July 8, 1947. L. A. FALCO 2,423,695

BUILDING STRUCTURE

Filed April 26, 1944 2 Sheets-Sheet 1

Fig. 1.

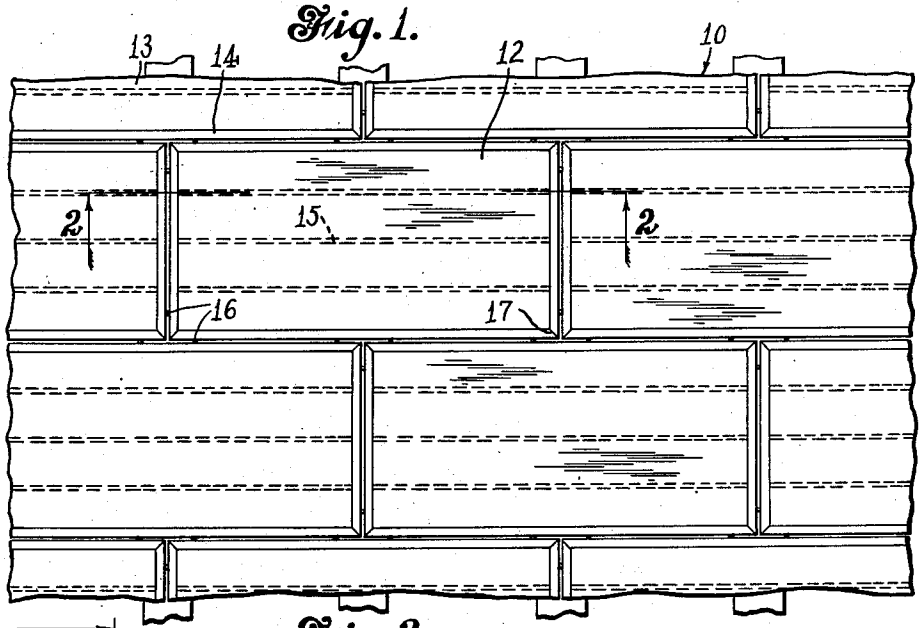


Fig. 2.

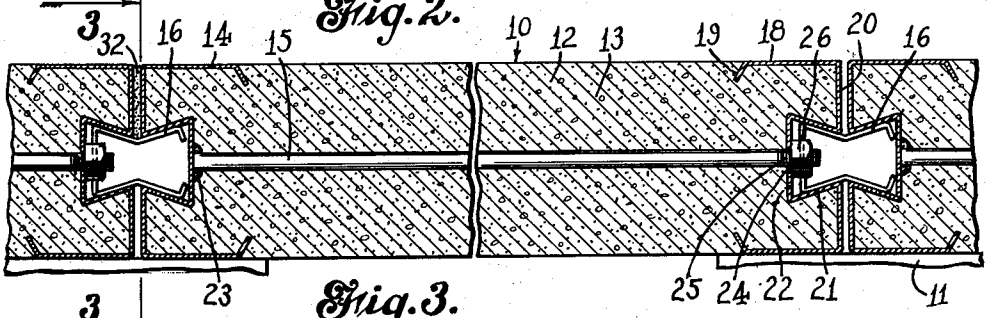
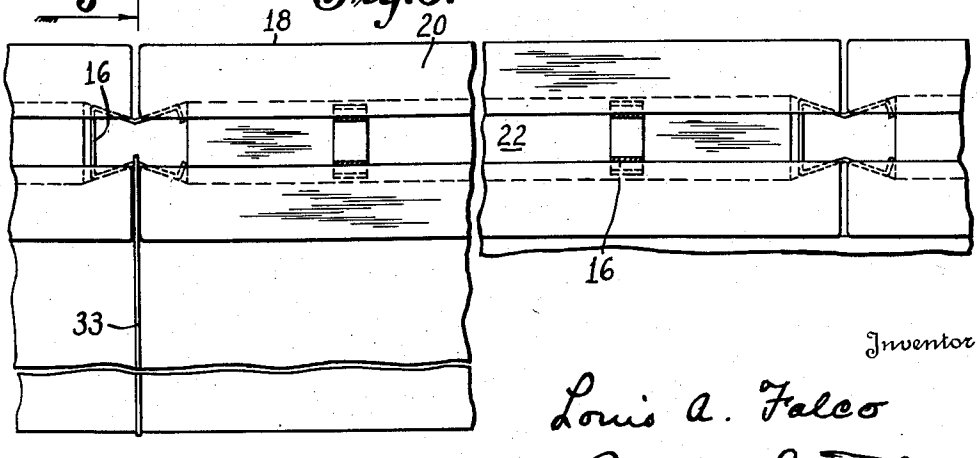


