Dec. 7, 1937. H. A. FABER 2,101,538

FLOOR CONSTRUCTION

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Fig. 1.

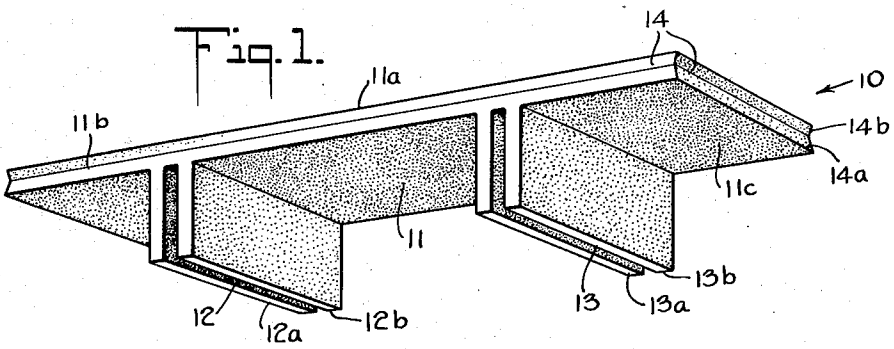


Fig. 2.

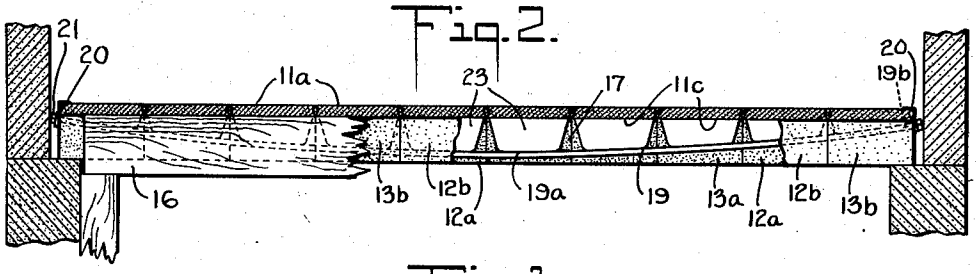


Fig. 3.

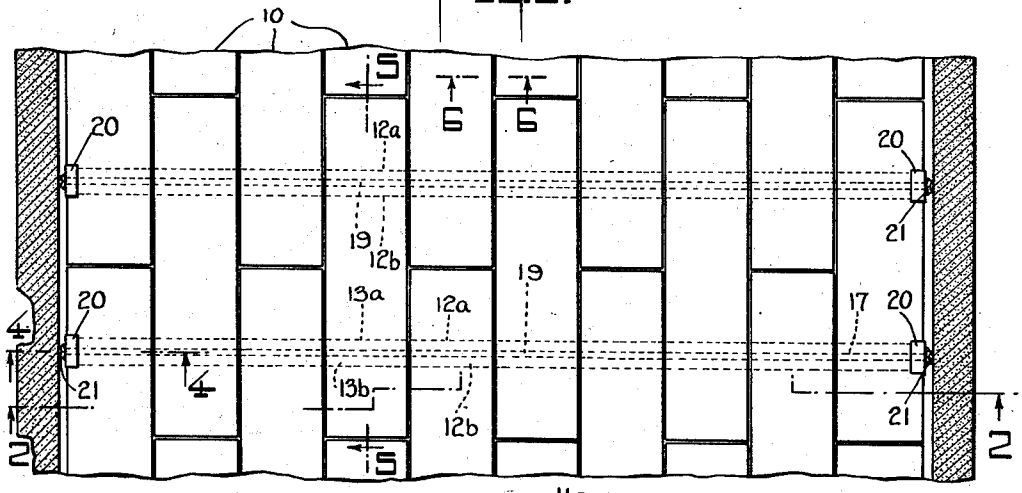
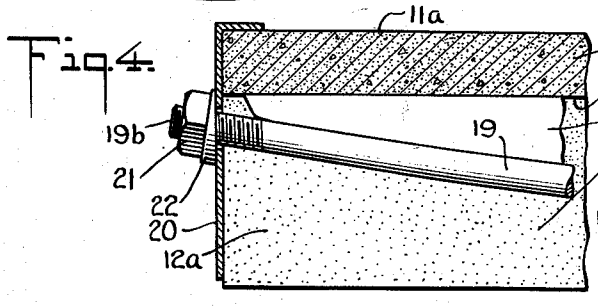


Fig. 4.



