

March 5, 1935.

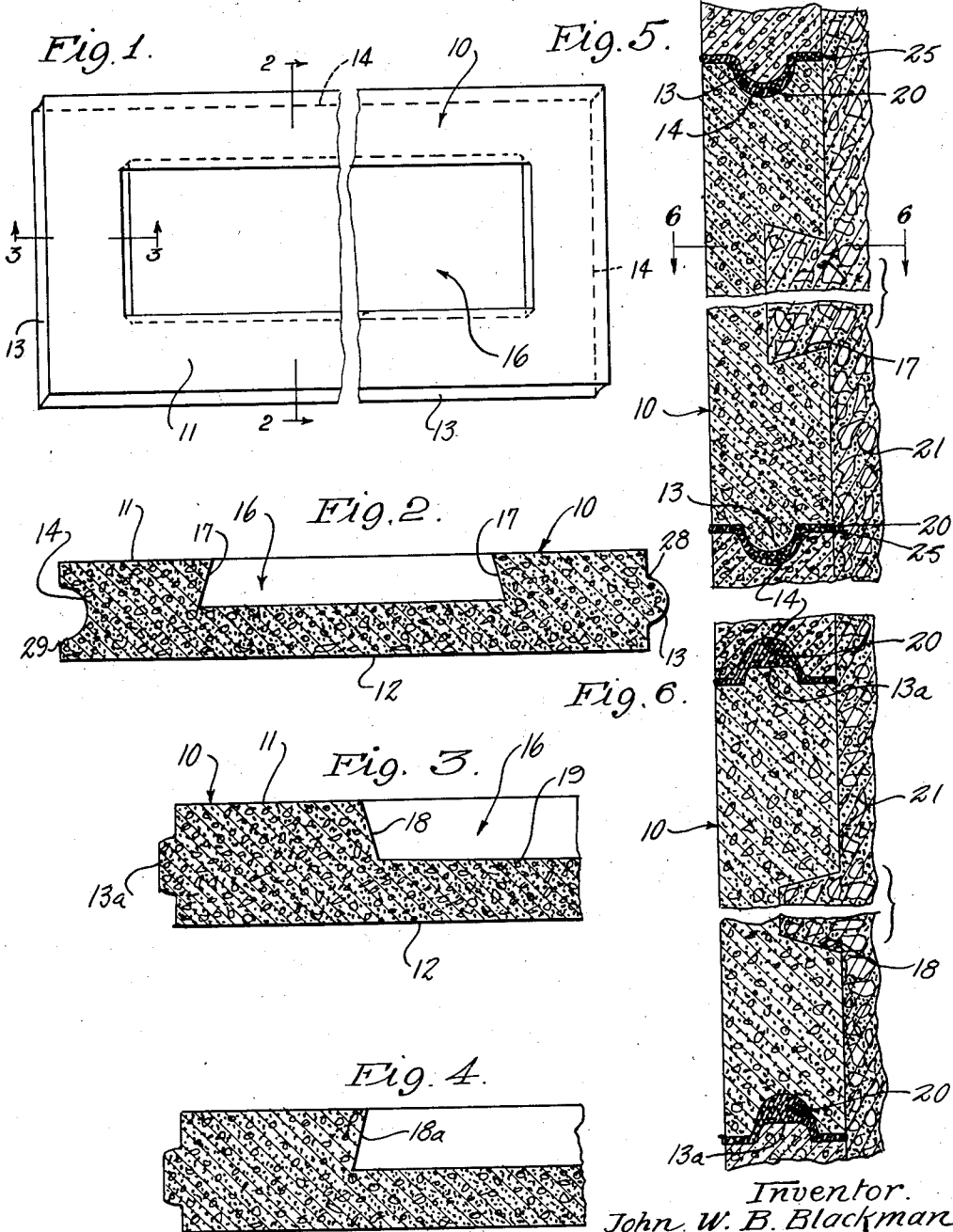
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PROTECTIVE SLAB FOR CONCRETE BODIES