Fig. 3.



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July 8, 1947. L. A. FALCO 2,423,695

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Filed April 26, 1944 2 Sheets-Sheet 2

Fig. 4.

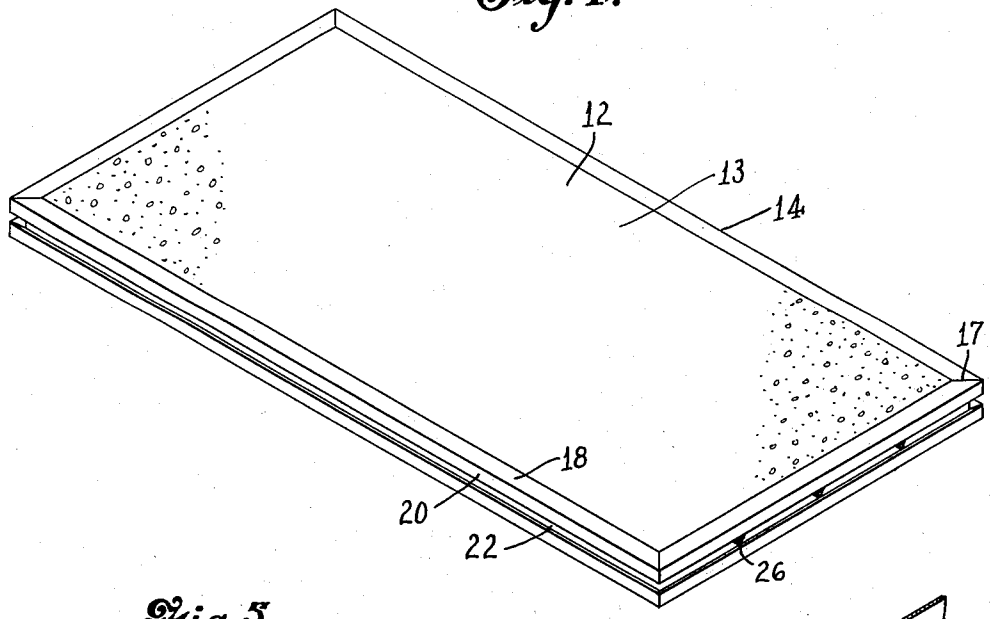


Fig. 5.

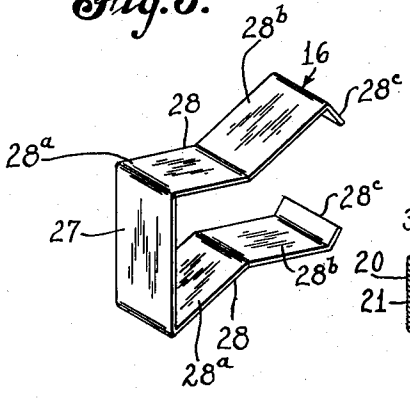
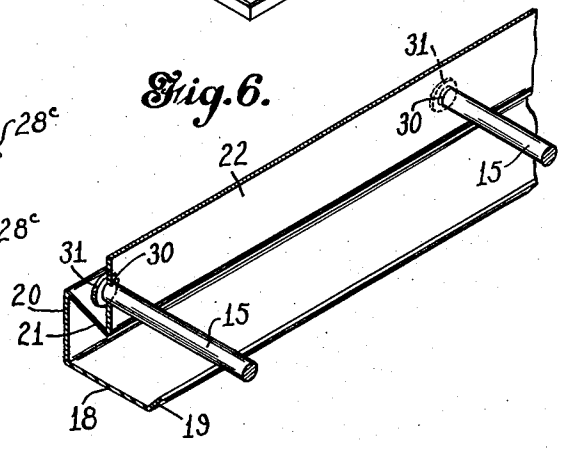


Fig. 6.