INVENTOR
Herbert A. Faber
BY Henry J. Rucke
HIS ATTORNEY

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FLOOR CONSTRUCTION

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Fig. 5.

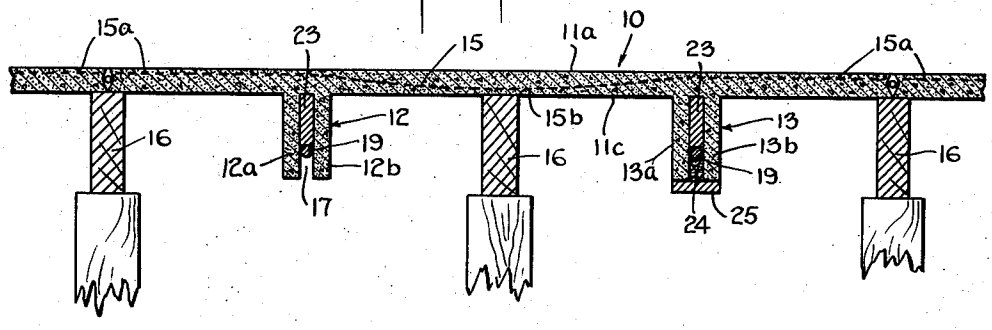


Fig. 6.

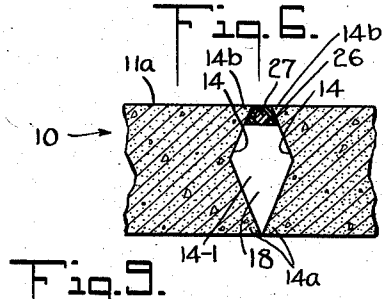


Fig. 7.

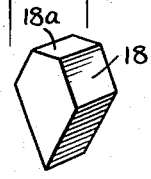


Fig. 8.

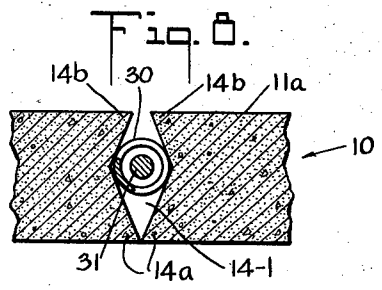


Fig. 9.

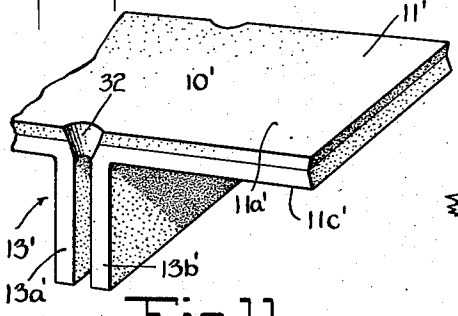


Fig. 10.

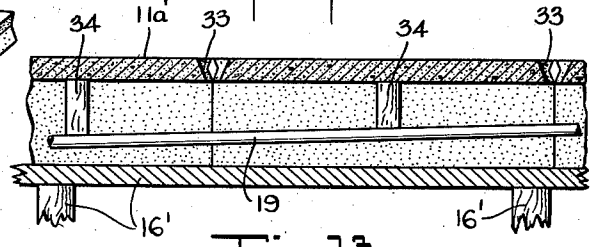


Fig. 11.

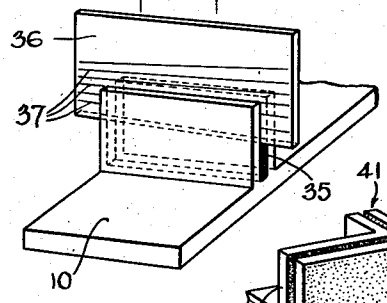


Fig. 13.

