March 29, 1960 R. D. BENDER 2,930,222

PREFABRICATED INTERLOCKING STRUCTURAL SLABS

Filed Nov. 14, 1955 3 Sheets-Sheet 1

Fig. 1

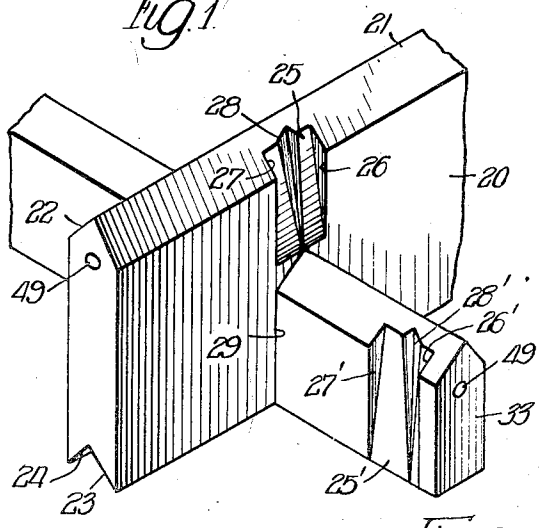


Fig. 2

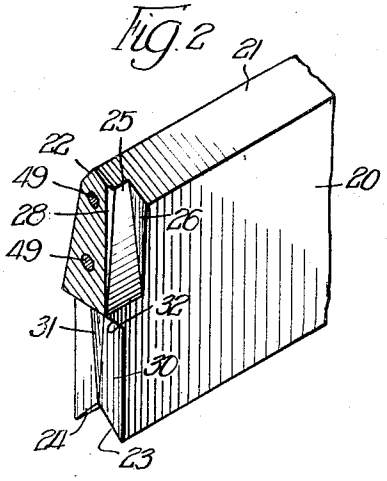


Fig. 3

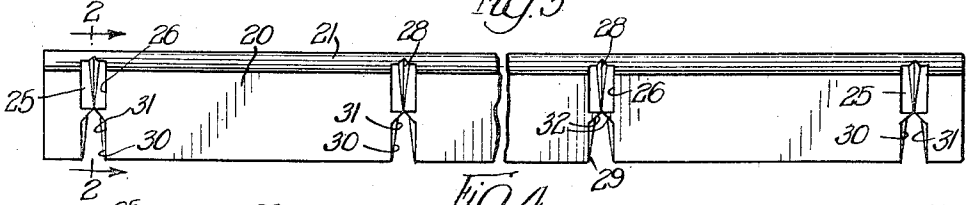


Fig. 4

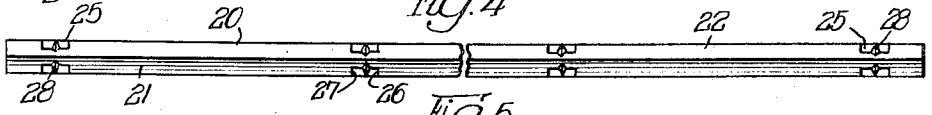


Fig. 5

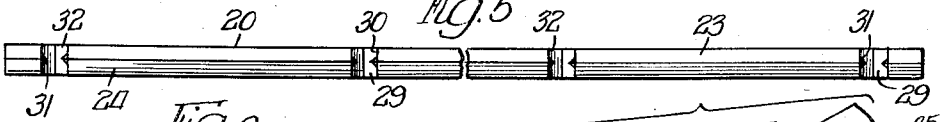


Fig. 6.

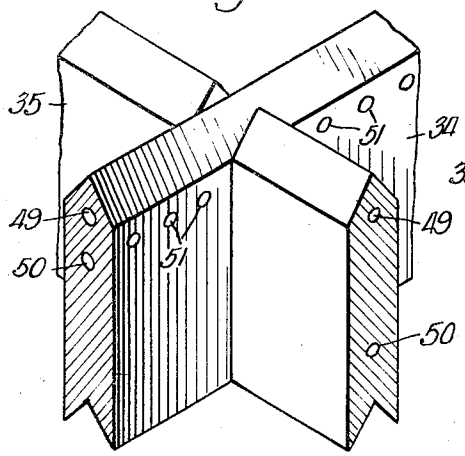
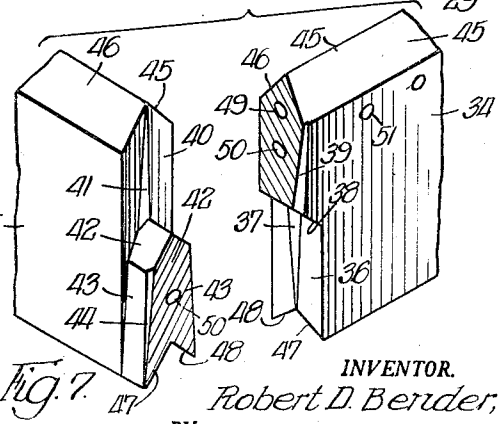


Fig. 7.