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UNITED STATES PATENT OFFICE

2,423,695

BUILDING STRUCTURE

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Application April 26, 1944, Serial No. 532,699

1 Claim. (Cl. 72—68)

1

This invention relates to building structures and, more particularly, to structures of the type of floors or roofs comprising a number of units in the form of slabs. The invention, however, has particular application to floors, roofs, and other building elements where the slabs are of reinforced concrete or like cementitious material and where they are of relatively small size so as that they can be easily carried from place to place and easily laid in position when they are used as units of flooring or the like.

Small concrete slabs have, of course, been used for flooring. The ordinary concrete slab, however, has the serious disadvantage that, in handling the same, great care must be exercised to prevent breaking or chipping, particularly at the edges. The breaking and chipping is also likely to occur after the unit has been laid or installed. The ordinary slab is also lacking in structural strength. Such slabs have been reinforced with steel reinforcing elements, but the reinforcements used in the past have been too expensive, or ineffective for the contemplated purposes, or have been open to other objections.

One of the objects of the present invention is to overcome the disadvantages and drawbacks of prior structures of the class to which reference has been made.

Another object is to provide a building floor, roof, or the like in which provision is made for the expansion and contraction of the units under the effects of temperature changes and the like; and it is particularly desired to prevent the structural part from becoming humped or buckled as a result of the expansion of the units.

Another object is to provide an improved unit marginally reinforced with metal, lending itself to easy installation and having provisions whereby it can be interlocked with adjacent units very readily and in a manner to permit expansion and contraction without injurious effects.

Another purpose of the invention is to provide an improved unit having an embedded reinforcement of metal which is light and cheap and which acts effectively in increasing the load-carrying capacity.

To these and other ends, the invention consists in the novel features and combinations of parts to be hereinafter described and finally pointed out in the claim.

2

In the accompanying drawings:

Fig. 1 is a fragmentary plan view of a structural member such as a floor embodying my improvements, showing the floor as it appears before the joints are closed;

Fig. 2 is an enlarged section on line 2—2 of Fig. 1, but with the joint at the left hand side closed by the use of filling material;

Fig. 3 is a section on line 3—3 of Fig. 2, the filling material being omitted;

Fig. 4 is a perspective view of one of the slabs;

Fig. 5 is an enlarged perspective view of one of the clips by which the units are interlocked; and

Fig. 6 is a detail showing a somewhat modified form.

In illustrating the invention, I have shown by way of example a portion of what may be assumed to be a concrete floor. This floor comprises a reinforced concrete layer or body formed by laying on a suitable foundation a number of reinforced concrete slabs or, as they may be termed, reinforced concrete planks. These units are of a character to enable them to be readily transported, handled, and laid in place, and with that in view the unit is preferably relatively shallow in depth and is also preferably narrow, being of greater length than width. It is considered desirable to provide a unit in a stock width and to provide the unit in several different lengths, the shortest of these lengths being the one illustrated in the drawings by way of example. For purposes of explanation, it may be said that the unit illustrated in the drawings has a depth of one and one-half inches, is sixteen inches wide, and has a length of thirty-two inches, but it is of course understood that the invention is not limited to any particular dimensions. The body of the unit is constructed of concrete and, in the form shown, the unit has a reinforcement of relatively thin sheet metal extending around all four sides. Also, the unit in the form shown is reinforced by the employment of embedded reinforcing rods, in the manner hereinafter described.

