Dec. 16, 1924. 1,519,140

H. M. KNIGHT

BUILDING CONSTRUCTION

Filed Aug. 10, 1921 2 Sheets-Sheet 1

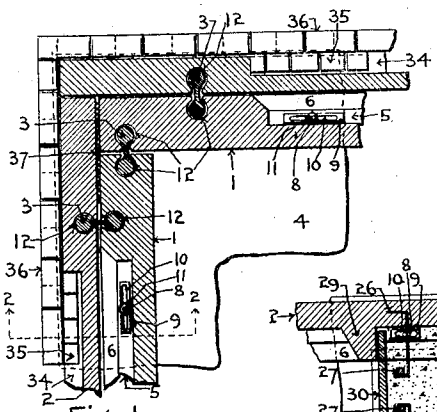


Fig. 1

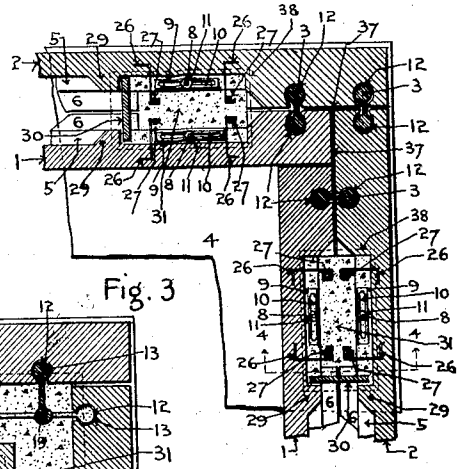


Fig. 3

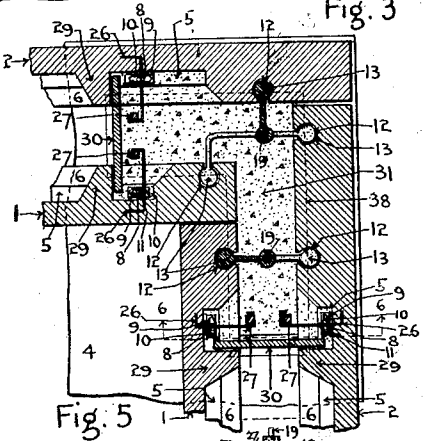


Fig. 5

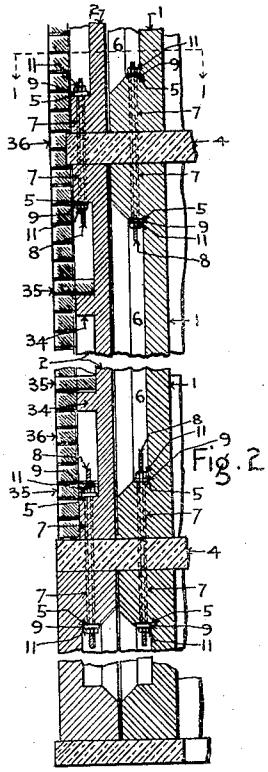


Fig. 2

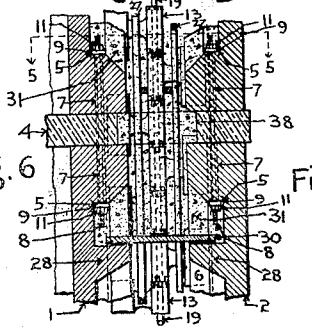


Fig. 6

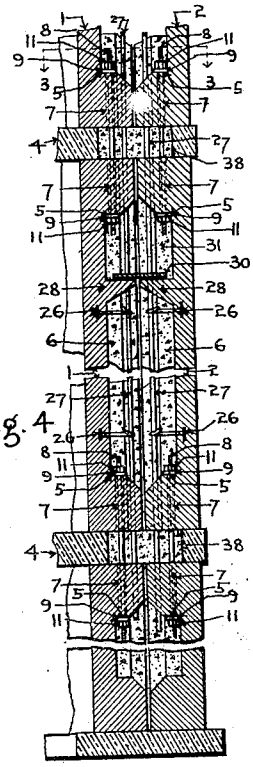


Fig. 4

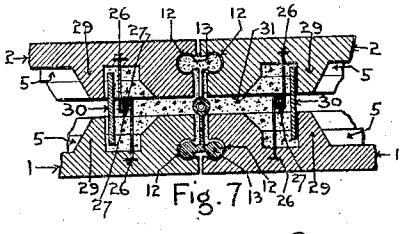