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Filed Nov. 14, 1955 3 Sheets-Sheet 2

Fig. 8

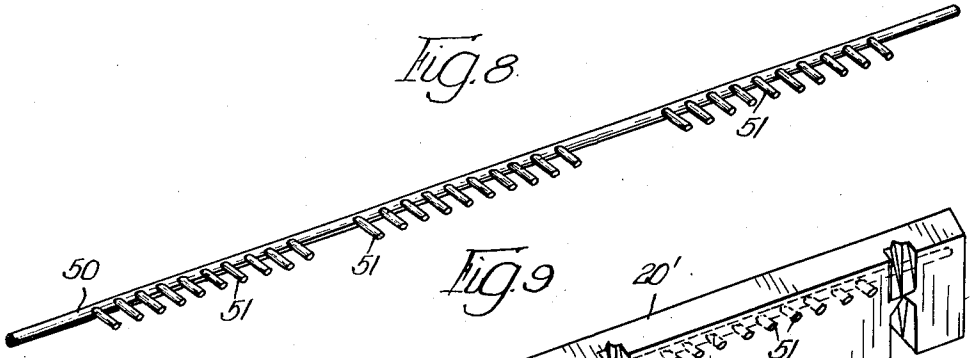


Fig. 9

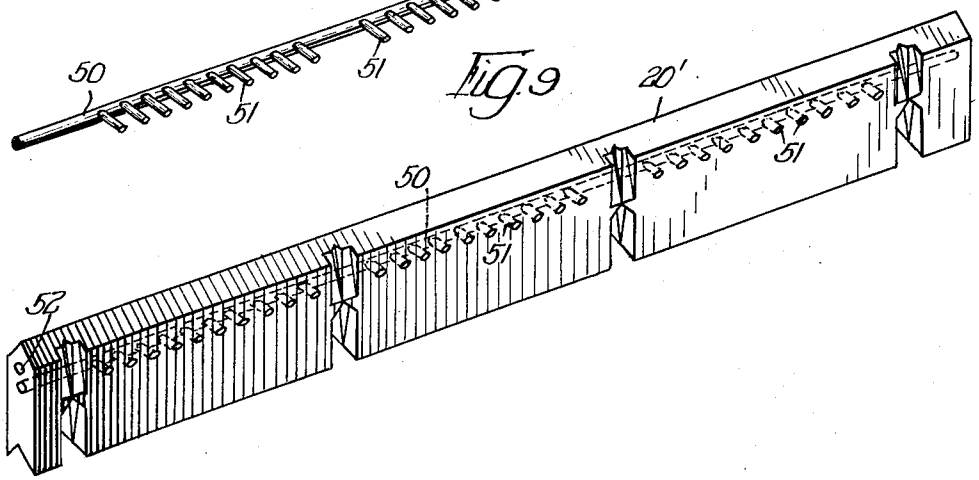


Fig. 10

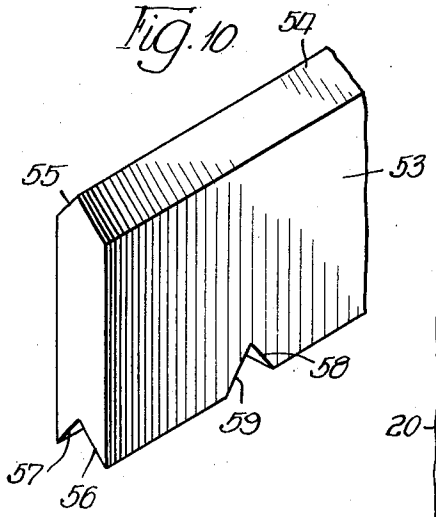
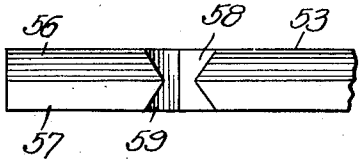


Fig. 11



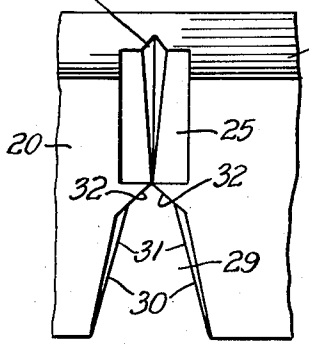


Fig. 3A

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March 29, 1960 R. D. BENDER 2,930,222

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Filed Nov. 14, 1955 3 Sheets-Sheet 3

Fig. 12.

