R. H. ROBINSON.

COMPOSITE BUILDING FRAME STRUCTURE

APPLICATION FILED JAN. 2, 1908.

1,038,440.

Patented Sept. 10, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

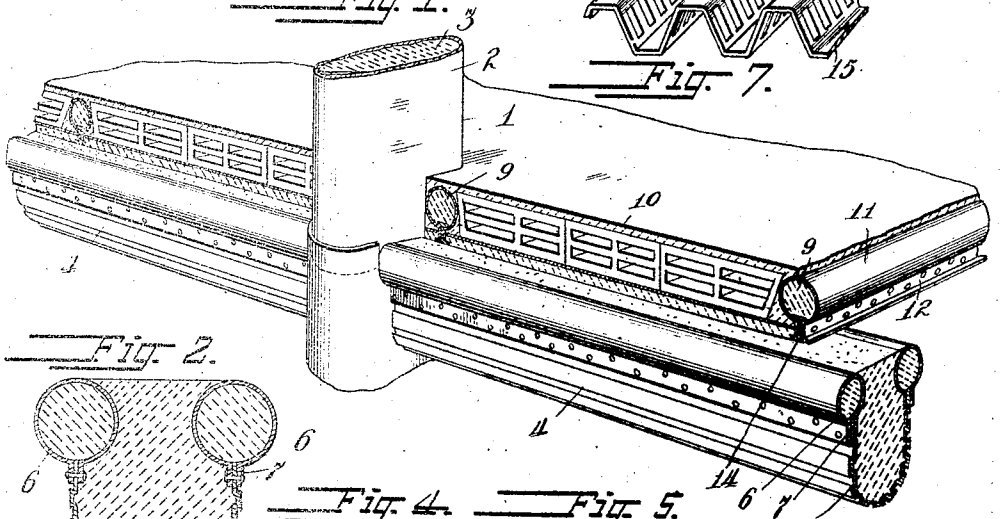


Fig. 7.

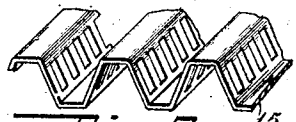


Fig. 2.

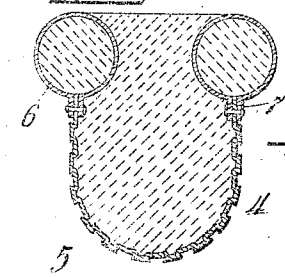


Fig. 4.

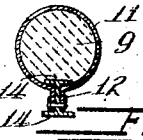


Fig. 5.

Fig. 3.

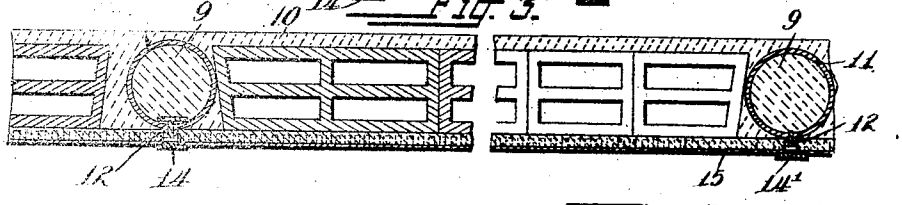


Fig. 9.

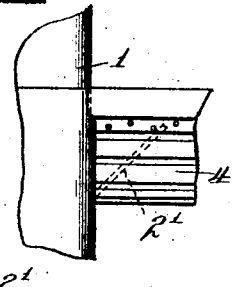


Fig. 8.

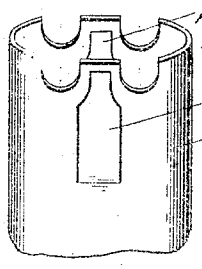
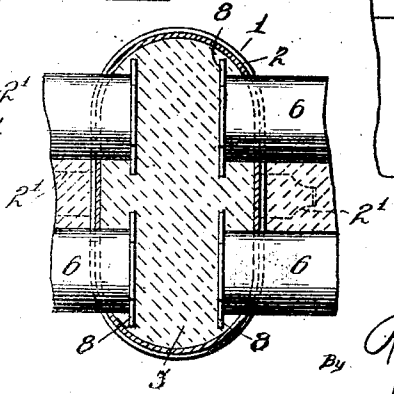


Fig. 6.