Fig. 7

INVENTOR

Herbert M. Knight

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Fig. 8

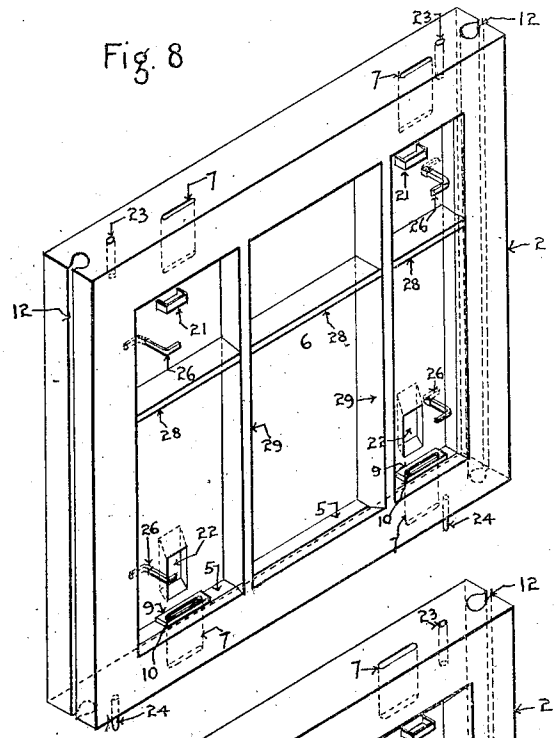


Fig. 11

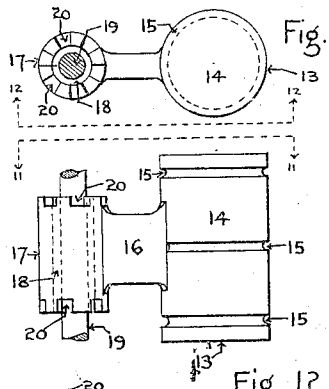


Fig. 12

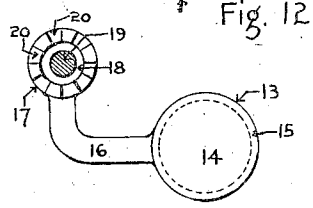


Fig. 13

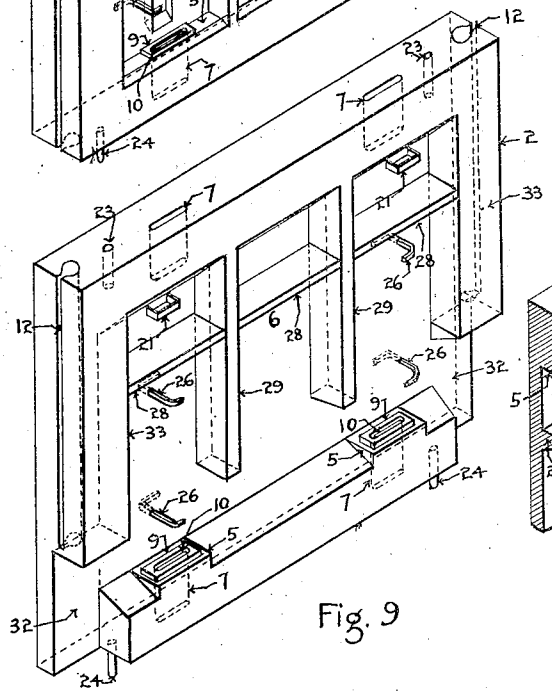


Fig. 9

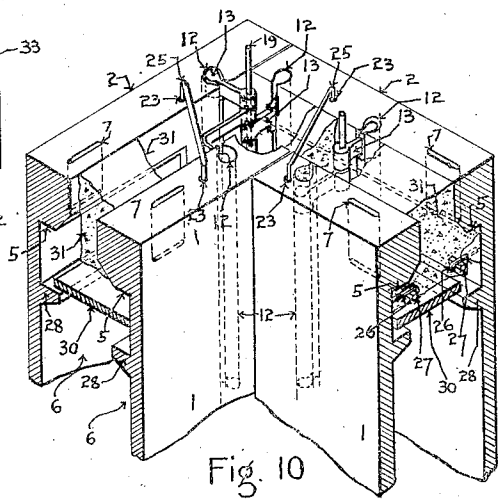


Fig. 10

Herbert M. Knight INVENTOR

Patented Dec. 16, 1924. 1,519,140

UNITED STATES PATENT OFFICE.

