

Dec. 22, 1936.

Q. TWACHTMAN

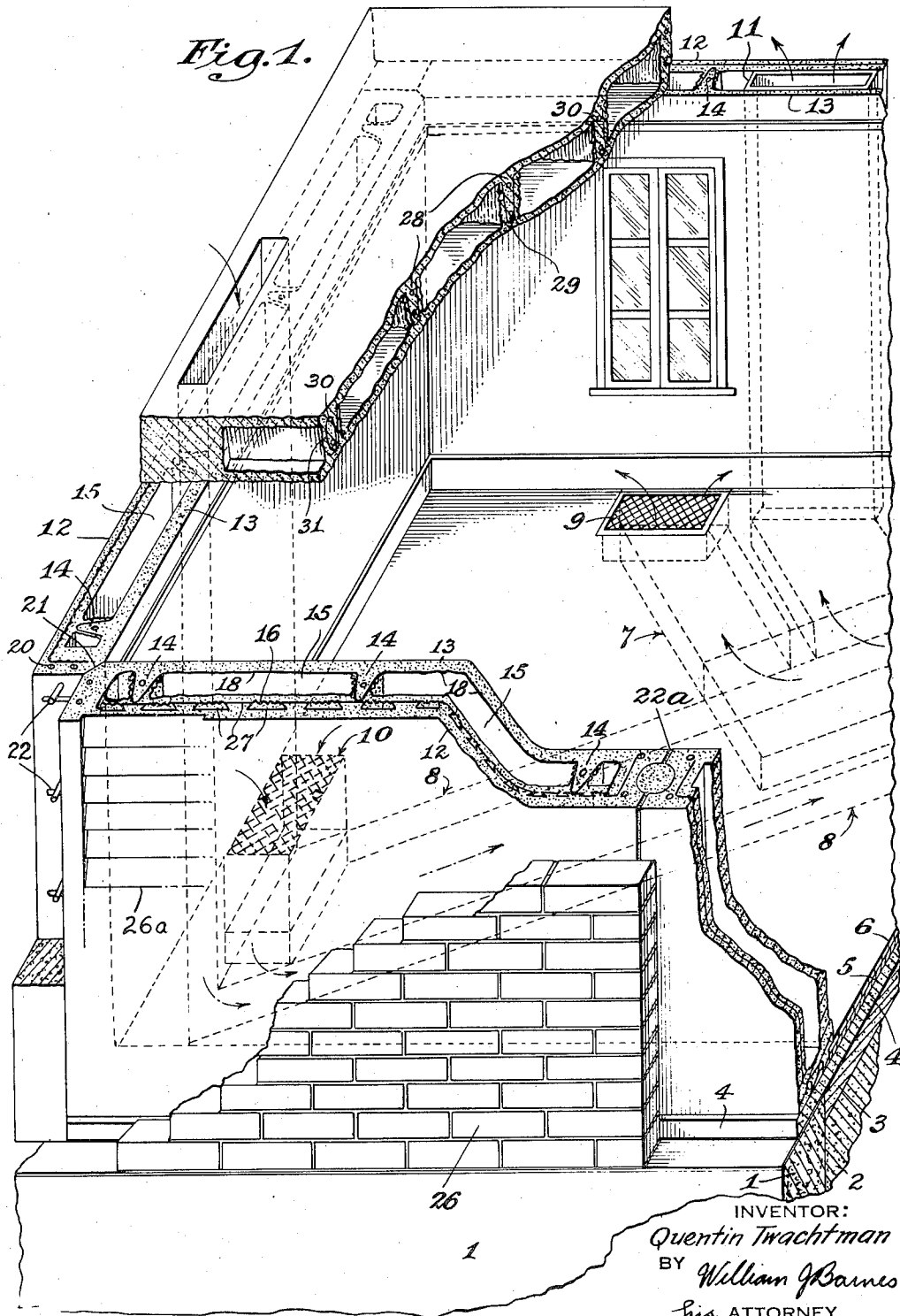
2,065,355

CONCRETE BUILDING CONSTRUCTION

Filed Nov. 27, 1934

4 Sheets-Sheet 1

Fig. 1.



INVENTOR:

Quentin Twachtman

BY William J. Barnes

his ATTORNEY

Dec. 22, 1936.

Q. TWACHTMAN

2,065,355

CONCRETE BUILDING CONSTRUCTION

Filed Nov. 27, 1934

4 Sheets-Sheet 2

Fig. 2.