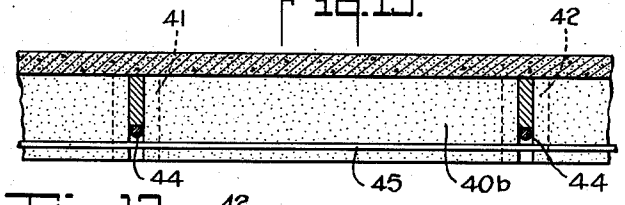
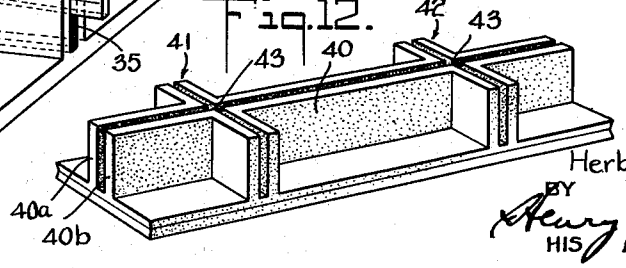


Fig. 12.



INVENTOR
Herbert A. Faber
BY
Henry J. Cooke
HIS ATTORNEY

Patented Dec. 7, 1937 2,101,538

UNITED STATES PATENT OFFICE

2,101,538

FLOOR CONSTRUCTION

Herbert Alfred Faber, Cincinnati, Ohio

Application March 14, 1936, Serial No. 68,789

17 Claims. (Cl. 72—68)

This invention relates to an improved floor construction, and more particularly to a floor construction assembled from pre-shaped blocks of novel configuration tied to one another by suitable reinforcing means.

Embodiments of the present invention include individual blocks pre-shaped, preferably from concrete, to provide sets of parallel depending flanges suitably spaced apart from one another to afford, when the blocks and the therewith associated flanges are positioned in end to end alignment in the floor assembly, a continuous channel suitable for the reception of reinforcing means, the reinforcing means being of a length sufficient to tie the associated units together and to coincidentally tie together associated flanges to complete the formation of composite beams running continuously across the undersurface of the assembled floor.

Advantageously, such reinforcing means take the form of rods pre-bent to approximate a catenary, and are positioned with the vertex of the curve directed downwardly, the free ends of the rod being secured by appropriate means at the edges of the floor proper. Spacer means, having collectively the required coordinating curvature, are provided between the curve of the reinforcing rods and the undersurface of the floor, and permit the stressing of the rods to a degree necessary to enhance the usual load bearing characteristics of the floor construction. It is desirable that the reinforcing rods be surrounded by a grouting material when in final position.

Side surfaces of individual blocks preferably define grooves extending continuously around the lateral periphery of the block to permit a novel joinder, proximate the floor surface, of assembled blocks, the joinder being accomplished by the positioning of inserts at spaced intervals between co-ordinating grooves of respective contiguous blocks, and grouting therebetween.

The uniformity of configuration thus attained between individual blocks permits interchangeability of blocks in various locations in the floor arrangement.

The present invention, therefore, provides a solid floor construction capable of supporting comparatively great loads, the tying in of individual blocks to form both a flooring surface and beams therefor and the pre-stressing of the tying means, effecting this desired result.

The ease of assembly of the herein floor construction and the ready interchangeability of individual units in the preferred forms, are decided advantages in the art.

Further features and objects of the invention will be apparent from the following detailed description, and the accompanying drawings in which:

Fig. 1 is a view in perspective of a preferred form of individual, pre-shaped floor block pursuant to my invention.

Fig. 2 is a vertical section, taken on line 2—2 of Fig. 3, illustrating individual floor blocks of Fig. 1 assembled in a preferred embodiment of floor construction.

Fig. 3 is a top floor plan of the embodiment illustrated in Fig. 2.

Fig. 4 is an enlarged fragmentary detail view in vertical section taken on line 4—4 of Fig. 3.

Fig. 5 is a vertical section taken on line 5—5 of Fig. 3, and showing shoring temporarily supporting the partially completed floor construction.

Fig. 6 is an enlarged fragmentary detail view in vertical section taken on line 6—6 of Fig. 3.

Fig. 7 is an enlarged detail view in perspective of an insert element shown in Fig. 6.

Fig. 8 is a view corresponding to Fig. 6 but illustrating another embodiment.

Fig. 9 is a fragmentary view in perspective illustrating another type of pre-shaped block.