HERBERT M. KNIGHT, OF MONTCLAIR, NEW JERSEY.

BUILDING CONSTRUCTION.

Application filed August 10, 1921. Serial No. 491,228.

To all whom it may concern:

Be it known that I, HERBERT M. KNIGHT, citizen of the United States, and resident of Montclair, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Building Construction, of which the following is a specification.

This invention relates to buildings and has special application to buildings of cellular type of unit construction in which the units are connected together by keys.

One of the objects of this invention is to produce a cellular type of unit construction. Another object of the invention is to produce a cellular type of unit construction in which the several units are connected together by keys. Another object of the invention is to produce a cellular type of unit construction, the exterior of which can be veneered. A further object of the invention is to produce a cellular type of unit construction in which the units are connected to the reinforcement of a poured concrete frame. Still another object of the invention is to produce a cellular type of unit construction in which the units are connected together by keys which are interlocked with the reinforcement of a poured concrete frame. Another object of the invention is to produce a cellular type of unit construction in which a poured concrete frame can be introduced without the necessity of building a forming to retain the said mass concrete frame. A further object of the invention is to produce a cellular type of unit construction, in which the units are keyed to the reinforcing members of a poured concrete frame, said concrete of said frame entering key-ways in said units. Still other objects of the invention will appear from the following description and from the accompanying drawings.

The accompanying drawings illustrate the preferred and usual embodiment of the invention, but they are to be considered as illustrative only and not as inclusive of all types in which the invention may be embodied nor as exclusive of types other than that indicated.

I illustrate my invention by the accompanying drawings Figs. 1 to 13, inclusive, in which Fig. 1 is a horizontal section of a corner of such a building having veneered face walls, on the line 1—1 of Fig. 2; Fig. 2 is a vertical cross-section of such a wall on the line 2—2 of Fig. 1; Fig. 3 is a horizontal section of the corner of a building of this construction without veneering, on the line 3—3 of Fig. 4; Fig. 4 is a vertical section of such a wall on the line 4—4 of Fig. 3; Fig. 5 is a horizontal section of the corner of a building, the interior and exterior wall slabs of which are at considerable distance apart, on the line 5—5 of Fig. 6; Fig. 7 is a horizontal section showing an intermediate joint for both outer and inner wall-slabs; Fig. 8 is an isometric view of the back of a wall-slab; Fig. 9 is an isometric view of the back of a wall-slab of a slightly different form, in which the ribs are shortened and apertures left in the thickened edges; Fig. 10 is an isometric view of a corner of a building of this type of construction; Fig. 11 is a plan view of the particular form of key employed, on the line 11—11 of Fig. 12; Fig. 12 is an elevation of such a key on the line 12—12 of Fig. 11 and Fig. 13 is a plan view of an elbow key of the same general form. Referring to the drawings in which similar numbers refer to similar parts. A cellular wall is composed of an inner unit 1 and an outer unit 2 connected by a key 3. The inner and outer units respectively are superimposed either directly upon each other or upon an intervening floor slab 4. Shoulders 5 are cast upon the recessed back 6 of the various units and elongated bolt holes 7 pass through the said shoulders. Bolts 8 are inserted in the said bolt holes having washers 9 with elongated slots 10 therein and nuts 11 on said bolts brought into contact with the slotted washers resting upon the shoulders fastens the superimposed units together. Re-entrant grooves 12 are cast in the faces and ends of the units and keys 13, of the "mallet" type are cemented into the adjacent and juxtaposed re-entrant grooves. The keys have a head 14 with circumferential grooves 15 therein and are connected by a shank 16 to an arbor 17 having a bore 18 therethrough adapted to partially or entirely surround a reinforcing bar or member 19 and having a serrated edge 20. Nut housings 21 are cast in the back of the units being within the depressed back thereof, and are adapted to hold nuts and washers in positions, otherwise inaccessible, during the assembling of the units. Windows 22 are

left in the body of the units for the insertion of the bolts after the units have been assembled. Positioning depressions 23 and plugs 24 for immediately and accurately positioning the units, are cast into the thickened edges thereof. Dogs 25 drop into the depressions 23 for the initial alining and holding of the adjacent units. Attachment means 26 are cast in the back of the units for attachment to reinforcing bars 27. Horizontal ledges 28 and vertical ribs 29 are cast in the back of the units, adapted to sustain a means 30 of retaining mass concrete. A mass concrete frame 31, adapted to surround the keys and reinforcing members and to be confined by the means 30, is poured at determined vertical and horizontal joints. Apertures 32 are left in the thickened edges 33 for access to bolt holes and washers. Ribs 34 are cast on the back of outer units and engage headers 35 of a veneer 36. Insulating medium 37 is introduced between outer and inner units to prevent conductivity of heat and condensation of moisture upon the interior units. Voids 38 are left in the floor slabs for the passage of the mass concrete frame.