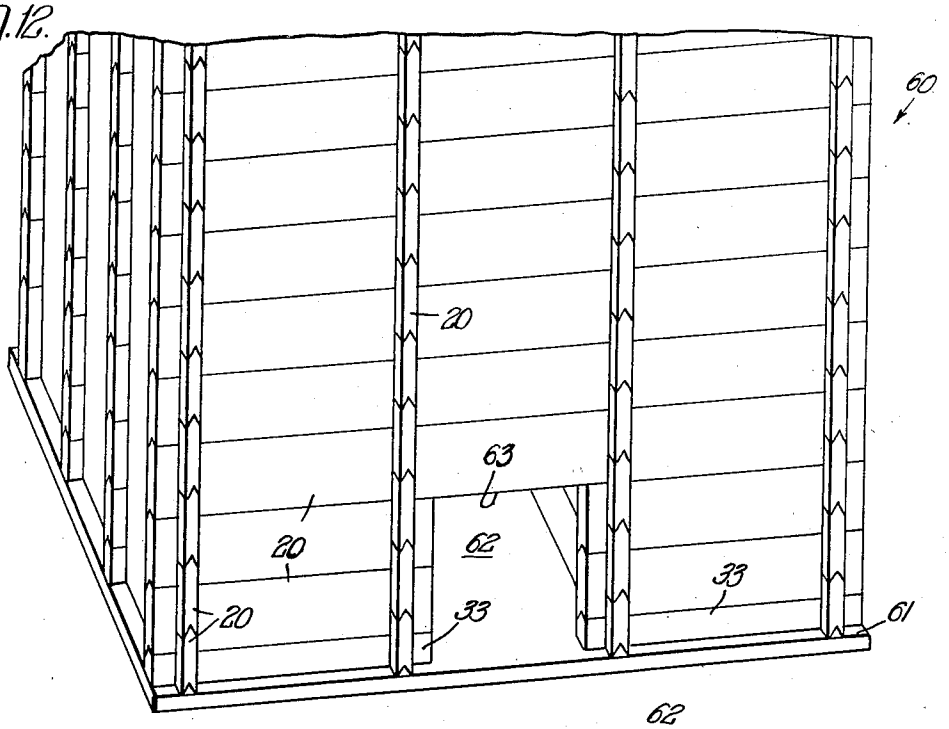
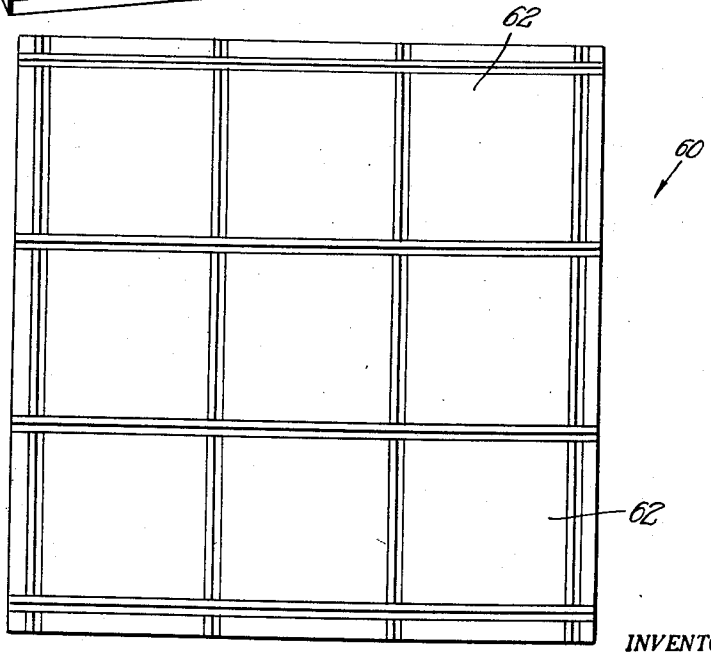


Fig. 13



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PREFABRICATED INTERLOCKING STRUCTURAL SLABS

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Application November 14, 1955, Serial No. 546,661

5 Claims. (Cl. 72—38)

The present invention relates generally to prefabricated interlocking structural slabs and improved structural units formed therefrom, the slabs being provided with improved interlocking elements. More specifically, the present invention is directed to new and improved prefabricated structural slabs provided with improved elements for interlocking a plurality of such slabs and further being adapted for the provision of conduit means for aeration purposes or the like when such slabs are used in the building of structural units such as grain elevators.