Fig. 10 is an enlarged fragmentary view, in vertical section, of an embodiment of the floor construction utilizing the floor block of Fig. 9.

Fig. 11 is a perspective fragmentary view showing a method of forming reinforcement-spacer-means integral with the individual floor block.

Fig. 12 is a view in perspective of another type of individual floor block, pre-shaped to provide cross bracing in the assembled floor construction.

Fig. 13 represents a vertical section, longitudinal with respect to the arrangement of Fig. 3, through a floor construction embodying the floor blocks of Fig. 12.

Referring to the drawings, and particularly to Figs. 1 through 5, at 10 is indicated an individual building block, pre-shaped to include preferably a slab portion 11; having a suitable floor surface 11*a*, a peripheral side surface 11*b*, and an under surface 11*c*; and, further, to include sets 12 and 13 of parallel spaced flanges 12*a* and 12*b*, and 13*a* and 13*b*, respectively, the flange sets 12 and 13 depending in mutually parallel, spacial relation from the undersurface 11*c* of the slab portion 11, and extending between two opposite faces of the peripheral side surface 11*b*. The block 10 is desirably of a rectangular configuration with the

flange sets 12 and 13 extending between the two longer sides thereof, and spaced apart inwardly from the two shorter sides or ends. To provide for proper beam formation upon assembly of a plurality of blocks in a building construction, as hereinafter described, the related flanges 12a and 12b, and 13a and 13b of each set 12 and 13, respectively, of flanges preferably define between each other an open slot having a mean width substantially commensurate with, or less than the mean thickness of an individual flange, and a mean depth substantially equal to the outward extension of the flanges, the width of the slot being small compared to the distance between the sets of flanges 12 and 13, respectively.

Advantageously the peripheral side surface 11b defines a groove 14 which completely encircles the slab 11 laterally, to allow for joinder of assembled blocks.

The blocks 10 are preferably of cast concrete, the flanges 12a, 12b and 13a, 13b being formed integral with the slab portion 11. Reinforcing steel mesh 15, see Fig. 5, may be included within the slab 11 during the casting operation; its two ends 15a, 15a being preferably disposed proximate the floor surface 11a, and the central portion 15b curving downward to approximate a catenary.

The block 10 thus formed is symmetrical. Consequently, in an assembly of such blocks any one block may be readily interchanged with another without disturbing the general continuity of the construction.

In assembling the floor construction illustrated in Figs. 2, 3 and 5, the individual building blocks 10 are positioned end-to-end and side-by-side on the shoring 16, see Figs. 2 and 5, the flanges 12a and 12b and 13a and 13b of the flange sets 12 and 13, respectively, aligning end-to-end with like flanges of adjacent blocks to compositely form channeled beams, Figs. 2 and 5, extending completely across the resulting construction.

Advantageously, the blocks are disposed in staggered relation respective to one another, as clearly shown in Fig. 3, the flanges 12a and 12b, of one block, according to the arbitrary designation here used, aligning with the flanges 13a and 13b, respectively, of adjoining blocks. The channel included within a composite beam and defined by the respectively end-to-end aligned flanges is designated 17.

Assembly of the blocks, as above, includes the positioning of inserts 18, shown in detail in Figs. 6 and 7, in spaced relation to each other between the coordinating grooves 14 of adjacent blocks. The grooves, as shown, are preferably of a wide V-formation, the vertex of the V being offset upwardly from the horizontal axis of the slab 11 to give the lower V-lip 14a a greater outward protrudence than the upper V-lip 14b. Consequently, coordinating grooves of contiguous blocks define a substantially diamond-shaped space 14—1 between slab portions 11 of the blocks, the space being closed at the bottom by contact of the lower V-lips 14a, and being open lengthwise along its top by reason of the spacial relationship of the upper V-lips 14b. The inserts 18 are shaped, see Fig. 7, to conform to the cross-sectional area of the space 14—1, and are preferably positioned at locations near the corners of the slabs. Desirably, the upper portion of the insert 18 is reduced in height and flattened, as at 18a, for a purpose hereinafter set forth.

Reinforcing means, such as the rods 19, are positioned within the channel 17 formed compositely by the alignment of the spacially related flanges 12a and 12b, and 13a and 13b, respectively, the channels running completely across the floor proper.