One of the greatest defects in a building, the walls of which are of concrete is caused by the porosity of the concrete, which allows a certain, and often a considerable amount of moisture to percolate through the shell or the dividing ribs making the interior of the building damp, and undesirable for residential or commercial purposes. Many types of concrete construction, both mass and cellular, have been devised with the object in view of remedying this defect, but such, either in whole or in part, are of solid construction, and often of such arrangement of the constituent elements as to be structurally weak and unsafe. This invention seeks to meet and overcome these difficulties by means of a unit type of structure in which no element is continuous from interior to exterior, and in which the units are severally united, and at the same time locked to an interior reinforced frame. This form of construction produces a dry building into which moisture cannot seep from without, and a structure so bound and connected together as to be structurally sound and strong.

Pre-cast reinforced concrete slabs or units have thickened edges, in the faces and edges of which are cast re-entrant grooves, these re-entrant grooves being variously located, but in all instances so that, when the units shall have been assembled in their place of final location, the grooves of juxtaposed edges shall be in alignment and adapted to the insertion of a key which partially fills and is finally cemented into the groove. Shoulders are cast on the rear of the thickened edges and elongated holes perforate the said edges, being adapted to the insertion of a bolt. In the assembling of the various units either vertically upon each other or above each other with an interposed floor slab between, said floor slab being perforated with an elongated hole, the several elongated holes in the wall units, or in the floor and wall units are assembled in registration and bolts inserted in the said holes having nuts thereon which are brought into contact with washers having elongated holes therein, and which rest upon the shoulders upon the thickened edges of the wall units. The bolts therefore fasten the wall units and the floors and units together along the horizontal joints.

The thickened edges are chamfered on their back corners. By the thickening of the edges of the units a depressed back or recession is formed upon the rear of the unit. The only point of contact between the units which constitute the interior and exterior faces of the cellular walls are the thickened edges, which in the process of assembling are separated sufficiently to permit the introduction of a thin insulating medium between the said thickened edges. A projecting rib is cast on the back of the unit, just back of the chamfered corners of the thickened edges, the purpose of such rib being to form a rest, either vertical or horizontal, for a thin board or plate which acts as a stop for mass concrete poured as a strengthening frame within the cellular units, both in a vertical and horizontal direction. It is at once evident that a closed form is constituted by the abutting thickened edges, the recessed backs of the wall units and the thin board resting against or upon the projecting ribs 28 and 29, into which mass concrete can be poured to constitute a frame. Reinforcing members, both vertical and horizontal, are embedded in this mass concrete and attaching means, cast in the wall units are wrapped around, or otherwise fastened to, the reinforcing members of the frame, thereby uniting the units and the frame reinforcement and the units and the frame.

While in the case of wall units in close contact a simple form of key, such as the "dumb-bell" illustrated, is employed, when the thickness of the wall is increased so that the units occupy a smaller portion of the cross-section of the wall, a modified type of key becomes desirable, and one which joins the units of wall to the reinforcement of the frame, and to each other. This modified type of key consists of a head adapted to loosely fit within the re-entrant grooves, a shank, either of rectilinear or elbow form, connecting the head and an arbor, and an arbor adapted to partially or entirely surround a reinforcing member of the strengthening frame. The head is provided with

encircling circumferential grooves which increase the adhesion between the key and the surrounding mortar within the re-entrant grooves. The keys are run upon the frame reinforcing bar so that they connect adjacent units in alternation, that is, while all of the keys from contiguous units are located upon the same reinforcing bar, the keys from the various units alternate in their position on the reinforcing member. This results in empty spaces being left in the several re-entrant grooves between the consecutive keys in the same groove, and concrete, poured to make up the frame enters the unoccupied spaces of the grooves and also surrounds the heads and shanks as well as the arbors of the keys, tying the entire structure together. It is apparent that, as a result of the process, details and attachments above enumerated, a unit type of construction is produced which is firmly and completely united, through the mass concrete of the frame filling the unoccupied spaces of the re-entrant grooves and surrounding the arbored keys connecting the wall units to the frame reinforcement, together with the attachment of the said wall units directly to the frame reinforcement, to secure a practically monolithic concrete structure.