In reinforced concrete construction the necessity of using large quantities of wooden forms and other subsequently discarded materials at the building site greatly adds to the total over-all cost of the completed structure. The carpenter work alone necessary to complete and properly position the wooden forms into which the concrete is poured is not only tedious but costly. Efforts have been made to design precast or prefabricated concrete blocks or slabs capable of being efficiently used at the building site to construct a structurally sound building while alleviating the use of costly materials that must subsequently be discarded. In designing the precast blocks for this purpose it is necessary to provide means for interconnecting or interlocking the blocks without the necessity of using highly skilled labor. The interconnecting means must furthermore be capable of joining the blocks or slabs in an efficient manner so as to produce a structurally sound building. Not only must high structural requirements be met, but it is also necessary that the preformed blocks or slabs be capable of protecting the interior of the building from damaging weather conditions.

At the present time the vast majority of grain elevators or storage bins are constructed from reinforced concrete. The total cost of the structure is materially increased where it is considered necessary to go to the additional expense of providing the reinforced concrete walls with fresh air circulating means. The storing of grain in closed bins without proper air circulation involves the risk of the damp grain becoming musty through lack of fresh air or even becoming heated to an extent that the product is ultimately worthless for human use. The cost of providing circulating means for fresh air in reinforced concrete bins is extremely high due to the necessity of using highly skilled labor in properly installing the conduit means while the reinforced concrete walls are being poured so that the former will perform their intended function in an efficient manner.

It is an object of the present invention to provide new and improved forms of prefabricated structural slabs including new and improved elements adapted to cooperate with one another in interlocking the slabs so as to insure a structurally sound building as well as protection against the passage of water into the interior of the building even though the source of the water brought into contact therewith is rain under wind-driven conditions.

A further object is to provide new and improved forms of structural slabs having new and improved interlocking elements which may be made from lightweight material and which may be readily assembled at the building site without the necessity of using highly skilled labor while at the same time insuring the formation of a structurally sound building.

Still a further object is to provide new and improved structural slabs as above described which may be readily provided with fluid conduit means during the casting thereof under low cost conditions and which, when provided with such conduit means, are particularly adapted for use in the construction of grain storage elevators or bins.

Other objects not specifically set forth will become apparent from the following detailed description made in conjunction with the drawings wherein:

Fig. 1 is a fragmentary perspective view of a single interlocked joint formed by two types of structural slabs incorporating the interlocking principles of the present invention;

Fig. 2 is a fragmentary perspective vertical section of the slab of Fig. 3 taken along line 2—2 therein;

Fig. 3 is a fragmentary side elevation of the form of slab shown in Fig. 2;

Fig. 3A is an enlarged fragmentary elevation of one of the slots shown in Fig. 3;

Fig. 4 is a fragmentary top plan view of the slab shown in Fig. 2;

Fig. 5 is a fragmentary bottom plan view of the slab of Fig. 2;

Fig. 6 is a fragmentary perspective view of two modified forms of slabs shown in interlocking relation;

Fig. 7 is a fragmentary exploded view of the interlocked slabs of Fig. 6 showing each form of slab in vertical section along a line intersecting its interlocking elements;

Fig. 8 is a perspective view of one form of fluid conducting means adapted for use with the prefabricated slabs of the present invention;

Fig. 9 is a perspective view of the form of slab of Fig. 2 having incorporated therein the fluid conducting means of Fig. 8;

Fig. 10 is a fragmentary perspective view of a modified form of prefabricated slab;

Fig. 11 is a fragmentary bottom plan view of the slab of Fig. 10;

Fig. 12 is a fragmentary perspective view of a finished grain elevator constructed from prefabricated slabs of the present invention; and

Fig. 13 is a top plan view of the finished structure of Fig. 12 with the roof removed therefrom.