Reinforcing means are positioned within the channels 17, and co-extensive therewith lengthwise, to effect a tying together of the assembled blocks. Such reinforcing means preferably take the form of tie-rods 19, each pre-bent to approximately the curvature of a catenary, and disposed within the channel 17 with its vertex 19a directed downwardly, and each of its ends 19b, 19b, see Fig. 4, extending slightly beyond its respective edge of the floor proper, to receive thereon an angle end-plate 20; the end-plates 20 and therewith the tie-rod 19, being securely held in place by means of the nuts 21 bearing, respectively, in threaded engagement with the ends 19b, 19b of the rod 19 against the tapered-washers 22.

Between the body of the rod 19 and the undersurfaces 11c of the slabs 11 are spacer-inserts 23, being preferably individual blocks of suitable material such as wood, metal, etc., and having a curvature approximating the curvature of the rod 19 to provide a firm conforming abutment therefor. The angle plates 20 fit snugly, as shown in detail in Fig. 4, around the respective end surfaces of the floor proper, and the washers 22 are tapered, respectively, as illustrated, to provide a bearing surface normal to the horizontal and also a bearing surface normal to the axis of threading of the threaded tie-rod end 19b. The nuts 21 may be tightened against the washers 22 as desired to effect suitable tensioning of the tie-rod 19, the spacer-inserts 23 presenting abutment surfaces along the length of the rod under tension.

Desirably, a cementitious material 24, see Fig. 5, is grouted into the channel 17 to complete the formation of composite beams. In the embodiment of floor construction just described, the shoring 16 is placed between the sets of aligned flanges, and the material 24 is grouted into the channel 17 from below the floor structure. Any suitable means, such as the furring strip 25, Fig. 5, may be employed to retain the grout 24 in place during the stage of hardening.

Bonding of the blocks proximate the floor surface may be accomplished by grouting a suitable bonding material, such as the cementitious mortar 26, into the space 14—1 between the coordinating grooves 14 of contiguous units and between and around the spaced inserts 18.

Before grouting, however, reinforcing rods 27 may be laid on top of the surfaces 18a, and may thus be incorporated into the bonded joint between blocks.

Fig. 8 illustrates another form the joinder between contiguous slabs 11 may advantageously take. A continuous helix 30, usually of steel, and of a diameter to effect alignment between adjacent blocks is positioned within the space 14—1. If desired, a reinforcing rod 31 may be disposed within the helix 30. Bonding of the joint may then be accomplished by grouting into the space 14—1 as heretofore explained relative to Fig. 6.

Fig. 9 illustrates, fragmentarily, a building block similar in general configuration to the block 10, Fig. 1. Fig. 10 illustrates a floor construction assembled from the blocks of Fig. 9 in the same manner as the floor construction of Fig. 2 is assembled from the blocks of Fig. 1. Parts of Figs. 9 and 10 identical with parts of Figs. 1 and 2 are designated correspondingly; a "prime" has been added, however, to the nu-

merals of the latter group to differentiate the two embodiments.

The block 10', Fig. 9, includes, as an additional feature over the block 10, Fig. 1, means whereby, upon assembly of a number of the blocks in contiguous relationship, a passage of communication is afforded between the flooring surface 11a' of the slab 11' and the under-surface 11c' at a location between related flanges 12a' and 12b' (not shown) and 13a' and 13b'.

Such means preferably take the form of the semi-funnel-shaped indentations 32 defined in the lateral peripheral surface 11b' at respective locations thereof directly above the space between related flanges. Thus, when the blocks 10' are assembled in contiguous relation with one another, as in Fig. 10, sets of two individual indentations 32 coordinate to form substantially funnel-shaped openings 33 leading from the flooring surface 11a' into the channel 17' of composite beams.

The blocks 10' are assembled on shoring 16' to utilize such shoring as a lengthwise closure for the open channels 17' during the hardening of grouting material. Grouting is accomplished from the flooring surface through the passages 33, the passages themselves being finally filled to floor level with the grouting material.

In the embodiment of floor construction illustrated in Fig. 10, wood block spacer-inserts 34 of comparatively small cross-sectional area are shown as a substitute for the spacer-inserts 23 of Fig. 2.

