March 2, 1937. C. L. POST 2,072,381

CONCRETE SLAB JOINT

Filed June 8, 1934 2 Sheets-Sheet 1

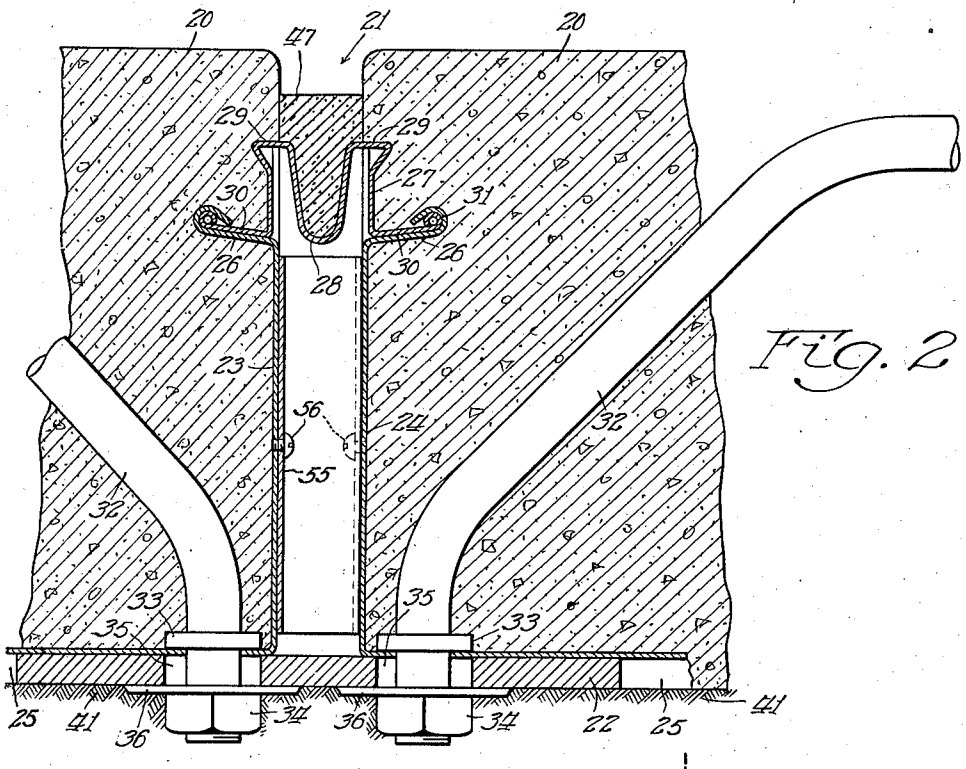


Fig. 2

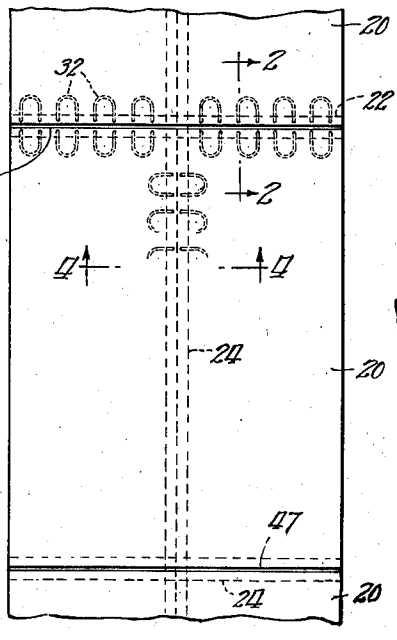


Fig. 1.

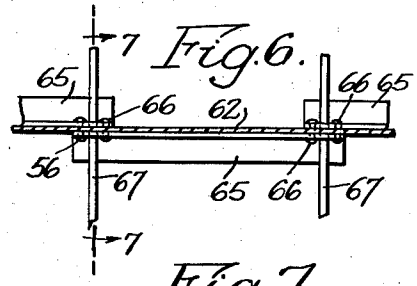


Fig. 6.

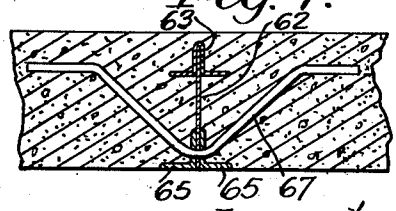


Fig. 7.

