Feb. 2, 1932. G. W. DENISON 1,843,112

FLOOR AND CEILING CONSTRUCTION

Filed Nov. 10, 1927 2 Sheets-Sheet 1

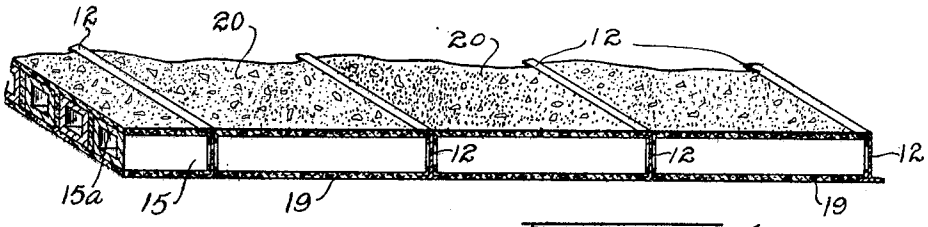

FIG. 1

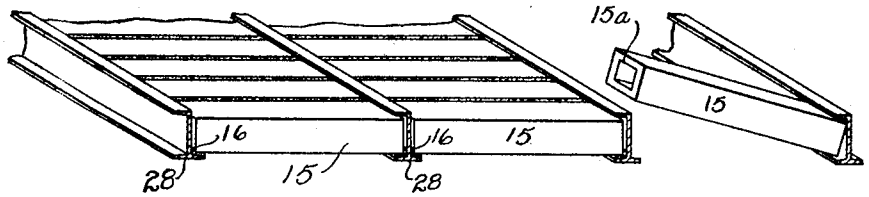

FIG. 2

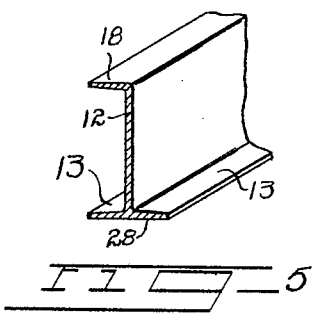

FIG. 5

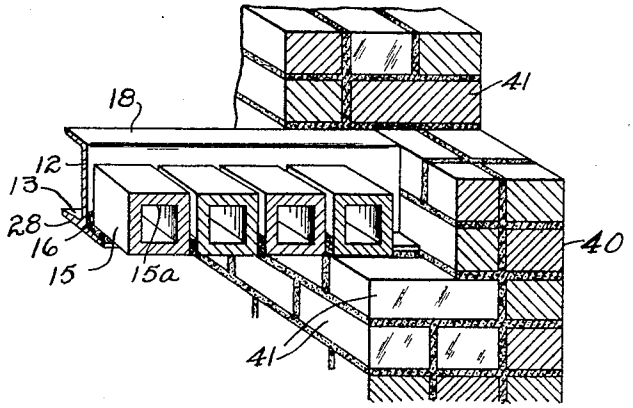

FIG. 3

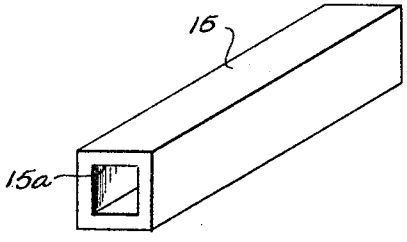

FIG. 4

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FLOOR AND CEILING CONSTRUCTION

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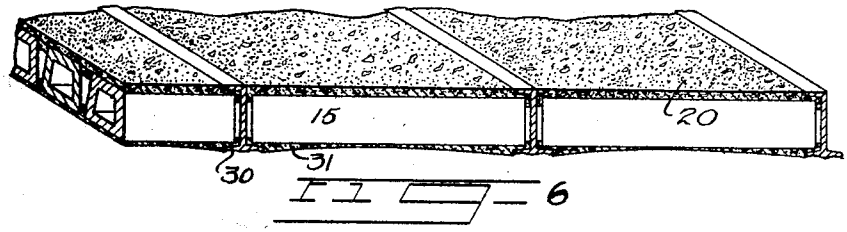