In Figs. 1, 2, and 3, the floor is shown, and in these views the layer of concrete slabs or planks is indicated at 10 while, at 11, is indicated a suitable support of any appropriate character serving as a foundation, upon which the planking is laid.

The support may, for example, include suitable beams. The planking comprises a number of units 12 of the kind previously mentioned, each unit having in this instance a relatively shallow concrete body 13 provided on all four sides with a metal binding 14. Interiorly, the unit is preferably provided with longitudinal reinforcing means which may comprise longitudinal reinforcing rods 15 embedded in the concrete. The metal binding around each of the units is, as hereinafter described, of a character to provide locking grooves extending around the units, and the units are interlocked by means of a number of locking elements 16 which engage in these grooves.

The metal binding around the unit is of thin sheet metal and this binding is preferably rolled or otherwise formed to give it the desired profile, and is then made up into a rectangular rim into which the concrete 13 is cast. The rolled sheet metal strip provided for binding purposes may, if desired, be cut to provide four separate portions to extend along the respective margins of the slab, these portions being separated from each other by open joints as indicated for example at 17 in Fig. 4. As best shown in Fig. 2, the binding strip has, at each horizontal face of the unit or slab, a marginal portion 18 which is flush with the face of the slab, the free edge of this marginal portion being bent as indicated at 19 so as to lie within the concrete. At the edge of the slab or plank, the metal binding includes planar portions 20 defining the edge of the slab, and between these portions is an inwardly bent or depressed portion 21 which is of dovetail cross section, the bottom of the dovetail groove thus provided being formed by a metal portion indicated at 22. In this manner there is provided a metal-bound dovetail groove, preferably in the median horizontal plane of the slab, extending throughout the entire periphery of the slab, said groove being deeper at its bottom or inner portion than at its mouth and being adapted to receive the locking devices 16 above mentioned. The reinforcing rods 15 above mentioned extend between and interconnect the inner portions or bottoms of the dovetail grooves which are provided at the respective ends of the unit. In the form shown, there are three of these rods, but the number can be varied if desired. In the form shown, there is a central rod running longitudinally of the slab and, between this central rod and each side margin of the slab, another rod is employed in an intermediate location. In the form shown in Fig. 2, the lefthand end of the rod 15 is secured to its base member by welding, as indicated at 23. At the opposite end of the rod, the same extends through a perforation 24 in part 22, and the end portion of the rod is threaded as shown at 25, and, within the dovetail groove, the rod is provided with a nut 26 which is adapted, when screwed up on the rod, to tension the same.

For the purpose of interlocking the slabs, the devices 16 are used, and while these may be of various forms it is preferred to have them of the nature of bent sheet metal clips as in the example illustrated. In Fig. 5, one of these clips is shown. Fig. 1 illustrates, in a general way, the manner in which the clips can be located for interlocking the slabs, but this is only one example, and various other arrangements and locations of the clips can be employed. In the arrangement of Fig. 1, the slabs or planks are in staggered rows and at the ends of the slabs interlocking is effected by two of the locking devices 16 spaced from

each other; and along the sides of the slabs, four of the locking devices are used.

In the preferred form of sheet metal clip shown in Fig. 5, the clip is constructed of a sheet metal plate bent to provide a dovetail portion at one end to engage a groove of one slab, and a dovetail portion at the other end to engage a groove of the adjacent slab. Generally speaking, the clip is in the shape of a U having resilient legs or branches, each leg or branch being bent in order to give the clip the desired shape. In the drawings the connecting portion of the clip is shown at 27, and the resilient legs at 28, each leg having a portion forming part of a dovetail 28^a to engage the groove of one slab, and a similar portion 28^b adapted to engage the groove of the adjacent slab. At the free ends of the portions 28^b the clip has inclined lips 28^c. It will be noted that the width of the clip is less than the width of the mouth of the groove in the slab, so that, with its free extremities rearmost, the clip can be introduced into the groove and then turned through 90° so that the dovetail portion 28^a will be in engagement with the dovetail of the groove, leaving the dovetail portion 28^b projecting out of the groove. By the use of a wire or other instrument the clip can then be slid along the groove to the desired location. Another slab can then be placed in position alongside the first, and can be locked to the first slab. The leg portions of the clip providing the dovetail 28^b may be compressed to facilitate the assembly, or the second slab can be forced against the lips 28^c in such a manner as to compress the clip as the second slab is advanced toward the first. When released the leg portions providing the dovetail part 28^b spring out into the groove of the second slab for interlocking purposes in a manner which will be readily apparent.