Witnesses
Milton Lenoir
Emilie Rose.

Inventor:
Roy N. Robinson
By Albert N. Graves
Attorney.

R. H. ROBINSON.

COMPOSITE BUILDING FRAME STRUCTURE.

APPLICATION FILED JAN. 2, 1908.

1,038,440.

Patented Sept. 10, 1912.

2 SHEETS—SHEET 2.

Fig. 10.

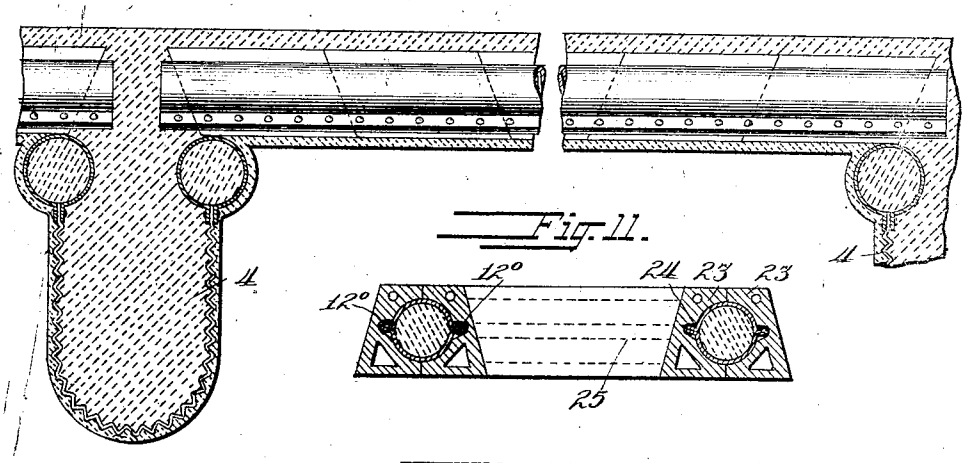


Fig. 11.

Fig. 12.

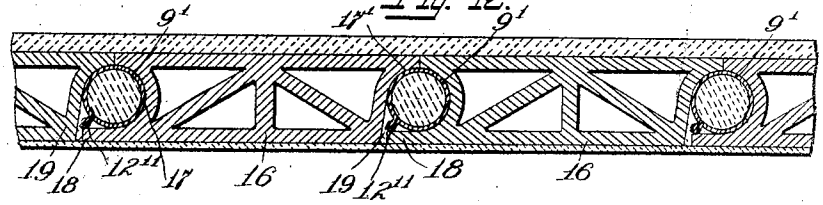


Fig. 13.

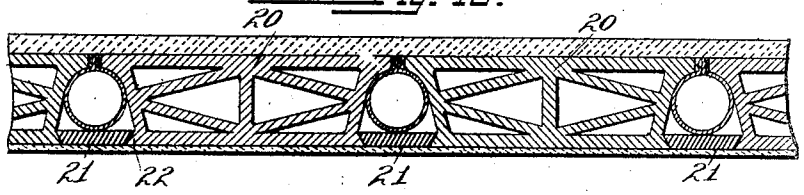


Fig. 14.

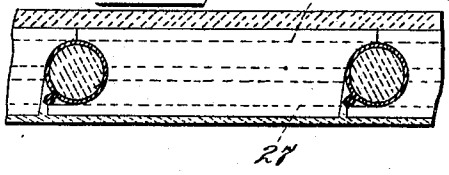
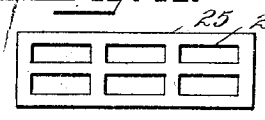


Fig. 15.



Witnesses
Milton Lenox
Emilie Rose.

Inventor
Roy H. Robinson
by Albert W. Graves,
Atty.

UNITED STATES PATENT OFFICE.

ROY HENRY ROBINSON, OF CHICAGO, ILLINOIS.

COMPOSITE BUILDING-FRAME STRUCTURE.

1,038,440. Specification of Letters Patent. Patented Sept. 10, 1912.