Filed April 21, 1933

2 Sheets-Sheet 1



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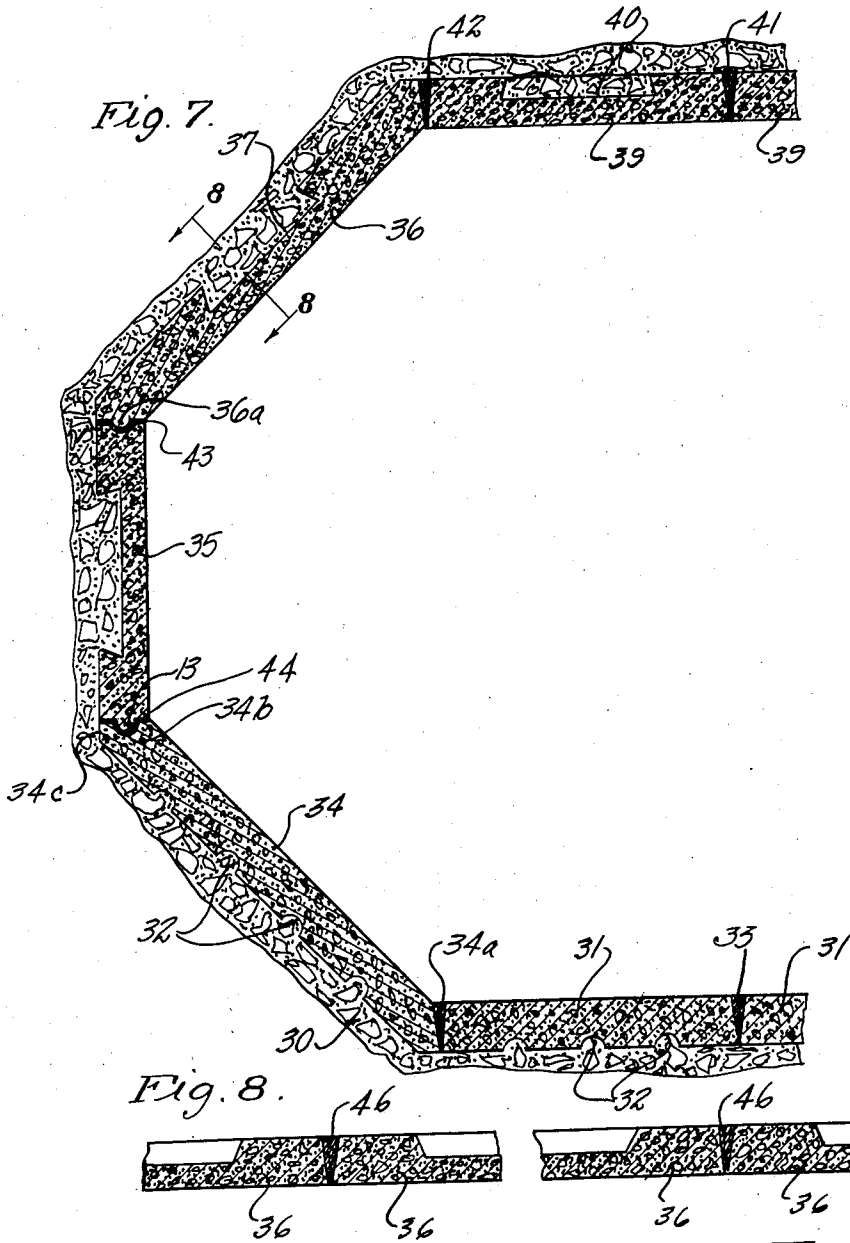
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PROTECTIVE SLAB FOR CONCRETE BODIES

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16 Claims. (Cl. 72--18)

This invention relates generally to protected concrete structures in which concrete walls, dams, floors, concrete piling and the like, are rendered immune to the deleterious action of such agencies as sea water, acids and alkalis, and also the effect of frost in rupturing the concrete where water is allowed to penetrate the pores, by the application to such structures of preformed slag members impregnated with waterproofing material and connected by waterproof joints. In its more specific aspects, the invention deals in improvements upon the types of slabs and joints comprising the subject matter of my copending application on Protected concrete structures, Ser. No. 587,702, filed Jan. 20, 1932, now issued as Patent No. 1,953,920, dated April 10, 1934.