The various forms of prefabricated interlocking structural slabs incorporating the principles of the present invention include longitudinally spaced slots which extend inwardly of the slabs and which are opened along two sides thereof while being closed along the remaining two sides. The slots are provided with outwardly projecting ribs along the side walls thereof, which ribs cooperate with inwardly directed grooves suitably located in corresponding slabs held in interlocking relation thereby. The slabs are further provided with upwardly projecting V-shaped ribs extending longitudinally along the upper surfaces thereof which are nestingly received by superimposed slabs provided with inwardly recessed V-shaped grooves extending longitudinally along the bottom surfaces thereof. The spaced slots are adapted to receive portions of corresponding slabs in such a manner as to provide interlocked slabs at right angles to one another thereby particularly adapting the slabs of the present invention for use in the construction of grain elevators being subdivided internally thereof with a plurality of separated storage bins.

To particularly describe one form of slab incorporating the principles of the present invention reference is

made to Figs. 1–5 of the drawings. A prefabricated slab 20 is shown as having substantial height with respect to its thickness and along the top surface thereof being provided with upwardly projecting slanted walls 21 and 22 which join one another centrally thereof to define an upwardly projecting V-shaped rib. The bottom surface of slab 20 is defined by inwardly projecting slanted walls 23 and 24 which, in turn, define a recessed V-shaped groove adapted to receive an upwardly projecting V-shaped rib of a second slab when the former is superimposed thereon. This particular interlocking relation allows a series of slabs 20 to be superimposed and maintained vertically by the spaced nesting of the ribs in opposed grooves.

Extending upwardly from approximately the vertical midpoint of the slab 20 and on each side thereof is an inwardly directed slanted groove 25 which is defined by outwardly directed walls 26 and 27. Centrally of the grooves 25 and extending vertically with respect thereto are V-shaped grooves 28 which expand laterally in an upwardly direction. The grooves 25 occur on both sides of the slab 20 in opposed relation, as clearly shown in Fig. 4. Immediately below the grooves 25 are corresponding upwardly directed slots 29 which are opened along two sides thereof in a direction radial with respect to the longitudinal axis of the slab 20 and which are defined by inclined walls 30 on the two remaining sides thereof. Centrally located along each of the inclined walls 30 is an outwardly projecting V-shaped rib 31 which expands laterally in an upwardly direction. The tops of the slots 29 are defined by upwardly extending slanted walls 32 which combine to form an inverted V adapted to receive the V-shaped rib formed by top walls 21 and 22 of a corresponding slab 20.

A slightly modified form of slab 33 is shown in Fig. 1 inserted within the slot 29 of the slab 20. The slab 33 is provided with the slanted grooves 25′ and 28′ which are similar to the grooves 25 and 28 previously described. In view of this arrangement the slab 33 is adapted to be inserted within a slot 29 of a slab 20 in interlocking relation therewith by reason of the ribs 31 of the slab 20 being received within the grooves 28′ of the slab 33. This latter slab is not provided with slots 29 and therefore may be used in conjunction with a slab 20 to form a smooth bottom surface in the construction of a building or the like. However, it should be understood that a plurality of slabs 20 are adapted for interlocking relation therebetween due to the provisions in each of the slabs of corresponding slots 29 and grooves 25. Because of this a plurality of slabs 20 may be interlocked at right angles with relation to one another and at the same time additional slabs 20 may be superimposed on both of the legs of the angular relation.

Figs. 6 and 7 illustrate a modified form of locking arrangement between interlocked slabs 34 and 35. As can be seen in Fig. 6 the slabs 34 and 35 are so designed as to be interlocked to provide a structural unit of a predetermined height. These slabs are particularly adapted for use in the construction of corners having segments of equal height whereas the form of slab shown in Figs. 1–5 are particularly adapted for vertical stepwise construction. In first considering slab 34 it will be noted that this slab is provided with an upwardly directed slot 36 having a centrally located vertically extending V-shaped rib 37 which expands laterally in an upwardly direction. The slot 36 and rib 37 are similar to the slot 30 and the rib 31 previously described. The slot 36 is further provided with a slanted top 38, and an upwardly directed V-shaped groove 39, half of which is shown in Fig. 7, extends upwardly therefrom. The groove 39 expands laterally in a downwardly direction for a purpose to be described.