Interior, as well as exterior, walls may be constructed of pre-cast units in multiple, set back to back and connected by keys cemented in position. These units may be very thin and often have to be located far enough apart to admit of ducts, flues or pipes passing therethrough, in which case a shanked key, similar to the key employed with exterior units is used, except that a double-bulbed instead of a single bulbed head is used.

Due to the roughness of the exterior superficies of the wall units, and to the presence and appearance of the joints separating the units, it is often desirable to veneer or otherwise treat the exterior of the assembled slabs, in order to secure a more pleasing or unbroken surface, and a brick veneer is often used for this purpose. In order to strongly unite this veneer to the body of the unit and of the structure, the exterior wall units are reversed in their position in the wall, the smooth face of the exterior wall unit being turned inward and constituting one face of the cell. The recessed back is ribbed horizontally, and, vertically if desired, the brick courses being supported by and tied by headers to the horizontal ribs. By this means the veneer and the body of the building are united thoroughly and the weight of the veneering carried through the units to the foundations.

In the assembling of the various units making up a structure of the character described, it is highly desirable that the locating and positioning of the various units should be made quickly and accurately, and, with this object in view the lower of the units as assembled is provided with sockets or indentations in the thickened edges thereof adapted to receive pins, either inserted therein, or projecting from the edges of the units to be superimposed upon the lower unit. Such sockets and pins immediately and accurately locate the several units in position. In addition, the sockets serve to receive the teeth of "dogs" which temporarily hold the units during the insertion of the keys and during the pouring of the concrete of the strengthening frame.

What I claim is:—

1. In a building, pre-cast outer wall units, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, said grooves in the juxtaposed faces of adjacent units being in alinement and keys in said alined grooves.

2. In a building, pre-cast outer wall units, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, keys in said grooves and positioning means in said edges.

3. In a building, pre-cast outer wall units, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, keys in said grooves, said grooves in the juxtaposed faces of adjacent units being in alinement, keys in said alined grooves and positioning means in said edges.

4. In a building, pre-cast outer wall units, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, keys in said grooves, said grooves in the juxtaposed faces of adjacent units being in alinement, keys in said alined grooves, positioning sockets in the edges of said outer wall units and positioning sockets in the edges of said inner wall units.

5. In a building, supporting pre-cast wall units, superimposed pre-cast wall units, thickened edges to said units, positioning sockets in one of the edges of said units and positioning pins in the abutting edges of other units, said sockets and said pins registering.

6. In a building, a multiple of pre-cast wall units, thickened peripheral edges to said units, re-entrant grooves in said edges and vertical ribs and horizontal ledges on the back face of said units.

7. In a building, a multiple of pre-cast wall units, thickened peripheral edges to said units, re-entrant grooves in said edges and means attaching to reinforcing members on the back of said units.

8. In a building, a multiple of pre-cast wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, shoulders to said edges, perfora-

tions through said thickened edges from said shoulders and apertures in said unit and above said perforations.

9. In a building, a multiple of pre-cast wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, shoulders to said edges, perforations through said thickened edges from said shoulders, apertures in said unit above said perforations and nut housings below said perforations.

10. In a building, a multiple of pre-cast wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, said grooves in the juxtaposed faces of adjacent units being in alinement, keys in said grooves, positioning means in said edges, vertical ribs and horizontal ledges on the back face of said units, reinforcement attachment means, shoulders to said edges, perforations through said edges from said shoulders and apertures in said units and above said perforations.

11. In a building, supporting pre-cast wall units, superimposed pre-cast wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, shoulders to said edges and perforations through said edges and from said shoulders, said perforations in said supporting and said superimposed wall units registering.

12. In a building, supporting pre-cast wall units, superimposed pre-cast wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, shoulders to said edges, perforations through said edges and from said shoulders and means tying said supporting units and said superimposed units together.

13. In a building, supporting pre-cast wall units, superimposed pre-cast wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, shoulders to said edges, perforations through said edges and from said shoulders and bolts passing through said perforations and abutting upon said shoulders.