Application filed January 2, 1908. Serial No. 409,053.

To all whom it may concern:

Be it known that I, ROY HENRY ROBINSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Composite Building-Frame Structures, of which the following is a specification.

This invention relates to composite building frame structures, and more particularly to building frame structures wherein the frame members of the invention are formed of concrete and metal so combined as to attain the objects of the invention.

Among the salient objects of the invention are to provide a composite frame member so constructed that the metallic reinforcement constitutes a form or receptacle to determine the conformation of the cement which combines with the metal reinforcement to form the frame member; to provide a construction in which certain of the skeleton metal reinforcements may be in part filled with concrete before being set in position and the main body or bulk of cement filled into the partly-filled and stiffened members after being set in position, thus facilitating the operation of erecting; to provide a frame member of such construction that it is characterized by maximum strength, very low cost and suitability for its intended use; to provide a composite frame construction which may be entirely plastered in and concealed by any suitable plaster or cement compound; to provide in combination with frame structures of the character above referred to a composite flooring which is characterized by great strength and lightness, and in general to provide improvements in the details of construction and arrangement of structural frames.

To the above ends the invention consists in the matters hereinafter described, and particularly pointed out in the appended claims.

In the drawings—Figure 1 is a perspective view showing a fragmentary portion of a pillar, fragmentary portions of two adjoining stringers or beams and portions of a floor construction superposed upon the beams; Fig. 2 is a cross sectional detail of one of my improved major stringers or beams; Fig. 3 is a cross sectional detail of the flooring shown in Fig. 1; Figs. 4 and 5 are cross sectional details of various forms of tubular beams which may be used as constituent parts of the flooring, such for example as that shown in Fig. 3; Fig. 6 is a horizontal sectional view through one of the main uprights or pillars and connected beams; Fig. 7 is a perspective view of a fragmentary portion of one form of skeletonized metal which may be used to form the permanent centering or under layer of the floor construction; Fig. 8 is an isometrical perspective of the upper end portion of one of the pillars; Fig. 9 is a fragmentary view in side elevation of a portion of one of the uprights and an end portion of one of the main beams or girders connected therewith; Fig. 10 is a sectional view of a modified construction taken transversely of the main girder and alongside of one of the joists, the latter being shown in side elevation; Fig. 11 is a section taken transversely through a pair of joists showing another modification in which skewbacks are employed; Figs. 12, 13 and 14 are views similar to Fig. 11 showing still other modifications; Fig. 15 is an end elevation of the tile block shown in side elevation in Fig. 11.

Referring to the drawing, 1 designates an upright pillar or post consisting of an outer tubular shell 2 and a filling of concrete or analogous material 3. The post is most advantageously made in lengths or sections equal to the distance between stories of the building; the upper section being arranged to telescope a short distance within the lower section, as shown clearly in Fig. 1. Preferably also these pillars are made of flattened oval form in cross section.

4, 4, designate major stringers or girders connected with the opposite flattened sides of the pillar and supported by the latter. Each of these girders comprises a trough-like metal member 5, constituting a combined form and reinforcement and the upper edges of which are provided with stiffening members 6, preferably and as shown of tubular form and united with the edges of the member 5 in any suitable manner, as for example by means of overlapping flanges 7 riveted together. The ends of these stiffening members 6 constitute convenient means of uniting the beams to the pillars, and to this end they are extended slightly

beyond the end of the member 5, inserted in suitable openings in the shell of the pillar and provided within the latter with outturned flange portions 8 whereby they are bonded in place by the filling of cement 3. In order to still further unite the transverse beams 4 with the uprights, and particularly in order to anchor the lower edges of said beams to the uprights, I provide metal arms or anchors 2′ which are desirably struck out as integral extensions or tongues from the tubular uprights and arranged to extend obliquely into the lower parts of said beams, as shown clearly in Figs. 8 and 9. When the concrete is filled in, these reinforcements 2′ obviously constitute anchors which very strongly unite the lower portions of the beams with the pillars, and they also act as trussing reinforcements which to some extent strengthen the mass of concrete.