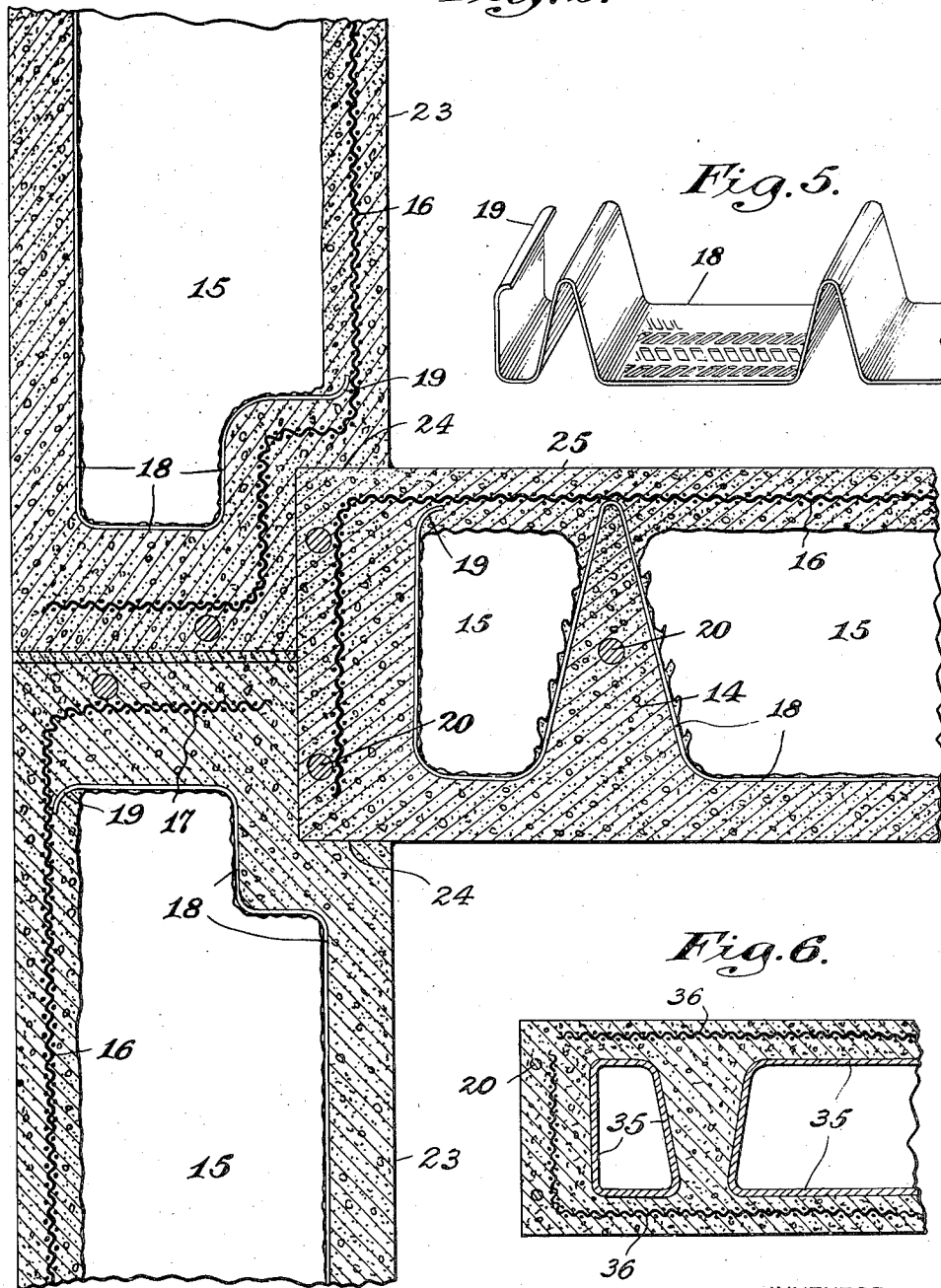


Fig. 5.

Fig. 6.

INVENTOR:
Quentin Twachtman
BY *William James*
his ATTORNEY

Dec. 22, 1936.