In certain cases it may be desirable to incorporate space-inserts as integral members of component blocks. In such cases, referring now to Fig. 11, the space between related flanges of any set of flanges of a block 10 may be filled to the required level with a cementitious mortar or the like, as at 35, and the surface of this filler provided with the proper unit-curvature by a form-board 36 having a number of limit-stop marks 37 to correspond with the successive or variant curvatures ensuing in a given embodiment of floor construction.

A floor construction covering a considerable flooring area is usually provided with cross-bracing between joists or beams for the attainment of solidity and rigidity. Pursuant to the present invention, cross-bracing may be had by an assembly of units of the type illustrated in Fig. 12. Such units are preferably identical in configuration to those heretofore illustrated, as at 10, Fig. 1, or at 10', Fig. 9, except for the addition of a preferably centrally located set 40 of spacially related flanges 40a and 40b running lengthwise across the block between the shorter ends thereof, this additional flange-set 40 intersecting the heretofore described primary flange-sets 41 and 42 preferably at right angles, and in such manner as to effect a 4-way communicating space between flanges, see 43, Fig. 12.

Assembly of these units in a floor construction as illustrated in Fig. 13 is accomplished in substantially the same manner as is carried out with respect to Figs. 2 through 8, or Fig. 10, alignment of flange-sets 40 of respective units to form composite cross-beams being had automatically upon alignment of the respective primary flange-sets 41 and 42. Subsequent to the tying in of primary flange-sets by means of the preferably curved, tensioned reinforcing rods 44 which bear against the spacer-inserts to form composite beams or joists, tie-rods 45 are positioned in the composite channels between respectively aligned flanges 40a and 40b, and are secured at the edges of the floor proper by any suitable means. The tie-rods 45 are preferably straight, and effect a tying together of individual flange-sets 40 into composite cross-beams.

Whereas I have described my invention by reference to specific forms thereof, it will be understood that many changes and modifications may be made without departing from the spirit of the invention.

I claim:

1. In a floor construction, a block pre-shaped to include a plane flooring surface, sets of parallel spacially related flanges depending from the under-side of said flooring surface, each of the said sets of flanges completely crossing the said under surface between two oppositely related edges thereof and being spaced apart from the remaining edges thereof, said related flanges of each set defining between each other an open slot having a mean width substantially commensurate with the mean thickness of an individual flange, and a mean depth substantially equal to the outward extension of the flanges, the width of said slot being small as compared to the distance between any two mutually adjacent sets of related flanges.

2. In a floor construction, a block pre-shaped to include a plane flooring surface, sets of parallel spacially related flanges depending from the under-side of said flooring surface, each of the said sets of flanges completely crossing the said under surface between two oppositely related edges thereof and being spaced apart from the remaining edges thereof, said related flanges of each set defining between each other an open slot having a mean width substantially commensurate with the means thickness of an individual flange, and a mean depth substantially equal to the outward extension of the flanges, the width of said slot being small as compared to the distance between any two mutually adjacent sets of related flanges, and the side surfaces of the block, between the said flooring surface and said undersurface, defining grooves extending, collectively, completely around the lateral periphery of the block.

3. In a floor construction, pre-shaped blocks each having sets of parallel, spacially related flanges depending from its undersurface and running completely across the same between opposing sides thereof, said blocks being assembled in end to end and side by side relation to align sets of flanges of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction, reinforcing means preshaped to substantially catenary form positioned between related flange members of said composite beams, spacer means between said reinforcing means and the portion of said undersurfaces lying between related flanges, said spacer means corresponding in general contour to the curve of the said reinforcing means, and grouting material surrounding said reinforcing means and said spacer means.

4. In a floor construction, pre-shaped blocks each having sets of parallel, spacially related flanges depending from its undersurface and running completely across the same between opposing sides thereof, said blocks being assembled in end to end and side by side relation to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams

for the floor construction; and reinforcing means positioned between related flange members of said supporting beams to effectively tie together individual units of the floor construction.