14. In a building, pre-cast outer wall units, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said thickened edges, said grooves in the juxtaposed faces of adjacent units being in alinement, keys in said alined grooves, and a mass concrete strengthening frame between, and in contact with said units.

15. In a building, pre-cast outer wall units, horizontal supporting means on the backs of said wall units, pre-cast inner wall units, horizontal supporting means on the backs of said wall units, said supporting means on said outer wall units and said supporting means on said inner wall units being in the same plane, a confining form resting upon said supporting means of said outer and inner wall units and a mass concrete girder between said units and upon said confining form.

16. In a building, pre-cast outer wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, horizontal ledges on the back faces of said outer wall units, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, horizontal ledges on the back faces of said inner wall units, said ledges on said outer wall units and said ledges on said inner wall units being in the same plane, a confining form resting upon said ledges of said outer and inner wall units and a mass concrete girder between said units and upon said confining form.

17. In a building, pre-cast outer wall units, vertical projections on the backs of said outer wall units, pre-cast inner wall units, vertical projections on the backs of said inner wall units, said projections on said outer wall units and said projections on said inner wall units being in the same plane, confining forms resting against said projections from said outer and inner wall units and a mass concrete column between said units and between said confining forms.

18. In a building, pre-cast outer wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, vertical ribs on the back faces of said outer wall units, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, vertical ribs on the back faces of said inner wall units, said ribs on said outer wall units and said ribs on said inner wall units being in the same plane, confining forms resting against said ribs from said outer and inner wall units and a mass concrete column between said units and between said confining forms.

19. In a building, pre-cast outer wall units, horizontal supporting means on the backs of said wall units, vertical projections on the backs of said outer wall units, pre-cast inner wall units, horizontal supporting means on the backs of said inner wall units, vertical projections on the backs of said inner wall units, said supporting means on said outer wall units and said supporting means on said inner wall units being in the same plane, said projections from said outer wall units and said projections from said inner wall units being in the same plane, a confining form resting upon said supporting means of said outer and said inner wall units, confining forms resting against said projections from said outer wall units and said inner wall units and a mass concrete strengthening frame between said units and upon and within said confining forms.

20. In a building, pre-cast outer wall

units, thickened peripheral edges to said units, re-entrant grooves in said edges, horizontal ledges on the back faces of said outer wall units, vertical ribs on the back faces of said outer wall units, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, horizontal ledges on the back faces of said inner wall units, vertical ribs on the back faces of said inner wall units, said ledges on said outer wall units and said ledges on said inner wall units being in the same plane, said ribs of said outer wall units and said ribs of said inner wall units being in the same plane, a confining form resting upon said ledges of said outer and inner wall units, confining forms resting against said ribs from said outer wall units and said inner wall units and a mass concrete strengthening frame between said units and upon and within said confining forms.

21. In a building, pre-cast outer wall units, thickened peripheral edges to said units, shoulders to said edges, perforations through said edges from said shoulders, pre-cast inner wall units, thickened peripheral edges to said units, shoulders to said edges, perforations through said edges from said shoulders and a pre-cast floor slab with apertures in said slab between said outer and inner wall units.

22. In a building, supporting pre-cast outer wall units, thickened peripheral edges to said units, perforations through said edges, superimposed pre-cast outer wall units, thickened peripheral edges to said units, perforations through said edges, said perforations through said edges of said supporting and said superimposed units being in alinement, supporting pre-cast inner wall units, thickened peripheral edges to said units, perforations through said edges, superimposed pre-cast inner wall units, thickened peripheral edges to said units, perforations through said edges, said perforations through said edges of said supporting and said superimposed inner wall units being in alinement, a pre-cast floor slab resting upon said supporting outer and inner wall units and beneath said superimposed outer and inner wall units, apertures through said floor slab in alinement with said perforations through said edges of said outer wall units and with said perforations through said edges of said inner wall units, means tying said supporting and superimposed outer wall units and said floor slab and other means tying said supporting and superimposed inner wall units and said floor slab.