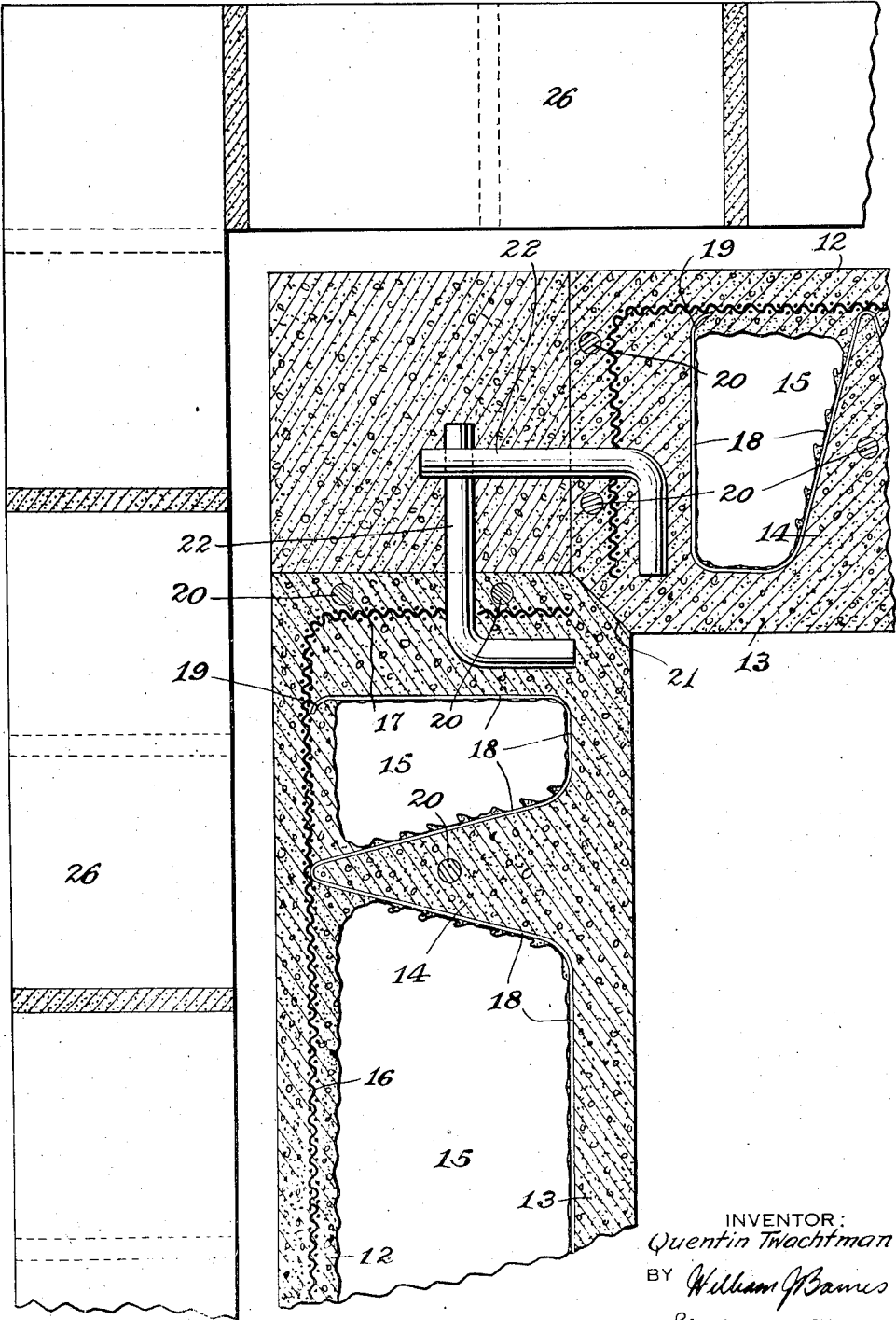
Q. TWACHTMAN
CONCRETE BUILDING CONSTRUCTION

2,065,355

Filed Nov. 27, 1934

4 Sheets-Sheet 3

Fig. 3.



INVENTOR:
Quentin Twachtman
BY *William J. Barnes*
his ATTORNEY

Dec. 22, 1936.