The principal objects of the invention are directed to improvements in slabs of the character stated, whereby more secure bonds with the body of concrete to which they are applied, may be had without lessening the strength and effectiveness of the joints between the slabs. The invention may be characterized as an improvement upon slabs having undercut or dovetailed recesses for bonding to the body of the structure to which the slabs are applied. Heretofore, it has been customary to extend key recesses continuously through the slab, with the result that the thickness of the portions of the slab at the ends where the key way opens, are so reduced that it becomes difficult, and in some cases impossible, to obtain an effective joint between such end portions of the slabs. This is due to fact that a satisfactory joint must be of greater depth than the remaining thickness of the slab at its ends, after the key way has been cut clear through. Although it would be possible even under such circumstances, to increase the depth of the joint by making the slab of greater thickness, this would be impractical in the majority of cases because of the resultant increase in bulk and weight of the slabs and material required for their formation.

In accordance with the invention, I have been able to obtain both the advantages of a key recess in the slabs and a full joint thickness at its ends, by confining the key recess exclusively within the slabs. In this manner, the slabs may be formed of minimum thickness and joined together with equal effectiveness on all sides. I am also able to form the slabs with plane surfaces so as to present, when applied to the concrete body, a smooth regular surface.

Other objects have to do with novel developments in shaping the slabs at their edges to facilitate the forming of normal joints, and to

provide for the formation of joints between slabs arranged at special angles.

The above mentioned and additional objects of the invention, as well as the features and details of certain typical and preferred embodiments thereof, will be understood most readily without need for further preliminary discussion, from the following description. Throughout the description reference is made to the accompanying drawings, in which:

Fig. 1 is a side view of a typical, preferred form of slab embodying the invention;

Fig. 2 is a section on line 2--2 of Fig. 1;

Fig. 3 is a fragmentary enlarged section on line 3--3 of Fig. 1;

Fig. 4 is a view similar to Fig. 3, showing a variational form of the invention;

Fig. 5 is a sectional view showing a series of the slabs applied to a concrete body, and illustrating the joint formation between adjacent slabs;

Fig. 6 is a view similar to Fig. 5, taken on line 6--6 of the latter;

Fig. 7 is a sectional view showing an arrangement of slabs at special angles for lining sewers, tunnels and the like; and

Fig. 8 is a fragmentary section on line 8--8 of Fig. 7.

Referring first to Figs. 1 and 2, my preferred form of slab, generally indicated at 10, is shown to be substantially rectangular in shape, and to have plane surfaces 11 and 12, between which the slab is of substantially uniform thickness. It will be understood that the invention in its broad aspects is by no means limited to slabs having the particular shape or dimensional characteristics of the illustrated forms, though for most purposes, these shapes may be used to best advantage.

Being designed to protect concrete bodies against destructive action of acids, alkalis, sea water, and the like, and to afford such protection by reason of its being impregnated with substance resistant to such agencies, the slabs are made of material having such porosity as to permit their impregnation to a substantial depth. Ordinarily, the slabs will be made of porous concrete, although other material, such as a specially prepared porous clay, of sufficient porosity for impregnation and of required strength, may be used if desired. The characteristics of the concrete from which the slabs are molded, and the methods employed in forming them comprise no part of the present invention, but I may mention that these features are fully set out in my copending applications

Impregnated slabs and method forming same, Ser. No. 668,379, filed April 28, 1933, and Forms for molding slab members, Ser. No. 667,252, filed on even date herewith. Likewise, the methods which may be employed for the purpose of impregnating the slabs with waterproofing material, constitute no part of this invention, and any suitable process of impregnation may be used, such as those now in commercial use. As typical of processes that have been found to be successful for the purpose of impregnating concrete or like bodies, I may cite the processes described in Letters Patents No. 1,555,208 and No. 1,555,209, both granted Sept. 29, 1925 to Frank S. Honberger. By the methods disclosed in these patents, it is possible to so thoroughly impregnate concrete and other porous bodies with asphalt or other waterproofing material, that the impregnated body will be rendered substantially immune to the deleterious action of the agencies hereinabove mentioned.