The slab 35 is substantially the opposite of the slab 34 in design. This slab is provided with a downwardly extending slot 40 which is provided along each of its closed sides with an outwardly extending V-shaped rib 41 which expands laterally in a downwardly direction. The rib 41 intersects upwardly projecting V-shaped bottom walls 42 which define the bottom of the slot 40. Extending downwardly from the V-shaped walls 42 are side walls 43 which slant outwardly toward the bottom of the slab 35. Centrally of the slanted walls 43 are vertically extending V-shaped grooves 44 which expand laterally in an upwardly direction. In Fig. 7 only one-half of a groove 44 is shown.

Upon the interlocking of the slabs 34 and 35 as shown in Fig. 6, the slot 36 receives the bottom portion of the slab 35 defined by the slanted walls 43. The ribs 37 nest within the grooves 44 in close interlocking relation. The slanted top walls 38 abut the slanted bottom walls 42 and the slot 40 receives the upper portion of the slab 34 while its ribs 41 are nestingly received by the grooves 39 therein. Each of the slabs 34 and 35 are provided with longitudinally extending top surfaces 45 and 46 which expand upwardly to form upwardly projecting V-shaped ribs. The bottom longitudinal surfaces of the slabs 34 and 35 are provided with inwardly slanting walls 47 and 48 which define inwardly directed recessed V-shaped grooves adapted to receive the V-shaped ribs of similar slabs upon which the former are superimposed. This additional interlocking relation is similar to that described in connection with Figs. 1–5. Each of the slabs described may be readily supplied with reinforcing rods 49 which are embedded therein and extend longitudinally therealong in any desired location. The rods 49 may be readily embedded within the material of the slabs as, for example, during the casting thereof when the slabs are formed from concrete or similar material.

As previously described, the structural slabs of the present invention have particular utility in the construction of grain elevators or storage bins. The interlocking arrangements including the use of the V-shaped ribs and grooves provide a complete weather seal to protect grain from moisture. It has been found that the combined locking elements are capable of prohibiting the entry of rain into the storage bin even though the rain is under wind-driven conditions to an extent that its movement is substantially vertical to the walls of the bin. The slabs are furthermore adapted for the provision of internally positioned conduit means associated with a plurality of outlets in spaced relation along the vertical sides of the slabs for use in the delivery of dry air or other suitable fluid into the storage bin to either dry the grain stored therein or maintain the grain in a dry condition thereby alleviating spoilage. The type of conduit means may take many different forms. For example, Figs. 8 and 9 illustrate the use of a hollow metallic tube 50 having a plurality of radially extending tubes 51 which is adapted to be embedded in a slab 20′ as illustrated particularly in Fig. 9. The tube 50 extends the full length of the slab 20′ and its associated radially extending tube segments 51 are arranged to communicate outwardly of the slab along one side thereof. In this manner quantities of air may be forced through the slab and delivered into the interior of a storage bin. A similar tube 52 may also be embedded in the slab 20′ for use along the other side thereof to allow for the delivery of air from both sides of the slab.

While the aeration feature of Figs. 8 and 9 has been described in connection with the use of metallic tubes, it should be understood that any suitable type of tubing or any other suitable means capable of delivering a fluid through a slab is contemplated for use within the scope of the present invention. For example, it is possible merely to bore an internal longitudinally extending hole through the interior of the slab, if such is considered practical, and thereafter bore a plurality of radially extending holes through the side surface of the slab to contact the central passageway. Still further, it has been

found desirable to make use of laminated fiber tubes which may be readily embedded within the slab during the casting thereof and which are of considerably lighter weight than metallic tubing thereby reducing the overall weight of the prefabricated slab. Fiber tubing similar to that used in reinforcing concrete has been found entirely suitable for the above described purpose. When this latter type of tubing is used, it is entirely possible to provide radially extending outlets to the central tubing by the drilling of holes through the side wall of the slab as previously described.

It should be understood that the slabs of the present invention may be fabricated from any suitable material such as concrete. In the construction of grain elevators and the like it has been found that these slabs can preferably be formed from lightweight concrete, such as mixtures of crushed raw shale and cement, similar to that known as "Alton-Haydite" manufactured by the Alton Brick Company of St. Louis, Missouri. In making use of this material, the advantages of using a light-weight concrete as well as the advantages derived from the use of prefabricated slabs greatly reduces the total cost of the structure while at the same time providing to the structure the requisite strength and protection against elements normally required.