Q. TWACHTMAN

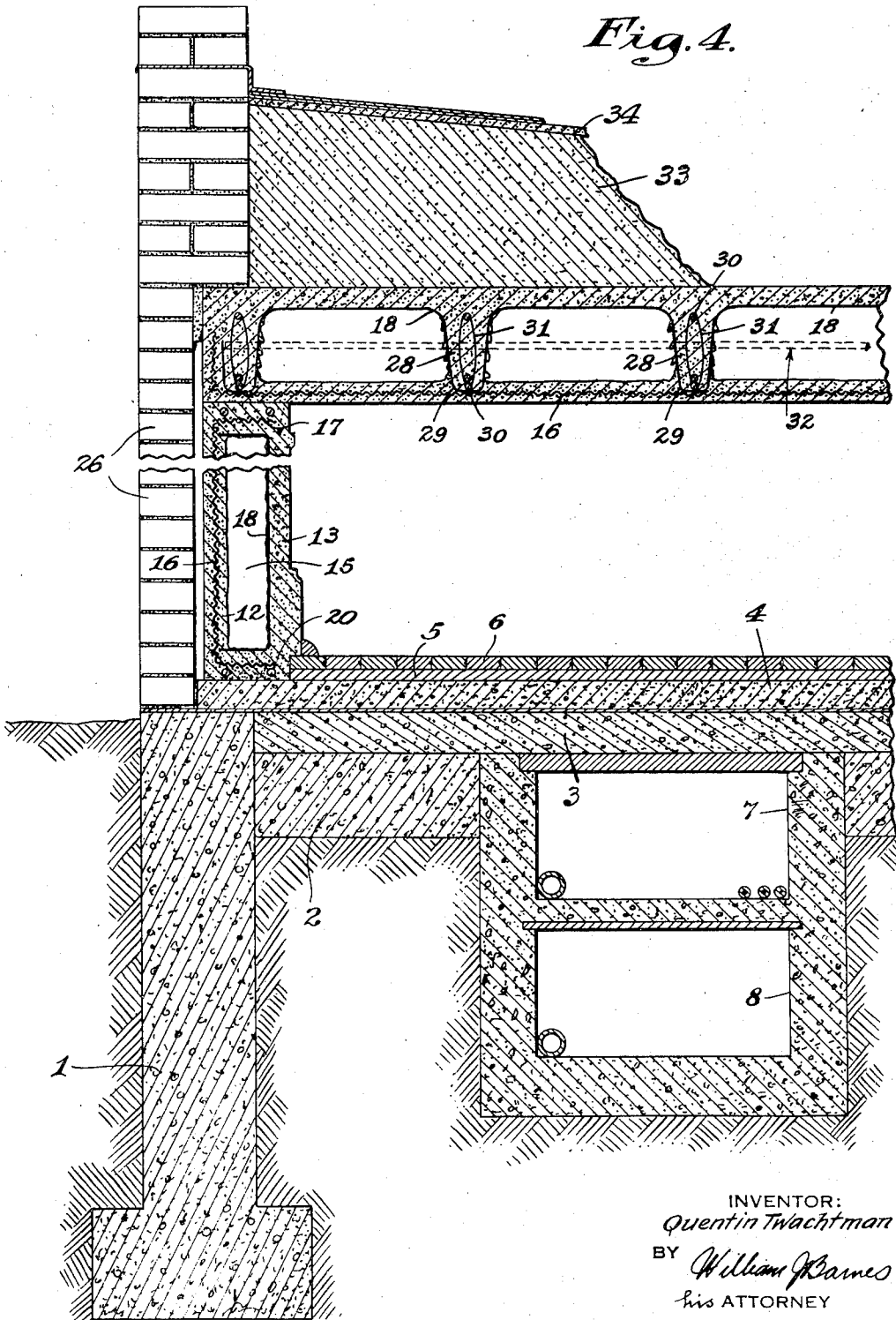
2,065,355

CONCRETE BUILDING CONSTRUCTION

Filed Nov. 27, 1934

4 Sheets-Sheet 4

Fig. 4.



INVENTOR:
Quentin Twachtman
BY *William Barnes*
his ATTORNEY

UNITED STATES PATENT OFFICE

2,065,355

CONCRETE BUILDING CONSTRUCTION

Quentin Twachtman, Greenwich, Conn., assignor
of one-half to William J. Knapp, Rye, N. Y.,
and one-fourth to Gordon Grand, Millbrook,
N. Y.

Application November 27, 1934, Serial No. 754,952

15 Claims. (Cl. 72-42)

This invention relates to improvements in concrete building construction and has particular reference to the construction of concrete houses in which the walls, roof, and floors, may be made of pre-cast concrete slabs, or units, of substantial area, comprising in some instances, for example, an entire wall. The invention also relates to the method of precasting such slabs and erecting the building.

It has heretofore been proposed to erect concrete houses using pre-cast slabs to form the walls, but such proposals have not met with success for various reasons. In some instances these slabs have been double walled structures of very complicated design necessitating the use of intricate, and usually impracticable, cores to form the spaces between the walls. The labor called for to construct such slabs has materially increased building costs. Because of the design thereof, difficulty has also been encountered in transporting such slabs from the place of pouring to the building site. Upon the erection of such slabs considerable labor was required in providing the necessary finishes to the exterior and interior walls.