23. In a building, supporting pre-cast outer wall units, thickened peripheral edges to said units, perforations through said edges, superimposed pre-cast outer wall units, thickened peripheral edges to said units, perforations through said edges, said perforations through said edges of said supporting and superimposed units being in alinement, supporting pre-cast inner wall units, thickened peripheral edges to said units, perforations through said edges, superimposed pre-cast inner wall units, thickened peripheral edges to said units, perforations through said edges, said perforations through said edges of said supporting and said superimposed inner wall units being in alinement, a pre-cast floor slab resting upon said supporting outer and inner wall units and beneath said superimposed outer and inner wall units, apertures through said floor slab in alinement with said perforations through said edges of said outer wall units and with said perforations through said edges of said inner wall units, means tying said supporting and said superimposed outer wall units and said floor slab, other means tying said supporting and superimposed inner wall units and said floor slab and a mass concrete girder between said outer and inner supporting wall units and said outer and inner superimposed wall units and passing through said apertures in said floor slab.

24. In a building, pre-cast outer wall units, thickened peripheral edges to said units, inner pre-cast wall units, means tying said outer and inner wall units together, ledges on the outer face of said outer wall units and a veneer facing, exterior to said outer wall units and tied to said ledges.

25. In a building, pre-cast outer wall units, thickened peripheral edges to said units, pre-cast inner wall units, thickened peripheral edges to said units, means tying said outer and inner wall units together, ledges on the outer face of said outer wall units, a pre-cast floor slab projecting beyond said outer wall unit and a veneer facing resting upon said floor slab and tied to said ledges.

26. In a building, pre-cast outer wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, a mass concrete frame between said outer and inner units, reinforcing bars in said frame, keys in said grooves of said outer wall units, and other keys in said grooves of said inner wall units, said keys to said outer wall units and said keys to said inner wall units being connected to and slidable upon said reinforcement and embedded in said frame.

27. In a building, pre-cast outer wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, pre-cast inner wall units, thickened peripheral edges to said units, re-entrant grooves in said edges, a mass concrete frame between said inner and said outer units, reinforcing

bars in said frame, keys in said grooves of said outer wall units and other keys in said grooves of said inner wall units, said keys to said outer wall units and said keys to said inner wall units being connected to and slidable upon the same bar of the said frame and embedded in the concrete of the said frame.

28. In a building, pre-cast wall units, comprising a central slab, thickened peripheral upper edges to said slab constituting flanges, side flanges to said slab depending downward from said upper flange and terminating above the lower edge of said slab, vertical ribs depending from said upper flange and terminating above the bottom edge of said slab and bottom flanges to said units terminating inside the vertical edges of said slab.

29. In a building, the combination of inner and outer pre-cast units, re-entrant grooves in said units, keys in said grooves said keys being slidably connected to a reinforcing member of a strengthening frame, horizontal ledges and vertical ribs cast in the back of said units, a confining means supported by and in contact with said ledges and ribs and a mass concrete frame within said units and said confining means surrounding said keys and said reinforcement and entering said grooves.

30. In a building, the combination of inner and outer pre-cast units, producing a cellular type of construction, having thickened edges, shoulders on the back of said edges, perforations through said shoulders and said edges, washers with apertures therethrough in contact with said shoulders, such perforations and apertures being in registration, bolts in said registering perforations and apertures, windows in the body of said units above said perforations, nut housings on the back of said units beneath said perforations, grooves in said units, keys in said grooves, reinforcing members within said cellular construction, said keys being slidably connected to said reinforcing members, horizontal ledges and vertical ribs on the back of said units, confining means supported by and in contact with said ledges and ribs, attachment means projecting from the back of said unit and attached to said reinforcing member and a mass con crete frame within said units and said confining means, surrounding said keys and said reinforcing members and entering said grooves.

31. In a building, the combination of inner and outer pre-cast units, producing a cellular type of construction, having thickened edges, shoulders on the back of said edges, perforations through said shoulders and said edges, washers with apertures therethrough in contact with said shoulders, said perforations and apertures being in registration, bolts in said registering perforations and apertures, windows in the body of said units above said perforations, nut housings on the back of said units beneath said perforations, re-entrant grooves in said units, keys in said grooves, re-inforcing members within said cellular construction, said keys being slidably connected to said reinforcing members, horizontal ledges and vertical ribs on the back of said units, confining means supported by and in contact with said ledges and ribs, attachment means projecting from the back of said unit and attached to said reinforcing member and a mass concrete frame within said units and said confining means, surrounding said keys and said reinforcing members and entering said grooves.

Signed at New York, in the county of New York and State of New York this ninth day of August A. D. 1921.

HERBERT M. KNIGHT.