The slab 10 is shown to be formed with a tongue 13 projecting from one side and end thereof, and complementary grooves 14 formed in the other side and end. Broadly speaking, the edges of the slab may, of course, be shaped to provide any other suitable joint connections between adjacent members. A key recess, generally indicated at 16, is formed in one of the slab faces, the sides and ends of the recess terminating within the slab, as indicated. While the key recess may be of any suitable shape, it preferably is substantially rectangular. Opposite sides of this recess are undercut as shown in Fig. 2 at 17, the purpose of the undercut being to afford a secure joint between the slab and a body of concrete poured against it and into the recess, as shown in Fig. 5.

In Figs. 3 and 6, the ends 18 of the key recess are shown to slope inwardly toward the base 19 of the recess, the reason for so sloping the shoulders at 18, being to allow complete drainage of asphalt from the recess at the conclusion of the impregnating process. In accordance with my present practice, I stand the slabs on end in a bath of the waterproofing substance, in the operation of impregnating. After impregnation has become complete, the slabs are removed from the bath, whereupon any of the hot waterproofing material in recess 16, will drain therefrom completely, as permitted by the outward slope of the bottom end wall 18 of the recess.

Forms suitable for casting the slab with the key recess, are fully described in my copending application referred to hereinabove, on Forms for molding slab members.

If desired, the ends of the recess 16 may be undercut, as well as the sides 17, as I have indicated in Fig. 4 wherein the ends 18a are shown to be dove-tailed in a manner similar to the sides.

It will be noted that beyond the ends of the key recess 16, the slab has the same full thickness as it has at the sides of the recess, and that the joint thickness at the ends of the slab corresponds to the thickness at its sides. As I have previously mentioned, while undercut key ways have been heretofore formed in slab members of this general character, it has been the practice to extend the key way entirely through the slab so that the way opens at the ends of the slab. As a result, it has been impossible to secure the same effective joints between the ends of the slabs as at their sides, since the joint thickness at the ends of the key ways has been reduced to a distance correspond-

ing to the thickness between the base surface 19 of the recess and the slab face 12. As will be apparent, in accordance with the invention, the joints between adjacent ends of the slabs are equal in effectiveness to the joints between side edges.

In Figs. 5 and 6, I have shown the slabs applied to a concrete body in such manner as to protect the latter from deterioration. In construction, the slabs are arranged edge to edge in the manner illustrated, and joined together by waterproofing material 20 placed in the joint spaces between adjacent slab members. As I have stated, the slabs before being applied to the concrete body, are impregnated with waterproofing substance, typically and preferably asphalt. The joint filling material 20 is of a character such that it will not only form a bond between the material or concrete from which the slabs are formed, but also such that it will become substantially integrated with the material with which the slabs are impregnated. Asphalt is the preferred joint filling material. Ordinarily, a low penetration asphalt will be used, and the asphalt, after first being heated to a temperature above the melting point of the asphalt with which the slabs are impregnated, is poured into the joint space. The hot asphalt poured into the joint melts the impregnating asphalt at the joint surfaces, causing both asphalts to flow together to the extent that the joint filling asphalt, when cooled and hardened, will have become integrated or made continuous with the impregnating asphalt, in addition to having bonded or adhered to the concrete of the slabs.

After the slabs have been thus joined, the concrete is poured against them, filling the key recesses 16 as indicated. Having first been assembled or erected prior to pouring the concrete, the slabs serve, in one aspect, as a permanent form for the concrete. By virtue of the imperviousness of the slabs and joints, and the immunity of the impregnating and joint filling substance to attack by the common agencies responsible for deterioration of concrete, the body of concrete 21 is fully protected from the destructive effect of fluids to which the slabs may be exposed.

In view of the desirability that the joint between the ends of the slab correspond in thickness to the joint between the side edges, it will be seen that the joint structure has a definite relation to the form of key recess which I have illustrated. The desired efficiency of the joint as to strength and waterproofness, is largely dependent upon the full joint thickness which has been attained by discontinuing the key recess as described.

The horizontally extending joints indicated at 25 in Fig. 5, may be easily filled with waterproofing material, regardless of the length of the joint, simply by pouring the waterproofing material into the top edge groove of the lower slab and then placing the upper slab in position, the waterproofing material running freely throughout the full length of the joint. For horizontal joints, the tongues 13 and groove 14 preferably have the relative shapes indicated.