For these and other reasons, the use of pre-cast concrete elements for the construction of buildings has not been commercially feasible up to the present time. Nevertheless, the advantages resulting from the use of pre-cast concrete slabs, such as low initial building costs and lessened depreciation, heat insulation, water, fire and vermin proofing and other advantages, have been long known and have resulted in these prior, but unsuccessful, attempts to use this type of construction.

An important object of the present invention is to provide an improved type of building construction which is particularly adapted to the erection of concrete houses in which the structure above the foundation comprises, to a large extent, pre-cast slabs, or units of concrete of substantial area.

Another object of this invention is to provide such slabs, or building elements, of a double wall cross section with integral connecting studs, or webs, providing dead air spaces between the outer and inner walls which may be used as heating and ventilating ducts and in which the usual electric wiring, water pipes etc. may be run.

A further object is to provide an improved method of pre-casting such slabs or wall sections whereby the desired molding, baseboards, window frames, door hinges, registers, and other hardware, if desired, may be cast integral with the

slab. Electric wiring and piping may also be inserted in this wall structure during the pouring operation. The method of making such slabs, or building elements, also provides exterior and interior wall designs as desired, and such walls may be given an extremely smooth surface which is satisfactory for the application of paint or other decorative material, without further treatment.

A further object is to make these slabs of such design that although a single slab may compose an entire wall of the building, the slab may be pre-cast in a relatively short time with inexpensive labor and simple equipment. The hollow structure of such slabs is shaped by forms, simple in design, which are allowed to remain in the finished slab. The strength of such slabs is not dependent upon the existence of such forms therein so that should these forms deteriorate in time the slabs will not be weakened thereby. The slabs are reinforced in such a way that even though they are considerably lighter than those heretofore made they possess the necessary structural strength and permanence and are less likely to be damaged in transportation to the building site. These slabs are also nailable so that brick veneer, clapboard etc. may be readily attached thereto to form the exterior surface, if desired.

Another object is to provide an improved arrangement for waterproofing the walls of the building.

Still another object is to provide an improved foundation in which the necessary wiring, piping, heating and ventilating ducts may be located for association with the corresponding parts in the wall structure.

With these and other objects in view the present invention will now be described as applied to house construction, reference being made to the accompanying drawings, in which:

Fig. 1 illustrates a portion of a house showing various structural elements and certain details of construction,

Fig. 2 is a horizontal sectional view through adjoining slabs showing the construction thereof and one way of uniting adjacent slabs and joining an abutting interior partition or wall thereto,

Fig. 3 is another horizontal section through an exterior corner of the building showing among other things, one method of connecting the wall structures,

Fig. 4 is a vertical section illustrating principally the foundation and roof constructions,

Fig. 5 illustrates a sheet of expanded metal lath

which is preferably used to form the studs and one wall of a slab, and

Fig. 6 is a partial sectional view of another form of slab.

5 The construction of the house will now be described more in detail, beginning with the foundation, as more clearly shown in Figs. 1 and 4. No cellar is shown, but of course many, if not all, the features of the present type of construction
10 may be employed in a house which has a cellar. The exterior walls of the house, and if desired, certain of the interior walls, may be supported upon concrete footings 1. The foundation between these footings and the floor above may consist of the following, beginning at the bottom, viz:
15 a layer of gravel 2, a layer of concrete 3 which is preferably covered with asphaltum, or other water proofing material, a layer of relatively light weight concrete 4, which is provided with a smooth, level surface for the floor, a mastic 5 to which a suitable flooring such as wood 6, linoleum, or other material, may be applied. In cases where it is desired to heat or to ventilate the house by circulation of conditioned air, hot and cold air
20 ducts are provided in the foundation or under the floor. These may be formed as shown in Fig. 4, the hot air duct 7 being above the cold air duct 8. These ducts communicate with central heating and ventilating apparatus which may be located, for example, in an attached garage. The
25 ducts extend to hot and cold air registers, 9 and 10, respectively, located in the floors or walls, as desired, of the various rooms.

35 In buildings two or more stories in height, these ducts may communicate either with similar ducts located in the wall slabs as shown at 11 in Fig. 1, or the conditioned air may flow through the spaces between the studs of such slabs. As shown in Fig. 4, the necessary service pipes, such as
40 water, gas, etc., and the electric wiring may be located in these ducts.