FIG 6

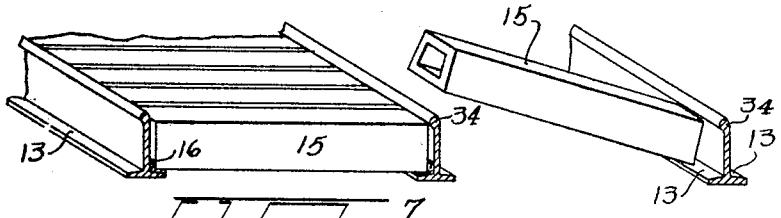


FIG 7

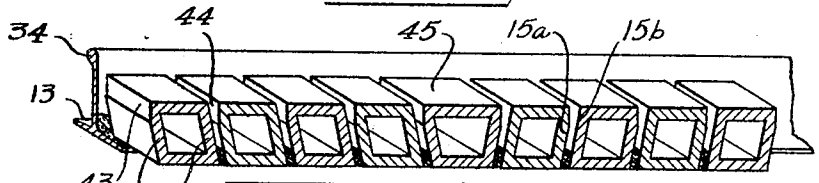


FIG 9

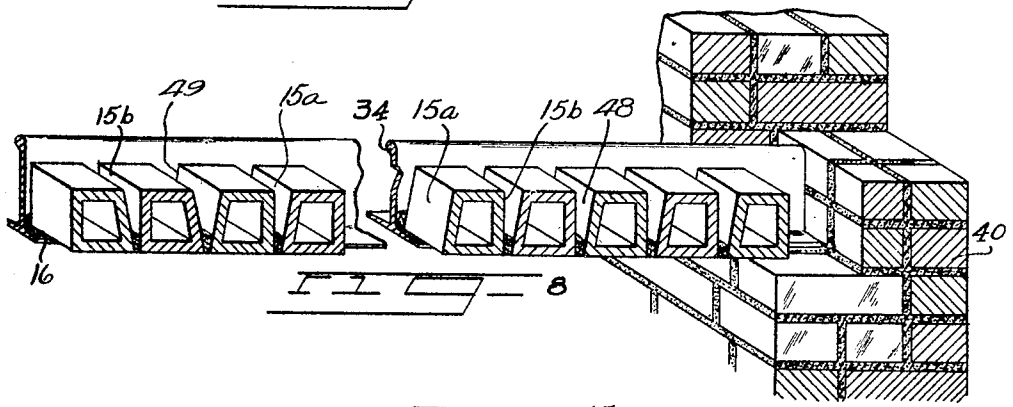
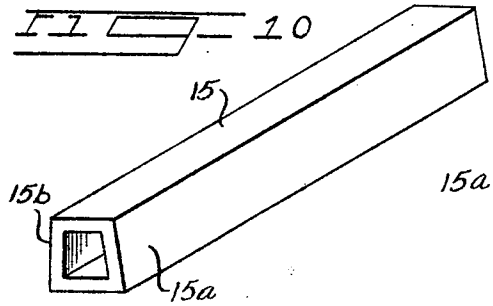


FIG 8

FIG 10



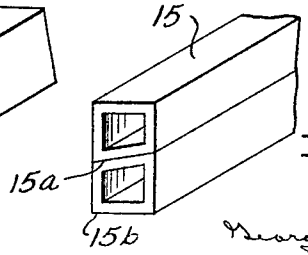


FIG 11

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Patented Feb. 2, 1932 1,843,112

UNITED STATES PATENT OFFICE

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FLOOR AND CEILING CONSTRUCTION

Application filed November 10, 1927. Serial No. 232,224.

This invention relates to floor constructions and more particularly to floor constructions of the flat arch type, and has for its general object the provision of durable floor structure formed of relatively light weight metal joists and tile and concrete in such manner that a marked saving in material and labor costs can be effected.

More particularly, my invention has for its object the provision of a floor structure which will involve the use of structural units of a very simple economical form; the nature of the assembly of the units being such that substantially all of the material in the structure is called upon to support the dead weight of the floor structure as well as the permissible live load for which the floor is designed, and the structural units are of such weight that the building mechanic may readily assemble the structure without unusual exertion.