Inasmuch as both slabs must be placed in position before the vertical joints can be poured, and since these joints may be of such length that where the joint space is restricted, the waterproofing material after being poured into the top of the joint may cool before reaching the bottom thereof, it sometimes becomes desirable to increase the cross sectional area of the vertical

joint spaces. Accordingly, as indicated in Fig. 6, I provide for increased space at 26 in the vertical joints, by beveling the face 13a of the tongue 13, the clearance at 27, however, preferably remaining substantially the same as in the corresponding part of the horizontally running joints.

Sharp corners and edges on the tongue and groove parts of the slab which might result in cleavage or chipping, are avoided by so shaping the slab forms as to provide rounded surfaces as indicated at 28 and 29.

In Figs. 7 and 8, I have shown certain variational forms of slabs that are given particular shapes to enable their arrangement at special angles as required for tunnel lining. In forming the tunnel, the concrete 30 at the bottom is first poured, and the floor slabs 31 placed on the wet concrete. Slabs 31 may be provided with semi-circular grooves 32 for the purpose of bonding to the concrete 30, and adjacent ends of the slabs may be beveled as indicated, to form a downwardly tapering opening at 33 into which waterproofing material may be poured. At the time slabs 31 are laid, lower side slabs 34 may also be laid on the fresh concrete 30, these slabs also having the bonding grooves 32, but having special shapes at their upper and lower edges to form special joints with the floor slabs 31 and the vertically positioned side slabs 35. The latter is shaped in accordance with the previously described slab illustrated in Fig. 1. The lower edge 34a of slab 34 is beveled as indicated, to form, with the adjacent edge of slab 31, a downwardly tapering space to receive the joint filling material. The upper edge of slab 34 is beveled at an angle with the faces of the slab, and has formed therein a groove 34b to receive tongue 13 on the lower edge of slab 35, and the outer face of slab 34 is beveled at 34c to align with the outer face of slab 35.

The upper inclined slab 36 is shaped generally similar to slab 34, being provided, however, with a key type recess 37, instead of semi-circular grooves, and having at its lower edge a tongue 36a projecting into the groove in the upper edge of slab 35. The roof of the tunnel is lined with slabs 39 having dovetailed key recesses 40, and beveled ends forming downwardly tapering joint spaces at 41. Similarly shaped joint spaces are formed at 42 between the edges of slabs 36 and 39.

As previously mentioned, slabs 31 and 34 are first laid upon the fresh concrete 30 in the bottom of the tunnel. Thereafter slabs 35, 36 and 39 are arranged in the positions illustrated by supporting them upon suitable forms, not shown, and the joint spaces at 41, 42, 43, and 44, filled with waterproofing material. The joints between lateral edges of adjacent slabs 36 will be of the tongue and groove type illustrated in Fig. 8, whereas the corresponding joints between slabs 31, 34, 36 and 39 will be substantially as indicated in Fig. 8, the lateral edges of the slabs being beveled to form spaces 46 into which the joint material may be poured from above.

After the joint material has hardened, concrete is then poured against the outer faces of slabs 35, 36 and 39, as illustrated, the concrete filling the key recesses so that after the concrete has set and the forms are removed, the slabs will be securely held in place. By reason of the slabs being thoroughly impregnated and the joints filled with waterproofing material, the tunnel or conduit is given a lining affording the concrete complete protection against the deleterious

action of fluids which the tunnel may carry under conditions of use.

I claim:

1. A slab member of the character described, having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess and one end of said recess being beveled inwardly toward the base thereof at an angle opposite the angularity of the undercut at the sides of the recess.

2. A slab member of the character described, having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess, and the ends of said recess being beveled inwardly toward the base thereof at an angle opposite the angularity of the undercut at the sides of the recess.

3. A slab member of the character described, having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess, tongues projecting from one side and end of the slab, and grooves formed in the other side and end thereof, the thickness of the sides and ends of the slab adjacent said tongues and grooves being substantially uniform.

4. A slab member of the character described, having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess, and joint forming irregularities on the sides and ends of the slab, the thickness of both the sides and ends of the slab adjacent said joint forming irregularities being substantially the full maximum thickness of the slab.