The construction of the slabs which make up the walls of the building and the method of making such slabs will now be described. These slabs
45 may be of concrete made from a mixture of gravel, sand, cement and water in accordance with the usual practice. However, it is preferable to substitute for the gravel and sand, a lighter aggregate which will reduce the weight of the slabs considerably without materially reducing their
50 strength. Such reduction of weight is an important factor in transporting the slabs. It is also desirable that such material should produce a slab which will be nailable. As the present time there are available a number of cellular mineral aggregates which are satisfactory for this purpose. A
55 suitable material is obtained by a process which involves the quenching of blast furnace slag while it is at high temperature. A further advantage of such materials, discovered in a house built according to the present invention, is that the slabs possess desirable accoustical properties, possibly due to the porosity of the aggregate used. When
60 reference is herein made to a "concrete" slab it will be understood that the use of such material as just described, is preferred, in making the "concrete" mixture.
65

70 The length of these slabs preferably corresponds to the height of the room and the width is such that one or two slabs are sufficient to form a wall of an average size room. The construction of a wall slab is shown in Fig. 3 as comprising an exterior wall 12 and an interior wall 13 between which integral webs or studs, 14 extend to hold
75 these two walls in spaced relation. These webs

are spaced a suitable distance apart to afford the necessary structural strength to the slab and divide the space between the walls of the slab into a number of air spaces 15 which may act as "dead" air spaces for heat insulating purposes. Such spaces also may conduct heating and ventilating air, as previously described, with or without separate ducts therein. Electric wiring and service piping may also be located in these spaces.

10 The walls of the slabs are provided with reinforcing material such as wire mesh, or lath, or other suitable material. In some instances it may be advisable to incorporate this reinforcing material in both walls of the slab but ordinarily putting it in either the outer or inner walls will
15 be sufficient. As shown in the drawings, the outer wall 12 of the slab is reinforced by such suitable means 16, which is bent at the ends, as indicated at 17 in Fig. 3, to reinforce each end of the slab. The inner slab wall 13 is spaced away from the outer wall 12 by the connecting webs, or studs, 14. As will be described hereinafter, this inner wall and the studs are poured in a form 18, illustrated in Fig. 5, which is conveniently made
20 of expanded metal lath, or, as it is sometimes called, herringbone wire lath. At the end of each slab this lath 18 is bent around as indicated at 19 and serves as the form for the ends of the slab also. The studs 14 are preferably wider next to one slab wall to facilitate pouring and may be substantially triangular in section, as illustrated. They may be formed by V-shaped depressions in the lath 18 at the desired places across the slab. After a slab has been poured, this expanded metal lath remains in place, being secured by the concrete mixture which protrudes through the openings in it, particularly in the studs, as represented in Fig. 3. Thus the double walled structure of a slab may be formed by very simple means instead of the complicated coring means heretofore used. Even if the lath 18 should deteriorate in time this will not weaken the slab because the lath is not used as reinforcing means but merely as the interior form during the pouring operation. Additional strength is given to each slab by reinforcing rods 20 in the studs and near the outsides of the slab, the latter rods preferably extending entirely around the slab.

25 A preferred method of molding such slabs, or wall sections, will now be described. Contrary to the more usual practice, the slabs of the present invention are poured or cast on a large, flat surface. A form of the same area as the desired slab is placed upon this surface and the reinforcing material 16, such as wire mesh, is placed therein. It will, of course, be understood that the necessary openings for doors and windows will be formed by the frames therefor, properly situated in the mold. A layer of concrete corresponding in thickness to one of the slab walls, for example, the outer wall 12, is placed on top of the reinforcing material 16 which is now lifted into this layer of concrete, preferably about half way. The lath 18, or other material for forming the outer wall of the slab, for example, the inner wall 13 and the studs 14 is now placed in the mold. In using lath shaped as shown in Fig. 5, the apexes of the V-shaped depressions in this lath are buried in the layer of concrete so that the wider sections of the studs are upward which facilitates the pouring of the concrete therein. These V-shaped depressions are filled with relatively wet concrete and the mold is then vibrated so as to force the concrete through the perforations at the lower ends of these depressions into intimate contact with the previously
75

poured layer of concrete. This produces studs integral with the slab wall already poured. During the pouring of the studs the reinforcing rods 20 are put in position. Thereafter the concrete forming the other wall, for example, the inner wall 13 of the slab, is poured on top of the lath 18. This may be a somewhat drier mixture of concrete as compared with the concrete for the studs.

The slab thus formed has not been provided with either exterior or interior finished surfaces. When it is desired to provide the slab with the required exterior wall finish the following additional steps are preferably employed. A layer of concrete is poured in a second form, the surface of which is provided with the desired configurations which may be made to resemble clapboards, shingles, or other exterior house design. This second mold may be then vibrated for a short period of time to produce an extremely smooth exterior surface if this be desired. After this vibration, the wall slab previously poured, and which has been allowed to set to some extent at least, is placed in contact with the concrete in the second mold and is bonded thereto.