Preferably, and as indicated, the trough-shaped reinforcement 5 is of inclave-formed metal, as indicated in the drawings, so as to facilitate the application and attachment thereto of plaster or concrete covering. Inasmuch as the trough-shaped reinforcement must ordinarily carry a comparatively heavy load of plastic cement when filled with the latter, the tubular stiffening reinforcements 6 thereof will preferably be filled with cement and allowed to harden before the beam or girder is erected. This strengthens the beam amply to enable it to support the load of plastic concrete until the latter hardens.

The metallic skeleton of the beam, constructed as described, having been set in position, the interior thereof is filled with concrete or analogous cementitious material, which filling is preferably brought up flush with the top surfaces of the pillar reinforcements 6 at the upper edge thereof, as shown clearly in Fig. 2.

As a further feature of improvement I provide what I term a formless floor construction, which is seated upon and supported by the major beams or stringers 4. This floor construction comprises a series of parallel tubular joists or minor transverse frame members 9 and interposed tile blocks 10 forming in effect flat arches extending between the joists 9. Describing the joists more particularly, each in its preferred embodiment consists of a tubular main body 11 provided along one or both sides coincident with its vertical axis with flanges, as 12, 12′ and 13. In the most efficient form which I have devised I insert a small I-beam reinforcement 14 between the lower flanges 12 of the tubular member, and unite said I-beam and said flanges by through-rivets. This provides an extremely strong but nevertheless light joist member. For additional strength it will usually be filled with concrete, as indicated in Fig. 3. The sides of these joists are of admirable configuration to enable the tile members to be interlocked therewith in such manner as to form efficient flat arches. In the construction shown in Fig. 3, the tile members are of such shape as to fit or abut against the sides of the joist members, and the members of each set are of such shape as to key together to complete the arch.

Before laying the tile a metal reinforcement, which is preferably in the form of a corrugated and skeletonized or expanded sheet (see Fig. 7), is laid across from the flange of one joist to the flange of the next, as indicated at 15 in Fig. 3, and this metal reinforcement is covered and embedded in a relatively thin layer of concrete or cement, which is allowed to set and harden before the tiles are placed in position. This forms a preliminary support or floor which entirely dispenses with the usual "centering" or temporary scaffolding commonly used for building such tile or composite floor arches upon. Subsequently a bed of concrete is provided upon which the tiles are laid and the tiles are thereafter covered with a layer of concrete or cement, all as indicated clearly in Fig. 3. Finally, the ceiling or upper side of the floor structure may be plastered or otherwise finished as desired.

Where considerable strength is required, yet not so much as to demand the I-beam reinforcement 14, I may substitute a reinforcement of inverted T-shape in cross section, as indicated at 14′ at the right hand end of Fig. 3. In some instances, I form the flanges as continuations of the lateral edges of the sheet metal of which the tubular reinforcements are formed and in this manner dispense with the insert of I-beam or T-shape in cross section. Such a modification is shown in Fig. 5.

Heretofore the comparatively great cost of the minor beams or joists of floorings of this general character has led to making the floor arches of considerable width from joist to joist and this has in turn necessitated the employment of a plurality of tile blocks, since single blocks could not well be manufactured of a length sufficient to extend from joist to joist. By my present invention, in which I make these joists of tubular metal filled with concrete, I so lessen their cost that it is entirely feasible to place the joists sufficiently close together to enable tiles to be used each of a length to extend from joist to joist. In Figs. 10 *et seq.* I have shown a construction embodying this idea. Referring to Fig. 12, 9′ designates the joists, the tubular outer member of each of which is formed of sheet metal and is provided with an inner reinforcement of concrete as before. The edges of the tubular sheet are brought together and turned outwardly to form flanges 12″ which are riveted together, and in order to avoid interference with the

special tile blocks, to be described, these joists are so disposed that their flanges are at their lower side and at an angle of about forty-five degrees from the vertical. 16 designates as a whole the tile blocks which are fitted between the joists. These blocks are so formed that in placing them in position one end can be engaged with one of the joists and so-to-speak hooked around the latter, after which the opposite end can be lowered into engagement with the other joists and the tiles supported in proper position. To admit of this manipulation, one end of each tile is concave, as indicated at 17, to fit against one-half of the joist, and is provided with a prolongation 18 at its lower side which underlies the joists. The opposite end is partially concave, as indicated at 17' so as to fit against the upper side of the joist, but its corresponding lower corner is omitted or shortened, as indicated at 19, so that the tile may be swung into position. The angle formed between the corner 19 of the tile and the extension 18 of the companion tile accommodates the flanges 12'' of the joists.