An important feature of the present invention consists in the provisions whereby expansion and contraction are permitted at the joints between the units so as to overcome trouble from the bulging of the floor, roof, or the like, under the effects of temperature changes. As initially set, the slabs or planks, instead of being closely abutted against each other, have intervening spaces allowing for expansion. These spaces may be say of the order of 1/16". Such an arrangement is shown in Figs. 1, 2, and 3 of the drawings. Obviously, it is necessary that the locking clips or other interlocking devices be of a character to permit the slabs to be spaced in this manner. As shown in Fig. 2, the ends of adjacent slabs are slightly spaced apart, and it will be noted that when the parts are in this position, each clip has its dovetails in full engagement with the side walls of the corresponding grooves in order to resist further separation of adjacent slabs, although separation up to a certain limit, say 1/16", is carefully provided for, for the important reason above given. With such a setting, it will be understood that considerable expansion of the slabs can take place without causing any bulging or heavy strains.

In manufacturing the slab or plank, the metal binding is arranged to form an enclosing frame, in the manner previously described, and the filling material (which is preferably concrete) is cast into the frame, the frame being held in a suitable form. The steel reinforcement, comprising the rods 15, is placed in position before the concrete, but the nuts 26 are not set up tightly and therefore the rods are not subjected at this stage to tension. After the concrete has had its initial

set, of say from twenty-four to forty-eight hours, the rods are brought up to tension by screwing up on the nuts, which can be readily done by inserting a small wrench of suitable character into the groove in which the nuts are located. By screwing up on the nuts at this stage, the rods are pulled up, the reaction being against that part of the metal binding to which the rods are anchored at their other ends. The rods being under tension, and the slab being under compression in its plane by virtue of the metal binding portions in and around the concrete at the respective ends of the slab being urged toward each other by the tensioned rods, the load-carrying capacity of the slab is greatly increased as compared to a slab lacking such reinforcement. Yet, on the other hand, the amount of steel required in bringing about the very advantageous result which is obtained is comparatively small.

Another advantage arises from the fact that, with bindings on the long sides of the slab, the reinforcing rods or wires can be of a minimum number. In this respect, the arrangement of the rods in the manner shown in the drawings, that is to say the employment of a central rod with a rod on each side of it arranged in the manner shown, is of distinct advantage.

It is of course to be noted that, in a construction such as described, the metal bound grooves in the slabs provide not only for the reception of the locking devices but also for the mounting of the longitudinal reinforcing elements. These longitudinal reinforcing elements, by interconnecting the bottoms of the grooves, are of less length than would be required otherwise. On the other hand, the compressive effect on the filling material, brought about by tensioning the longitudinal reinforcing elements, is very substantial owing to the fact that because of the channeled form of edge binding employed, extending practically the full thickness of the slab, the compressive effect on the slab is transmitted throughout its full depth or thickness.

In the modified form shown in Fig. 6, the reinforcing rods, instead of being welded to the groove lining at one end of the slab, are threaded through perforations **30** in such lining and are held in fixed relation to the lining by heads or lugs **31**.

As previously stated, the locking clips or like devices, used for interlocking two slabs either at the ends or at the sides, cooperate with the dovetail grooves in such a manner as to permit a predetermined separation of the slabs from each other, although resisting any further separation. The locking devices can be used at any point in the length of a slab, and, except for the location of the nuts, at any point in the width of a slab. It is obvious, however, that the locking devices may be used, if desired, only at the ends of the slabs or only at the sides, as certain forms of slabs which are not bound and/or grooved all the way around are within the contemplation of the invention.