It will be understood that where it is desired to provide a slab with a certain interior wall design the bottom surface of the first mold may be provided with the necessary configuration for moldings, baseboards and other trim. In this case it would be desirable to vibrate the mold after pouring the first layer of concrete. Vibration of the concrete forming the walls has been found to produce a surface sufficiently smooth to receive paint or other decorative material without further treatment.

It is desirable to cast hardware, such as metal window frames, door hinges and heating and ventilating registers, in the wall slabs which may be readily done during the pouring operations. Likewise any piping or wiring which it is desired to run through a slab or wall section may be placed between the studs during the pouring operations.

Referring now more particularly to Fig. 1 it will be observed that the walls of the building comprise a number of slabs set in place on the foundation to form the various rooms. Where the slabs have been provided with the desired moulding, baseboards, hardware, etc., during the precasting, the erection of these slabs leaves very little to be done in finishing a building. One method of connecting slabs at a corner is shown in Figs. 1 and 3. The end of each slab is beveled as indicated at 21 and these beveled surfaces are placed in contact. Reinforcing rods 22 of the form shown, or other suitable design, which have been cast in each slab are preferably wired or otherwise fastened together. The corner is then built up of concrete or other suitable material, as shown in these figures. Adjoining slabs in a straight wall may be united as indicated at 22a in Fig. 1, the circular opening between the slabs being filled with concrete. One method of supporting an interior wall or partition is shown in Fig. 2. Here the adjacent wall slabs 23 have been formed with cooperating recesses or grooves 24 adapted to receive the interior wall, or partition, 25.

As shown in the drawings, a brick veneer 26 may be applied outside the wall slabs. Such brickwork may be secured to the wall slabs by nails since these slabs when made of the material referred to are readily nailable. Suitable waterproofing material such as asphaltum, or roofing paper, may be applied to the outside surface of the wall slabs before the brick veneer is laid.

In some constructions it may be undesirable to

apply a brick veneer or other coating outside the wall slabs. In such cases the outsides of these slabs, as previously described, may be cast to resemble shingles, clapboards 26a, or other desired exterior finish. It now becomes advisable to provide means for water-proofing these slabs in such a way as not to mar their appearance. It has been found that a layer of roofing paper or other water-proofing sheet material may be placed in the outside wall of a slab as indicated at 27 in Fig. 1. It will be noted that the paper is arranged so as to cause the concrete on either side of it to form an alternate series of interlocking keystones thus holding the concrete portions on opposite sides of the paper securely together. When precasting slabs with such water-proofing material, the latter is placed in the mold before the reinforcing lath 16, and the slab cast on top of it. A desired exterior surface is thereafter united to the slab through the interlocking connections in the water-proofing paper. The other surface of the slab may have bonded to it a desired interior wall design.

The slabs may also be water-proofed by impregnation with paraffin.

The construction of floor or roofing slabs is shown in Figs. 1 and 4. These slabs, in general, are similar to the wall slabs but usually it will be found necessary to make them of somewhat stronger construction. Accordingly the internal webs, or studs, 28 are thicker than in the case of the wall slabs, which arrangement is readily obtained by bending the expanded metal lath slightly differently as shown at 29. Additional reinforcing rods 30, preferably secured by wiring 31, are cast in the webs 28. Reinforcing rods 32 may extend around the circumference of the slabs.

If desired, the roof slabs may be so placed on the walls as to form a sloping roof. In general, however, it will be found more convenient to lay the roof slabs flat on the walls. In this case the roof must be provided with sloping surfaces to afford drainage. This may be done by laying a mixture of cinders 33 and dry cement on the roof slabs and properly grading this layer. In a short time, this mixture will "air harden" and retain its grade. On top of this mixture is a layer of cement 34 covered with asphalt or other waterproofing material.

Instead of using a continuous strip of metal lath to form the studs, as previously described, separate forms 35, as illustrated in Fig. 6, may be used. These forms may also be of wire lath, paper or wood, as desired. It will be advisable in most cases to provide suitable reinforcement 36 in each slab wall. In this arrangement, as in that described above, the studs are thicker at one end to facilitate pouring, but may be made with parallel sides, or otherwise, if desired.

What is claimed is:

1. A pre-cast concrete slab comprising an outer wall with reinforcing material therein, an inner wall connected to said outer wall by integral webs spaced at intervals across said slab to form a substantially hollow structure, said webs being of largest cross sectional area where united with said inner wall and located within a form adapted to remain within the slab, said form being perforated and extending within said outer wall substantially to the reinforcing material therein, said webs being united with said outer wall through the perforations of said form.

