs within the slab 62 trending at right angles to the large supporting beam. In Figure 14 use is made of a steel I beam 64 with the longitudinal tension bars of the hollow slab joists curved up over the I beam as at 63 to provide shear support.

Figure 15 illustrates a modification for roofs in which the upper surface is cambered or arched for drainage to slope from a ridge crest 65 to side gutters 66 formed by a raised margin 4 of low brick or concrete. This figure illustrates a section parallel to the joists including a manner of placing conduits 53 and of splicing reinforcing by bending wall rods 32 down parallel to joist tension rods 25. Electric outlets 49 can be placed at flushout holes or conversely the position of flushout holes selected in advance where outlets are intended. Water, gas and plumbing outlets can similarly be passed through flushout holes, slab cavities and cells of the walls.

Some building codes arbitrarily require that all construction joints in concrete slabs including those in a ceiling must occur at the middle of a span. For such cases the procedure described with reference to Figure 5 must be modified as follows with reference to Figures 17 and 18.

To provide construction joints at mid span 67, 68 an auxiliary sheet 69 is set at approximately 60

degree inclined slope along the longitudinal center line of each pen. Sheets 69 lean against supporting pins 70 which in turn lean against props 71 and are steadied by clamps 72 or wire loops 73. Plate 19a is made larger than plate 19 because of the absence of a sand slope to a toe 46 (Fig. 5).

Assuming that work of pouring a slab has proceeded to a construction joint 67, 68 as described in the following paragraphs I now describe the procedure for continuing the work.

This stage of the proceedings is illustrated at F and H on Figure 18. Work can be suspended at this stage for an indefinite length of time: perhaps a minute, perhaps a year.

When work is resumed ceiling concrete 74 is first poured to cover floor 13 from the last construction joint to the next sheet 69 and part way up the web to 75. At the same time sand 14 is filled inside the pens to slope 76 at approximately the plane of repose.

This stage of the proceedings is illustrated at G on Figure 18 and work should continue immediately without stopping.

Pins 70 are then pulled and being in hardened concrete may require twisting to loosen. Props 71 and sheet 69 are then pulled from the sand and green concrete to leave a construction joint at 67 between old and new concrete of the ceiling. Work of pouring continues immediately as previously described with reference to Figure 5 by first pouring the web with concrete, then the pens with sand, then drawing the pen sheets and completing the upper diaphragm as far as strike board 50 at midspan. The poured concrete then ends at another construction joint 67, 68 where work can again be discontinued for an indefinite time.

The stage of proceeding is again as illustrated at F and H in Figures 18.

The following miscellaneous conditions and variations from those previously described may be mentioned.

For the granular material used in filling the cavity forms common loam is probably the cheapest but sand is more satisfactory although slightly more costly. Other material may be used.

Metal sheets are preferable for the pens erected on the construction floor because most durable. Other material such as plastics, paper or wooden sheets may be used if sufficiently water resistant to remain stiff until the materials are in place. In some cases it may not even be desirable to salvage the sheets for use again.

Ordinary cement-sand-rock concrete can usually be used but other concretes such as pumice, cinders, gypsum plaster, pure cement, or other substances can be used to fit individual conditions and preferences.

Ordinarily the construction floor and external forms are of wood boards but when desirable other material may be used such as metal, a part of an adjoining structure, a previously made part of the new structure or the original ground surface if a ground floor.

Referring to the construction joints at 46, 47, 67 and 68 parallel to and midway between joists. Concrete may be poured in groups of several joists with corresponding diaphragms to leave the construction joints at the next expected work stoppage such as the close of the shifts work. Or each joist may be poured singly to leave a construction joint ready between each joist for an unexpected work stoppage. Where

joists are poured in groups the welded mesh for the upper diaphragm may be in wide strips or rolls but where single joists are poured it may be best to have narrow strips of mesh the width of the joists pacing plus splicing allowance.

I claim as my invention:

1. A method for making hollow monolithic reinforced concrete floor and roof slabs which consists of preparing an external form and construction floor, supporting reinforcing above the floor, erecting a plurality of pens of sheet material upon the floor, making a hole through the floor beneath each pen and temporarily closing said holes, pouring a lower concrete diaphragm upon the floor, pouring concrete into joist webs between the pens, pouring granular material into the pens to fill the spaces intended for cavities, removing the sheet pens to leave forms of granular material for the cavities within the concrete, pouring an upper concrete diaphragm above the granular material and previous concrete, finishing the upper surface of the concrete, waiting for the concrete to set, and removing the granular material from the cavities through said holes to leave a hollow monolithic reinforced concrete slab.

2. A method for making hollow monolithic concrete slab floors and roofs for buildings consisting of providing an external form around the margin of the intended slab and the upper portion of its permanent supports, constructing a temporary floor at the elevation intended for the lower face of the intended slab, placing main reinforcement bars upon the construction floor in more than one series of intersecting directions, placing minor reinforcement mesh for the lower slab diaphragm, erecting a plurality of sheet material fence like pens upon the temporary floor between the intersecting series of main bars, making holes through the temporary floor beneath each pen, temporarily closing each hole, pouring a layer of concrete upon the floor for a lower slab diaphragm to form a ceiling below the finished slab, pouring additional concrete into the reinforced spaces between pens to form the internal joists of the finished slab, pouring granular material into the pens to the height of the intended cavities, placing reinforcement above the poured concrete and granular material, pouring another layer of concrete to cover the granular material, mesh and already poured concrete, smoothing the upper surface of the soft concrete to form the upper surface of the finished slab, removing the granular material through the holes in the temporary floor after the concrete has set hard to leave hollow cavities in the finished slab, and removing the temporary floor and forms to leave a hollow monolithic concrete slab supported upon its permanent supports.

3. A method for making hollow monolithic roof and floor slabs which consists of preparing a construction base, placing reinforcement upon said base, erecting a plurality of sheet material pens upon said base, placing wads of non-hardening material for each pen adjacent said base, pouring a lower layer of concrete upon said base, pouring granular material into the spaces enclosed within each pen, pouring additional concrete into the spaces between adjacent pens, withdrawing said sheets to leave an interface of concrete against a form of granular material, pouring an upper layer of concrete approximately parallel to said lower layer over said granular

11

material and previously poured concrete, removing said wads of non-hardening material after the concrete has set to leave holes through the concrete, and removing the granular material of each pen through said holes to leave a hollow 5 monolithic concrete slab with cavities between upper layer, lower layer and internal concrete joists.

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