Fig. 10 shows a section of the flooring shown in Fig. 12 taken at right angles to the latter, and as shown by said Fig. 10 the meeting edges of the tiles which extend from joist to joist are inclined from the vertical and may be arranged in sets so as to key together between each set of major beams 4. In Fig. 13 is shown a construction embodying much the same idea, with this difference, however, that the tile blocks 20 are alike at each end, have their lower sides sufficiently shortened as compared with the upper portions of the tile so that they may be lowered into position without the rotative movement necessary in assembling those shown in Fig. 12. To complete the gap between the end margins at the lower sides of the tiles, socket tile members 21 are slipped into position; these tile blocks or slabs 21 having upwardly and outwardly flaring lateral edges which key them in place between the correspondingly beveled end margins of the tiles 20, as indicated at 22.

In Fig. 11 I have shown a construction in which the joists are each provided with lateral flanges 12° at each side, and the joists are inclosed between skewback tiles 23 arranged in pairs; these skewbacks being preliminarily supported in position by being recessed in their concave sides, as indicated at 24, to hook upon the flanges 12°. Between the skewback covered joists are arranged to extend tiles 25 which fit into place key-fashion and a peculiarity of these tiles 25 is that their tubular passages 26 (see Fig. 15) extend at right angles to those of the tiles shown in Figs. 12 and 13.

The construction shown in Fig. 14 is substantially that shown in Fig. 12, with the exception that in this instance the tubular passages (indicated in dotted lines at 27) extend lengthwise of the tiles, *i. e.*, from joist to joist instead of parallel with the joists.

While I have herein shown and described preferred and practical embodiments of the invention, yet it will be understood that the details of construction may be modified without departing from the spirit of the invention.

I claim as my invention:

1. In a composite floor construction, the combination with a pair of spaced apart stringers, each of said stringers consisting of a tubular member provided at its lower side with a depending web-like reinforcement having laterally outturned flanges, of a sheet metal reinforcement bridging the space between said stringers and having its edges interengaged with and supported by the corresponding flanges of the stringers, a layer of cementitious material resting upon and incorporated with said sheet metal reinforcement, and tile blocks resting upon said concrete layer, bridging the space between the stringers and keyed between the latter to form floor arches.

2. In a composite floor structure, the combination with a pair of spaced apart stringers, each of said stringers consisting of a tubular member provided at its lower side with a depending web-like reinforcement having laterally outturned flanges, of a sheet metal reinforcement bridging the space between said stringers and having its edges interengaged with and supported by the corresponding flanges of the stringers, a layer of cementitious material resting upon and incorporated with said sheet metal reinforcement, a filling of concrete occupying the interiors of the tubular stringers, tile blocks resting upon said concrete layer, bridging the space between the stringers and keyed between the latter to form floor arches, and a covering of concrete overlying said layer of tile blocks.

3. In a composite floor construction, the combination with spaced apart tubular joists, each provided at its lower side with a depending web like reinforcement having laterally out-turned flanges, of a sheet metal reinforcement bridging the spaces between said joists, and having its edges interengaged with and supported by the corresponding flanges of the stringers, a filling of concrete within said tubular joists, and tile blocks supported by said sheet metal reinforcement and bridging the spaces between the stringers, and keyed to the latter to form floor arches.

4. In a composite floor construction, the combination with spaced apart joists, each having lower lateral flange extensions and an expanded comparatively large hollow

head, of metal reinforcement bridging between the joists and supported on the lateral flanges thereof, a layer of concrete upon said metal reinforcement, tile blocks resting on said concrete layer extending between the hollow heads of the joists and keyed thereto to form floor arches, and concrete or cement filling the heads of said joists and applied over said tile and about said joists.

ROY HENRY ROBINSON.

Witnesses:
EMILIE ROSE,
F. L. BELKNAP.