5. In a floor construction, pre-shaped blocks each having sets of parallel, spacially related flanges depending from its undersurface and running completely across the same between opposing sides thereof, said blocks being associated in end to end relation to form rows, and said rows being associated in side by side relation, the individual blocks of any one row being staggered in position with respect to the individual blocks of adjoining rows, and said association of blocks being effective to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction; and reinforcing means positioned between related flange members of said supporting beams to effectively tie together individual units of the floor construction.

6. In a floor construction, pre-shaped blocks each having sets of parallel, spacially related flanges depending from its undersurface and running completely across the same between opposing sides thereof, said blocks being associated in end to end relation to form rows, and said rows being associated in side by side relation, the individual blocks of any one row being staggered in position with respect to the individual blocks of adjoining rows, and said association of blocks being effective to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction, reinforcing means pre-shaped to substantially catenary form positioned between related flange members of said composite beams, spacer means between said reinforcing means and the portion of said undersurfaces lying between related flanges, said spacer means corresponding in general contour to the curve of the said reinforcing means, and grouting material surrounding said reinforcing means and said spacer means.

7. In a floor construction, blocks pre-shaped to include a floor surface, sets of parallel spacially related flanges depending from the under-side of the said floor surface of each block and extending completely across the same between opposing sides thereof, said blocks being assembled in end to end and side by side relation to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction; means for joining individual blocks to one another at locations proximate the floor surface; and reinforcing means positioned between related flange members of said supporting beams to effectively tie together individual units of the floor construction.

8. In a floor construction, blocks pre-shaped to include a floor surface, sets of parallel spacially related flanges depending from the under-side of the said floor surface of each block and extending completely across the same between opposing sides thereof, said blocks being associated in end to end relation to form rows, and said rows being associated in side by side relation, the individual blocks of any one row being staggered in position with respect to the individual blocks of adjoining rows, and said association of blocks being effective to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction; means for joining individual blocks to one another at locations proximate the floor surface; and reinforcing means positioned between related flange members of said supporting beams to effectively tie together individual units of the floor construction.

9. In a floor construction, blocks pre-shaped to include a floor surface, sets of parallel spacially related flanges depending from the under-side of the said floor surface of each block and extending completely across the same between opposing sides thereof, said blocks being assembled in end to end and side by side relation to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction; side surfaces, between the flooring surface and the under-surface of respective blocks, defining grooves; inserts cooperating with coordinating grooves of contiguous blocks; grouting material surrounding said inserts and substantially filling the space between coordinating grooves; and reinforcing means positioned between related flange members of said supporting beams to effectively tie together individual units of the floor construction.

10. In a floor construction, blocks pre-shaped to include a floor surface, sets of parallel spacially related flanges depending from the under-side of the said floor surface of each block and extending completely across the same between opposing sides thereof, said blocks being associated in end to end relation to form rows, and said rows being associated in side by side relation, the individual blocks of any one row being staggered in position with respect to the individual blocks of adjoining rows, and said association of blocks being effective to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction; side surfaces, between the flooring surface and the undersurface of respective blocks, defining grooves; inserts cooperating with coordinating grooves of contiguous blocks; grouting material surrounding said inserts and substantially filling the space between coordinating grooves; and reinforcing means positioned between related flange members of said supporting beams to effectively tie together individual units of the floor construction.

11. In a floor construction, pre-shaped blocks each having sets of parallel, spacially related flanges depending from its under surface and running completely across the same between opposing sides thereof, said blocks being associated in end to end relation to form rows, and said rows being associated in side by side relation, the individual blocks of any one row being staggered in position with respect to the individual blocks of adjoining rows, and said association of blocks being effective to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction, tensioned reinforcing means pre-shaped to substantially catenary form positioned between related flange members of said composite beams, spacer means between said reinforcing means and the portion of said undersurfaces lying between related flanges, said spacer means corresponding in general contour to the curve of the said reinforcing means, and grouting material surrounding said reinforcing means and said spacer means.