A further object of my invention is the provision of a light weight, durable floor construction which may be built into and comprise a part of the load bearing wall which supports the floor structure. Other objects of my invention will hereinafter become apparent from the following description referred to in the accompanying drawings, illustrating some preferred forms thereof. The essential characteristics thereof are summarized in the claims.

In Fig. 1, I show a fragmentary perspective view of a flat arch floor construction embodying one form of my invention; Fig. 2 is a view similar to Fig. 1 showing the condition of the floor structure when partially completed; in Fig. 3 I illustrate the manner of extending the floor structure into a load bearing wall; Fig. 4 is a perspective view of one form of tile shape which may be used in the construction of my flat arch floor structure; Fig. 5 is a perspective detail of one form of joist or beam which may be utilized in my floor structure; Fig. 6 is a modified form of floor construction embodying certain features of ornamentation to provide a pleasing ceiling effect; Fig. 7 is a perspective detail of another form of my floor construction illustrating the manner of constructing or assembling the structural units thereof; Fig. 8 is a perspective view similar to Fig. 3 and illustrating the manner of building said modified form of floor construction; Fig. 9 is a perspective view of a modified form of tile utilizable in the structure embodying my invention; and Fig. 10 is still another form of flat arch construction embodying another form of my invention; and Fig. 11 shows the cluster form of the tile when extended.

My invention contemplates the provision of a floor construction of the flat arch type for use primarily in dwellings and building structures of the smaller type, and I propose to use metallic joists of an extremely light weight whereby they can be readily, manually positioned in the structure by the bricklayer or tile setter.

I also propose the use of a simple floor tile shape which may be cut in lengths corresponding to predetermined spacing requirements of metallic joists which are light in cross section and the depth dimension of the tile is dependent somewhat upon the predetermined beam height of the joist; the height of the joist being preferably a multiple of standard brick height dimensions plus mortar joints. The unitary weight of the tile, also receives consideration so that the repeated exertion of the building mechanic in assembling the tile on the structure will not be such as to cause undue fatigue and I incorporate such tile and metallic joists in a floor structure in a manner that will utilize to the fullest extent, the entire strength of the materials used in the floor structure within practical limits.

In Fig. 1 I show my floor structure as comprising spaced apart metallic joists 12, the cross section of which is illustrated in Fig. 5. The joist is designed to be extremely light in weight but sufficient to impart to the flat arch floor structure the required tensile strength, and its physical strength characteristics when acting solely as a beam supported at its ends are such that the usual factor of safety is considerably reduced as compared to the usual metallic beam, in that the section lacks the usual compression strength. These joists are provided at their lower ends with flanges 13

of sufficient width to impart the desired tensile strength to the beam span and to serve as dead weight bearings or supports for the ends of elongated tile blocks 15, which, as shown in Fig. 1, may be square in cross section. The tile are laid singly by the building mechanic upon mortar bearing pads 16 placed upon the flanges 13 of the beams 12 by the tile setter or brick-layer, one bottom longitudinal edge of each tile as it is laid being pointed with mortar to provide the usual mortar joint with an adjacent tile. At the top of the beam, I provide a flange 18 to give a certain degree of rigidity to the beam so that it may be handled during shipping and construction or incorporation into the building without becoming unduly bent or twisted.

The tile 15, as shown, have plane end surfaces and are of a length to extend substantially from webs to webs of the joists 12 and may be laid, as shown to the right of Fig. 2, by inserting one end of the tile beneath the top flange 18 of the joist and lowered into place, and thereafter shifted into mortar joint relation to an adjacent tile. Thus, the tile are laid in the floor structure in spaced apart relation a distance corresponding to the thickness of a mortar joint.

The relation of the height of the web of the beam to the height of the tile is such as to provide a substantial space between the top surface of the flange 18 of the joists and the tiles 15, whereby the spaces between the joist top flanges and the horizontal top walls 15*a* of the tile may be filled with a layer of concrete or grouting 20 to completely fill all of the intervening spaces between the ends of the tile blocks and the webs of the joist and also the space between the top surface of the tile and the top surface of the flanges 18 whereby each course of tile extending between the joists becomes a compression beam, the upper portions of the tile and the grouting being in compression under live load. By this arrangement a smooth floor structure is also presented, which is even with the top flange surfaces of the joists. This construction is shown in Figs. 1 and 2.