It is apparent, of course, that the structure as shown in Fig. 1 is open at the joints and is therefore not waterproof, but it is within the contemplation of the invention to make the structure waterproof where necessary or desirable, by the employment of a suitable filling material such as indicated at **32** in Fig. 2. Such material might be an asphaltic material or mastic which would make the joints leakproof but at the same time permit expansion and contraction.

It will be understood that, owing to the resilient character of the clips used for interlocking the slabs, the clips, after being placed in the desired longitudinal positions in the grooves, will be retained in those positions, the clip being of a nature to resist to a sufficient extent movement longitudinally of the groove. The spring action of the clip causes the latter to be held upright, that is to say, in the position of the sectioned clips in Fig. 3, with the spring fingers projecting out of the groove, while the adjacent slab is placed in position. When the building is in the course of erection, displacement of the slabs relatively to their underlying supports can be prevented, if desired, by fastening certain of the clips **16** to the underlying support in any suitable manner. As an example of this, there is shown at the left of Fig. 3 a wire **33** having its upper end entered between two adjacent slabs and hooked over one of the clips, the lower end of the wire being suitably secured to the underlying support, as by being looped around one of the supporting elements **11**.

While, according to the foregoing description, the slab is bound by a metal binding comprising four separate portions or pieces, with open joints at the corners, it is apparent that in some cases the binding strip may extend continuously around the slab. On the other hand, it is understood that the slab need not have a binding on all four sides. Where the binding is of the profile shown, or a generally similar profile, it is apparent that it will interlock very effectively with the cementitious body of the slab, and this facilitates the division of the binding into separate portions or pieces where this is considered advisable.

It will be seen that the invention provides a structure in which the breaking and chipping of the slabs of concrete (which was heretofore so objectionable) has been obviated or overcome to a large extent. This has been done in such a manner, moreover, as to allow the necessary expansion and contraction in the completed structure without resulting injurious effects. Furthermore, the slabs can be very easily installed. The means for interlocking the slabs also provides a notable improvement. The structural strength of the units is greatly increased as compared to units which are not reinforced. Notwithstanding these advantages, moreover, the amount of metal used for reinforcement is relatively small and the unit can be inexpensively produced, the cost being quite low for a product having the many advantages of the present product.

It is to be understood that various modifications may be made in the structure as herein described, without departure from the general principles of the invention or the scope of the claim.

What I claim is:

The combination of two slabs of substantial thickness laid edge to edge and provided in their adjacent edges with narrow mouthed dovetail grooves, and sheet metal clips having resilient portions of dovetail formation engaging respectively the grooves of the slabs, said clips permitting an initial setting of the slabs with their adjacent edges spaced from each other, and the walls of the clip engaging the sides of the dovetails of the grooves to resist more than a predetermined separation of the edges of the slabs, each clip being in general in the form of a U and the dovetail portions being formed by indenting the sides of the U, the clip being of a width adjacent the base or connecting portion to permit it to be inserted in the groove of one slab and turned through 90° to engage the dovetail of said

groove, the other dovetail portion of the clip being engaged with the dovetail of the other groove.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,257,001	Davis	Sept. 23, 1941
2,119,886	Kotrbaty	June 7, 1938
1,801,631	Knight	Apr. 21, 1931
2,119,318	Davison	May 31, 1938
1,966,041	Nelson	July 10, 1934
2,091,061	Waugh	Aug. 24, 1937
428,063	Boda	May 20, 1890
1,905,603	Place	Apr. 25, 1933
2,084,717	Wiley	June 22, 1937
1,723,306	Sipe	Aug. 6, 1929
2,142,305	Davis	Jan. 3, 1939
1,122,866	Cordes	Dec. 29, 1914
2,362,162	Sheldon	Nov. 7, 1944