12. In a floor construction, blocks pre-shaped to include a floor surface, sets of parallel spacially related flanges depending from the under-side of the said floor surface of each block and extending completely across the same between opposing sides thereof, said blocks being associated in end to end relation to form rows, and said rows being associated in side by side relation, the individual blocks of any one row being staggered in position with respect to the individual blocks of adjoining rows, and said association of blocks being effective to align sets of flanges, and therewith the included component flanges, of mutually adjacent blocks, and to thereby compositely form supporting beams for the floor construction; side surfaces, between the flooring surface and the undersurface of respective blocks, defining grooves; inserts cooperating with coordinating grooves of contiguous blocks; grouting material surrounding said inserts and substantially filling the space between coordinating grooves; tensioned reinforcing means pre-shaped to substantially catenary form positioned between related flange members of said composite beams, spacer means between said reinforcing means and the portion of said undersurfaces lying between related flanges, said spacer means corresponding in general contour to the curve of the said reinforcing means, and grouting material surrounding said reinforcing means and said spacer means.

13. In a building construction, building blocks each comprising a slab body portion the lateral sides of which define grooves, collectively, completely encircling the slab, each groove comprehending a major portion of the surface of its respective lateral side, and the lower defining-edge of each groove extending outwardly from the block a greater distance than does the upper defining edge, said building blocks being associated end to end and side by side with the lower defining-edges of adjacent grooves contiguous to each other and lying between the planes of the opposite major faces of the slab body portions of the blocks and means effecting joinder between adjacent blocks at locations of coordinating grooves.

14. In a floor construction, a block pre-shaped to include a floor slab, a plurality of parallel, spacially related sets of parallel, spacially related flanges depending from the under-side of said floor slab and extending between two opposite sides thereof and located intermediate the other sides thereof, and a set of parallel, spacially related flanges depending from the under-side of said floor slab and extending between the last named sides thereof and located intermediate the first named sides thereof.

15. In a floor construction, a block pre-shaped to include a floor slab, a plurality of parallel, spacially related sets of parallel, spacially related flanges depending from the under-side of said floor slab and extending between two opposite sides thereof and located intermediate the other sides thereof, and a set of parallel, spacially related flanges depending from the under-side of said floor slab and extending between the last named sides thereof and located intermediate the first named sides thereof, the last named set of flanges intersecting the first named sets of flanges at right angles, a four-way channel-crossing resulting at locations of intersection of said flanges.

16. In a floor construction, an assembly of blocks each pre-shaped to include a floor slab, a plurality of parallel, spacially related sets of parallel, spacially related flanges depending from the under-side of the floor slab and extending between two opposite sides thereof and located intermediate the other sides thereof, a set of parallel, spacially related flanges depending from the under-side of the floor slab and extending between the last named sides thereof and located intermediate the first named sides thereof, a four-way channel-crossing resulting at locations of intersection of said flanges, and means for joining contiguous sides of adjacent floor slabs; said blocks being associated in end to end relation to form rows, and said rows being associated in side by side relation, the individual blocks of any one row being staggered in position with respect to the individual blocks of adjoining rows, and said association of blocks being effective to align sets of flanges, and therewith the included component flanges, of adjacent blocks, and to thereby compositely form supporting beams and cross-bracing beams for the floor construction; reinforcing means positioned between related flange members of said supporting beams to effectively tie together individual units of the floor construction.

17. In a floor construction, an assembly of blocks each pre-shaped to include a floor slab, a plurality of parallel, spacially related sets of parallel, spacially related flanges depending from the under-side of the floor slab and extending between two opposite sides thereof and located intermediate the other sides thereof, a set of parallel, spacially related flanges depending from the under-side of the floor slab and extending between the last named sides thereof and located intermediate the first named sides thereof, a four-way channel-crossing resulting at locations of intersection of said flanges, and means for joining contiguous sides of adjacent floor slabs; said blocks being associated in end to end relation to form rows, and said rows being associated in side by side relation, the individual blocks of any one row being staggered in position with respect to the individual blocks of adjoining rows, and said association of blocks being effective to align sets of flanges, and therewith the included component flanges, of adjacent blocks, and to thereby compositely form supporting beams and cross-bracing beams for the floor construction; tensioned reinforcing tie-rods shaped to substantially catenary form positioned between related flange members of said supporting beams, spacer abutment means between said tie-rods and the portion of the under-side of said floor slabs lying between related flanges, reinforcing tie-rods between related flange members of said cross-bracing beams and positioned below said curve tie-rods, and grouting material surrounding the reinforcing tie-rods and the said spacer means.

HERBERT ALFRED FABER.