Figs. 10 and 11 illustrate still another form of prefabricated slab which may be used in conjunction with the above described forms. In these figures, a slab **53** is shown as including upwardly directed slanted top walls **54** and **55** which meet centrally thereof to form an upwardly extending V-shaped rib similar to those previously described. The lower surface of the slab **53** is defined by inwardly directed slanted walls **56** and **57** which define an inwardly directed V-shaped groove for nestingly receiving a rib similar to the aforementioned. The slab **53** may be supplied with slots **36** or **40** and grooves **39** or **44** of the type previously described but the purpose of Figs. 10 and 11 is to illustrate the use of right angle grooves along the bottom surface of a slab to permit the slab to straddle the top surfaces of interlocked slabs at their point of interception such as is shown in Fig. 6. For this purpose the slab **53** is provided along the bottom surface thereof with a radially extending groove defined by inwardly slanted walls **58** and **59** which intercept the longitudinally extending groove defined by the walls **56** and **57** at right angles thereto. By this arrangement the top surfaces of the slabs **34** and **35** may be nestingly received by the bottom surface of the slab **53** at their point of intersection. As a result, a continuous abutment between the opposed surfaces of the superimposed slabs may be maintained for sealing purposes.

Figs. 12 and 13 illustrate one form of a grain elevator **60** comprising a plurality of vertically extending divided bins therein which may be formed from the prefabricated interlocking structural slabs of the present invention. The particular type of slab utilized in the construction shown is slab **20** illustrated in Figs. 1–5. The grain elevator **60** includes a flooring foundation **61** on which is vertically positioned a series of slabs **33** which are interlocked with a plurality of slabs **20** at right angles thereto. An additional number of slabs **20** are also vertically superimposed upon the base slabs **33** and these slabs are in turn interlocked in the manner previously described with slabs of similar construction to provide therebetween the outside walls as well as the internal walls which divide the structure **60** into a plurality of rectangularly shaped storage bins **62**. The grain elevator is provided with a suitable entrance **63** which may be constructed in any desired form and is not shown in detail in Fig. 12.

From the foregoing it should be readily seen that the prefabricated interlocking structural slabs of the present invention are capable of providing a highly efficient interlocking arrangement therebetween which is capable of efficiently sealing off the interior of a building constructed therefrom. Buildings constructed from such slabs may be readily assembled at a minimum cost and are made structurally sound. In the instance where these slabs are used in the construction of grain elevators it is often desirable to make such a structure air-tight, particularly where air is introduced thereinto in the manner previously described. For this purpose the slabs of the present invention are particularly adapted for receiving rope-type mastic intermediate the top and bottom nesting walls and the provision of such sealing means will insure the construction of an air-tight building.

Obviously many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. A preformed slab of rectangular outline formed from flat side surfaces and top and bottom surface margins and being suitable for use in the construction of storage bins, said slab having a transverse slot extending inwardly along one surface margin thereof at substantially right angles to the longitudinal axis of said slab, said slot being defined by longitudinally spaced transverse walls each of which extend from one side surface of said slab to the opposite side surface thereof and terminate inwardly of said slab at approximately the longitudinal center line thereof and each of which are inclined toward one another in a direction toward said center line, recesses in the portions of the side surfaces of said slab intermediate the innermost end of said slot and the other surface margin of said slab, the rear surfaces of said recesses extending from coplanar intersection with their respective side surfaces of said slab and inclining inwardly toward said other surface margin into coplanar intersection therewith for wedged engagement with the inclined transverse walls of a slot of a similar slab when said slabs are interconnected in superimposed right angled relation, and ribs and grooves formed on said inclined rear surfaces and transverse walls and for interfitting and wedging engagement with cooperating ribs and grooves of said similar slab when said slabs are interconnected.

2. A preformed slab of rectangular outline formed from flat side surfaces and top and bottom surface margins and being suitable for use in the construction of storage bins, said slab having a transverse slot extending inwardly along one surface margin thereof at substantially right angles to the longitudinal axis of said slab, said slot being defined by longitudinally spaced transverse walls each of which extend from one side surface of said slab to the opposite side surface thereof and terminate inwardly of said slab at approximately the longitudinal center line thereof and each of which are inclined toward one another in a direction toward said center line, recesses in the portions of the side surfaces of said slab intermediate the innermost end of said slot and the other surface margin of said slab, the rear surfaces of said recesses extending from coplanar intersection with their respective side surfaces of said slab and inclining inwardly toward said other surface margin into coplanar intersection therewith for wedged engagement with the inclined transverse walls of a slot of a similar slab when said slabs are interconnected in superimposed right angled relation, and ribs and grooves formed on said inclined rear surfaces and transverse walls for interfitting and wedging engagement with cooperating ribs and grooves of said similar slab when said slabs are interconnected, the top surface margin of said slab being defined by two inclined faces joining the top edges of the side surfaces of said slab and being upwardly convergent to define a V-shaped rib extending longitudinally of said slab, the bottom surface margin of said slab being recessed as defined by two inclined faces joining the bottom edges of the side surfaces of said slab and being inwardly convergent to

define a V-shaped groove extending longitudinally of said slab.