5. A slab member of the character described, formed of concrete impregnated with asphalt and having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess, and joint forming means on the side and end edges of the slab, the sides and ends of the slab adjacent said joint forming means being of substantially uniform thickness.

6. A slab member of the character described having substantially plane surfaces and being of substantially uniform thickness between said surfaces, there being formed in one of said surfaces a rectangular key recess, the sides and ends of which terminate within the slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess and one end of said recess being beveled inwardly toward the base thereof, tongues projecting from one side and end of the slabs, and grooves formed in the other side and end thereof.

7. A slab member of the character described, having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess but at least one end of the recess having no undercut, said slab member being of uniform thickness beyond the sides and ends of said recess, and joint forming means on the sides and ends of said member.

8. In structures of the character described, a

plurality of slab members formed of porous material impregnated with waterproofing substance, each of said members having formed in one of its faces a key recess, the sides and ends of which terminate within the members, each recess having an undercut side to form a key for bonding to concrete poured into the recess, the sides and ends of one of said members having tongue and groove joints with the sides and ends of the other members, there being spaces between the sides and ends of said members to accommodate joint filling material, and said spaces being filled with waterproofing substance integrated with the substance with which said members are impregnated, the joint thicknesses at both the sides and ends of adjacent slab members being substantially the maximum thickness of the slab.

9. In structures of the character described, a plurality of slab members formed of porous material impregnated with waterproofing substance, each of said members having formed in one of its faces a key recess, the sides and ends of which terminate within the members, each recess having an undercut side to form a key for bonding to concrete poured into the recess, the sides and ends of one of said members having tongue and groove joints with horizontally and vertically extending sides and ends of the other members, there being spaces between said members to accommodate joint filling material, and said spaces being filled with waterproofing substance integrated with the substance with which said members are impregnated, the spaces in the vertically extending joints being of larger cross sectional area than the spaces in the horizontally extending joints.

10. In structures of the character described, a pair of porous members impregnated with waterproofing material and joined together along vertically extending edges, the joint between said members comprising a groove formed in one of said members, and a tongue on the other member projecting into said groove, there being a comparatively wide space between the tongue and the base of said groove and comparatively narrow spaces between the sides of the tongue and the sides of the groove, and waterproofing material filling the joint space and integrated with the material with which said members are impregnated.

11. In structures of the character described, a pair of porous members impregnated with waterproofing material and joined together along vertically extending edges, the joint between said members comprising a groove formed in one of said members, and a tongue on the other member projecting into said groove, the vertically extending tongues on said slabs having beveled ends, and waterproofing material filling the joint space and integrated with the material with which said members are impregnated.

12. A slab member of the character described, having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess, one peripheral edge of said slab being beveled at an angle with the faces thereof.

13. A slab member of the character described, having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess, and a tongue projecting from one peripheral edge of said slab at an angle with the faces thereof.

14. A slab member of the character described, having formed in one of its faces a key recess, the sides and ends of which terminate within said slab, opposite sides of said recess being undercut to form a key for bonding to material poured into the recess, one peripheral edge of said slab being beveled at an angle with the faces thereof and the opposite peripheral edge of the slab having a tongue projecting at an angle with the faces of the slab.

15. The combination comprising, a pair of slab members of the character described arranged edge to edge, each slab having formed in one of its faces a key recess, the sides and ends of which terminate within the slab, opposite sides of the recess being undercut to form a key for bonding to material poured into the recess, joint edges extending along opposite sides and ends of each slab, the thickness of both the sides and ends of each slab adjacent said edges being substantially the full maximum thickness of the slab, the adjacent edges of said slabs being shaped to form a downwardly tapering joint space, and joint forming material filling said space.

16. The combination comprising, a pair of slab members formed of concrete impregnated with waterproofing material arranged edge to edge, each slab having formed in one of its faces a key recess, the sides and ends of which terminate within the slab, opposite sides of the recess being undercut to form a key for bonding to material poured into the recess, joint edges extending along opposite sides and ends of each slab, the thickness of both the sides and ends of each slab adjacent said edges being substantially the full maximum thickness of the slab, the adjacent edges of said slabs being shaped to form a downwardly tapering joint space, and joint forming material filling said space and integrated with the waterproofing material with which said slabs are impregnated.

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