In Fig. 3, I show the manner in which such a simple floor construction may be extended into and comprise a part of the load bearing wall structure 40 of the building, and which carries or supports the floor. The lengths of the joists 12 being such that the ends thereof extend into the wall structure a substantial distance, and if desired, a distance which will be substantially equal to multiples of a brick width. In the structure illustrated, the height of the joists 12 are shown as being equal to twice the height of the standard brick plus the mortar joint when the joist ends are incorporated in the wall structure, but it is to be understood that such joist height is not necessarily determined by consideration of brick dimensions. The running courses of brick or tile in the load bearing wall are accordingly shown as extending evenly under and over the floor structure where it is built into the wall structure. If desired, the under surface of the floor structure may be finished with a layer of plaster 19, applied evenly with the bottom surfaces 28 of the bottom joist flanges, or these surfaces may be finished by the application of suitable pigment thereto.

In Fig. 6 I show a modified form of joist or beam and wherein I provide an ornamented surface 30 on the bottom surfaces of the flanges 13 of the beam whereby spaces between the flanges may be ornamented in any suitable manner with plaster 31, or if desired, the bottom faces of the tile 15 may be treated during the manufacture in such manner as to effect their ornamentation by causing the formation of variegated configurations or colors thereon. Thus, the tile faces may remain exposed; that is, without plaster covering, or if desired, they may be painted.

In Fig. 7, I show a modified form of joist construction, the joists being of the same practical dimension as the joist construction shown in Fig. 5, but in lieu of the flange 18, as shown in that figure, I provide a rounded upper end 34 for the purpose of imparting to the joists the characteristic of substantial rigidity during shipping and handling. I also show in this particular construction a modified form of cross section for the tile. The tile, as shown in perspective in Fig. 10, having one sloping side wall 15*a* which may be pointed with mortar to contact with the vertical side wall 15*b* of adjacent tile when set into floor structures. The tile are shown in Fig. 8 as being set with the sloping walls 15*a* thereof extending in a common direction to about one-half of the extent of the course, and they are laid in reverse order. The tile in this construction are laid on mortar bearing pads in the manner described, and wherein the upper surface of the floor structure is formed by filling the various spaces with concrete or grouting of the proper consistency, the upper half of the courses of tile are in compression relation when the floor is loaded, due to the key arrangement of the wedge-shaped portions 48 of the filling and the central key portion 49 thereof. In Fig. 8 I show that this modified form of floor construction can be built into or incorporated into the load bearing wall 40 in the same manner as I have illustrated in Fig. 3 in setting forth the description of my floor construction in Fig. 1.

In Fig. 9, I show still another form of flat arch construction wherein single void tile are utilized and which have parallel sloping side walls 42, there being straight or vertically extending surfaces 43 provided thereon, whereby when the tile are laid side by side in spaced relation, a wedge or key space 44 is provided, which when filled with concrete or grout will impart compression strength to

the floor. In this form of construction, the tile are set with the side walls sloping in a common direction to substantially half of the joist length, and the central wedge-shaped void filled with concrete or the spacing of the tile at the reversing point may be such that a key block or tile 45 is inserted in the structure and then the blocks are laid in reverse position, that is with their side walls sloping in an opposite direction. In Fig. 11 I show a tile cluster cross section whereby the tile shown in Fig. 10, may be extruded in duplicate and handled throughout the various stages of its manufacture and separated into units after burning.

These constructions, when incorporated in a building in the manner described, afford a very rigid floor, which when completed will have a dead load plus a live load strength in excess of the figured or calculated dead load compression strength plus live load compression strength of the joist, this being due to the fact that the tile when subjected to live load plus their weight load, are in compression along the upper portions of their side walls and part of the load reaction thus extends longitudinally of the joist to the load bearing walls 40.