2. A hollow, pre-cast, concrete wall slab comprising an outer wall and an inner wall, said walls being connected by integral studs spaced at

intervals across the interior of said slab and formed by sheet material cast in said slab and extending into one of said walls, the studs being wider adjacent the other wall, folded waterproofing sheet material cast in one of said walls to form interlocking sections of concrete on opposite sides of said last named material.

3. A pre-cast concrete building element comprising an outer wall with reinforcing material therein, an inner wall connected to said outer wall by integral webs spaced at intervals across said element to form a substantially hollow structure, said webs being of largest cross-sectional area where united with said inner wall and located within a form adapted to remain within the element, said form being perforated and extending within said outer wall, said webs being united with said outer wall through the perforations of said form, waterproofing material in one of said walls formed so as to provide interlocking layers of concrete on opposite sides of said material.

4. A double-walled concrete slab comprising a form provided with deformed portions between which are located webs integrally connected to the two spaced walls, said form being also provided with intermediate portions adapted to support one of said walls while said slab is being poured.

5. A double-walled concrete slab comprising a continuous sheet-form located within the slab and provided with a series of depressions projecting into one of said walls, studs lying within said depressions and integrally connected to the two spaced walls, said form having substantially flat surfaces between said depressions adapted to support the other of said walls during the pouring of the slab.

6. A double-walled concrete slab comprising a form having deformed perforated portions in which are located webs integrally connecting the two spaced walls, said webs being connected to one of said walls through the perforations, said form having intermediate portions adapted to support the other of said walls during the pouring of the form.

7. A pre-cast double-walled concrete slab comprising a substantially continuous sheet-form provided with a series of perforated depressions projecting into one of said walls, concrete studs located within said depressions and integrally connecting the two spaced walls, said studs being connected to one of said walls through the perforations, substantially flat surfaces between said depressions adapted to support the other of said walls during the pouring of the slab.

8. A horizontally pre-cast double-walled concrete slab comprising a substantially continuous sheet-form provided with a series of divergent depressions projecting into one of said walls, studs located in said depressions and integrally connected with the spaced walls, said studs being substantially wider where connected to the other of said walls, substantially flat surfaces on said form between the said depressions, adapted to support the last named wall during the pouring of the slab.

9. A horizontally pre-cast double-walled con-

crete slab, comprising a form provided with divergent perforated portions, webs within said portions and integrally connected to the two spaced walls, said webs being connected to one of said walls through the perforations and being substantially wider where connected to the other of said walls, said form having intermediate substantially flat portions adapted to support the last named wall during the pouring of the slab.

10. A pre-cast double-walled concrete slab comprising a substantially continuous sheet-form provided with a series of divergent perforated depressions extending into one of said walls, studs located within the said depressions and integrally connected to the spaced walls, said studs being connected to one of said walls through the perforations and being substantially wider where connected to the other of said walls, said form having substantially flat intermediate portions between the said depressions adapted to support the last named wall during the pouring of the slab.

11. A double-walled horizontally pre-cast concrete slab comprising studs integral with each of the walls, said studs being wider where joined to one of said walls and positioned within a form through perforations in which said studs are united with the other of said walls.

12. A horizontally pre-cast double-walled concrete slab comprising a continuous form, perforated and provided with depressed portions, studs positioned within said portions and integrally connected to the spaced walls, one of said walls comprising interlocking sections of concrete, waterproofing material between said sections and substantially flat intermediate surfaces between the depressed portions adapted to support the other of said walls during the pouring of the slab.

13. A pre-cast concrete slab comprising two spaced walls connected by concrete studs integral with each wall and having their greatest cross sectional areas where united to one of said walls, said slab embodying a form having surfaces adapted to support the last mentioned wall in spaced relation from the other wall during casting of the slab and depressions between said surfaces extending into that other wall and in which the studs are positioned.

14. A pre-cast concrete slab comprising two spaced walls connected by concrete studs integral with each wall and having their greatest cross-sectional areas where united to one of said walls, said slab embodying forms having a plurality of successive substantially flat surfaces adapted to support the last mentioned wall in spaced relation from the other wall during casting of the slab, and said studs being located between such successive surfaces.

15. A pre-cast concrete slab comprising two walls spaced apart by integral studs, said studs and one of said walls being positioned upon a substantially continuous sheet-form having the stud-forming portions imbedded in the opposite wall and having other portions at the ends also imbedded in said opposite wall and adapted to support the edges of the slab during casting.

QUENTIN TWACHTMAN.