3. A preformed slab of rectangular outline formed from flat side surfaces and top and bottom surface margins and being suitable for use in the construction of storage bins, said slab having a transverse slot extending inwardly along one surface margin thereof at substantially right angles to the longitudinal axis of said slab, said slot being defined by longitudinally spaced transverse walls each of which extend from one side surface of said slab to the opposite side surface thereof and terminate inwardly of said slab at approximately the longitudinal center line thereof and each of which are inclined toward one another in a direction toward said center line, recesses in the portions of the side surfaces of said slab intermediate the innermost end of said slot and the other surface margin of said slab, the rear surfaces of said recesses being inclined inwardly toward said other surface margin for wedged engagement with the inclined transverse walls of a slot of a similar slab when said slabs are interconnected in superimposed right angled relation, and ribs and grooves formed on said inclined rear surfaces and transverse walls for interfitting and wedging engagement with cooperating ribs and grooves of said similar slab when said slabs are interconnected, each of said ribs and grooves expanding laterally longitudinally thereof toward one end thereof to provide said interfitting and wedging engagement and being V-shaped in cross section.

4. A preformed slab of rectangular outline formed from flat side surfaces and top and bottom surface margins and being suitable for use in the construction of storage bins, said slab having a transverse slot extending upwardly from the bottom surface margin thereof at substantially right angles to the longitudinal axis of said slab, said slot being defined by longitudinally spaced transverse walls each of which extend from one side surface of said slab to the opposite side surface thereof and terminate inwardly of said slab at approximately the longitudinal center line thereof and each of which are inclined toward one another in a direction toward said center line, recesses in the portions of the side surfaces of said slab intermediate the innermost end of said slot and the top surface margin of said slab, the rear surfaces of said recesses being inclined inwardly in a direction toward the top surface margin of said slab for wedged engagement with the inclined transverse walls of a slot of a similar slab when said slabs are interconnected in superimposed right angled relation, each of said transverse walls carrying ribs formed from the material thereof which are of V-shape in cross section and which expand laterally in a direction toward the top surface margin of said slab, each of said inclined rear surfaces being provided with a groove which expands laterally in a direction toward the top surface margin of said slab, said ribs and grooves being adapted for interfitting and wedging engagement with cooperating ribs and grooves of said similar slab when said slabs are interconnected, the top surface margin of said slab being defined by two inclined faces joining the top edges of the side surfaces of said slab and being upwardly convergent to define a V-shaped rib extending longitudinally of said slab, the bottom surface margin of said slab being recessed as defined by two inclined faces joining the bottom edges of the side surfaces of said slab and being inwardly convergent to define a V-shaped groove extending longitudinally of said slab.

5. A preformed slab of rectangular outline formed from flat side surfaces and top and bottom surface margins and being suitable for use in the construction of storage bins, said slab having a transverse slot extending inwardly along one surface margin thereof at substantially right angles to the longitudinal axis of said slab, said slot being defined by longitudinally spaced transverse walls each of which extend from one side surface of said slab to the opposite side surface thereof and terminate inwardly of said slab at approximately the longitudinal center line thereof and each of which are inclined toward one another in a direction toward said center line, recesses in the portions of the side surfaces of said slab intermediate the innermost end of said slot and the other surface margin of said slab, the rear surfaces of said recesses extending from coplanar intersection with their respective side surfaces of said slab and inclining inwardly toward said other surface margin into coplanar intersection therewith for wedged engagement with the inclined transverse walls of a slot of a similar slab when said slabs are interconnected in superimposed right angled relation, and ribs and grooves formed on said inclined rear surfaces and transverse walls for interfitting and wedging engagement with cooperating ribs and grooves of said similar slab when said slabs are interconnected, each of said ribs and grooves expanding laterally longitudinally thereof toward one end thereof to provide said interfitting and wedging engagement and being V-shaped in cross section.

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