It will be noted that all of the tile disclosed are of such shape as to involve only the simplest steps of manufacture in the ceramic industry and are of such length as to not encumber the mechanic's skill in laying them in position on the joist. The joists are of such weight that they may be readily handled manually and placed in position in the building structure without requiring the use of cumbersome hoists and machinery, and the completed floor structure involves the use of no more material for finishing the ceiling surfaces and floor surfaces than the materials essential to the actual floor construction for the concrete or grouting serves primarily to join the courses of tile in such manner that the compression stresses extend along these courses longitudinally of the joists parallel with the upper longitudinally extending portions of the joists, which portions lack the physical characteristics which would permit them to absorb the compression stresses and the tension stresses which the tile courses cannot absorb are taken by the lower flanged portions of the joists. Also by having the tile height dimensions confined to the limitation of the joist height, that is, the height of the tile being less than the height of the joists and the height of the joists being dimensionally determined to conform to standard height dimensions of building units such as brick and mortar joints or load bearing wall tile, the floor structure can be readily embodied in the building and comprise part of the load bearing walls without necessitating any calculating of tile or brick setting unusual to standard practice.

It will be apparent from the foregoing description of the embodiments of my invention that a metallic joist can be used which is of an economical weight; that is, a considerable saving is effected by the use of light weight joists, which use is feasible due to the fact that the tile are arranged in single rows side by side, whereby the maximum benefit of their strength is utilized in a flat arch floor construction. The tile are extremely simple in cross-sectional form, thus insuring uniformity in their physical characteristics in the manufacture thereof, and by reason of the simple arrangement of joists and tile in the manner disclosed, the floor structure may be rapidly assembled by the mechanic without necessitating any unusual care, and the structure when completed has substantially flat upper and under surfaces which are not objectionable in dwellings and buildings of the type for which the structure is proposed, and the floor structure is quite durable and unitary due to the overlying grouting of concrete surfacing.

It is to be understood that where I have herein referred to the use of a metallic joist so light in cross section that it has not sufficient inherent strength to carry the dead load of the floor structure plus the live load, I mean that if it were not for the absorbing of a considerable part of the live load longitudinally along the single courses of tile to the side walls of the building structure, that the joists would deflect excessively.

I claim:

1. A floor construction comprising floor joists formed of metal to have opposed bottom flanges and a top flange connected by a beam web and single courses of hollow tile substantially square in cross-section laid with their side walls in juxtaposition to fill the spaces between the joists, the single courses of tile being laid to bear upon said flanges of the joists and held in place at one end only by said top flange whereby said tile may be inserted in position on the lower flanges without necessitating lateral movement of the tile.

2. A fireproof floor construction comprising floor joists formed of metal to correspond in cross-section to an I beam with one top flange portion omitted, and single courses of hollow tile laid with their side walls in juxtaposition to fill the spaces between the joists, said hollow tile being substantially square in cross-section and laid to bear upon said flanges of the joists, and of a height to be held in place by the single top flange of the joist.

3. In a floor construction of the character described, the combination of spaced apart floor joists comprising metal beams formed to have opposed flanges at the bottoms thereof, the under face or surface of the flanges being irregular and a single formed flange at the top thereof, the joists being spaced apart in conformity with standard practice, and the

spaces between the joists being filled with horizontal courses of tile of less height than the joists and, each tile being laid to extend substantially from web to web of the joists, and to bear upon bottom flanges in adjacent joists at the ends thereof, whereby the under surfaces of the joists will remain exposed and comprise part of a ceiling surface.

4. A fire-proof floor construction comprising floor joists formed of metal and having opposed flanges at the bottoms thereof, said joists being of a height corresponding to one or more standard height load bearing wall tile or standard brick plus necessary mortar joints, single courses of tile laid with their side walls in juxtaposition to fill the spaces between said joists, a layer of concrete filling the spaces between the top surfaces of the tile and the tops of the joists and the incidental joints between the ends of the tile and the sides of the joists, said joists, tile and concrete extending into and comprising a part of the load bearing wall.

5. A fire proof floor construction, comprising metal floor joists having opposed bottom flanges, a top flange connected by a beam web, said joists extending into the load bearing wall at spaced intervals, hollow tile laid between the joists, and a grouting filling the spaces between the layers of tile and the spaces between the tile and top of the joists, the bottom flanges of said joists being of a weight sufficient to take all of the tension of both the dead and live load, the top flange being of a weight sufficient to take the compression of the tile and grouting only while it is setting.

In testimony whereof I hereunto affix my signature.

GEORGE W. DENISON.