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Filed June 8, 1934 2 Sheets-Sheet 2

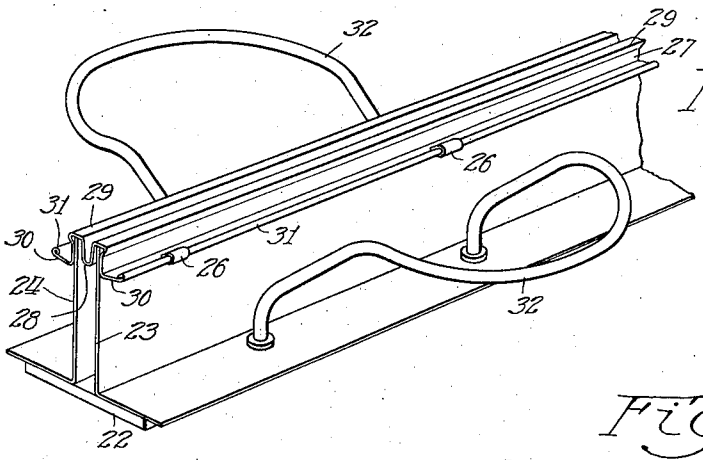


Fig. 3

Fig. 5

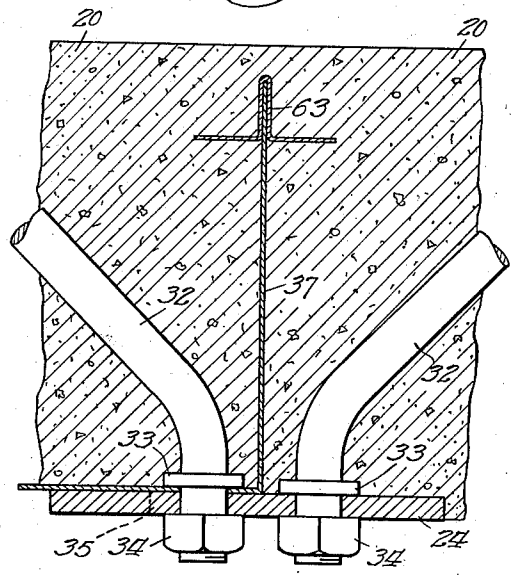
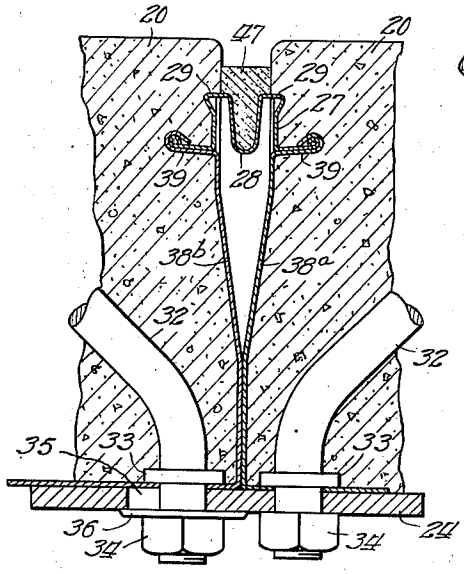


Fig. 4



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2,072,381

UNITED STATES PATENT OFFICE

2,072,381

CONCRETE SLAB JOINT

Chester L. Post, Chicago, Ill.

Application June 8, 1934, Serial No. 729,569

8 Claims. (Cl. 94—18)

My invention relates to devices providing joints between contiguous edges of slabs or other concrete sections, and more particularly it relates to what are commonly known as expansion and contraction longitudinal joints.

In highway pavements and similar concrete constructions, it is common practice to provide devices at predetermined spaced apart intervals between which concrete is poured, such devices thereby forming expansion and contraction joints to minimize cracking which would otherwise result from contraction of the masonry in cold weather and also eliminating the tendency to buckle which otherwise results from expansion in warm weather. No load can be transmitted from one slab to another through the spaces between contiguous slabs unless some means is especially provided for that purpose. The pavement deteriorates more rapidly adjacent the joints than at intermediate points because of the heavy concentrated loads to which modern highways are subjected and also because of the inadequacy of present joint structures as means for carrying loads from one slab to another across the joint spaces. This deterioration is due primarily to the yielding of the sub-base immediately underlying the edges of the slabs carrying the undistributed wheel loads. The yielding of the sub-base subjects the slabs to stresses causing them to crack and disintegrate adjacent the joints and in the course of time the joints become low points in the otherwise smooth surface of the pavement. Even though the slabs remain intact under heavy loads, the load carrying slab and its underlying sub-base yield noticeably under the undistributed load while the adjacent slab is not depressed. The advancing wheels thereby suddenly contact the undepressed adjacent slabs, resulting in a shock to the vehicle and slab and abrasion of the exposed edge of the forward slab so contacted.

The intermittent overloading of the sub-base on each side of the joint tends to cause the sub-base material to flow and force its way upwardly into the joint space and interfere with the efficient functioning of the joint to permit expansion of the slabs. The use of devices such as dowel bars to transmit loads from one slab to another through the joint space has proven unsatisfactory because of the relatively low bearing value of concrete and the tendency of such bars to produce high compressive stresses at the faces of the concrete, resulting in horizontal planes of cleavage or in crushing the concrete and eventually forming cone-shaped spaces in the concrete preventing the bars from functioning.

Among the objects of the invention is the provision of improved devices adapted to provide expansion spaces between the slabs; to transfer loads transversely from one slab to another across the intervening spaces; to preserve the true alignment of the pavement surface; to eliminate jar or shock from or to vehicles passing over the joints; to prevent passage of water and foreign material from the pavement into the joint spaces and to the sub-base; and to seal the joint spaces against infiltration of soil and foreign matter from the sub-base.

Still another object of the invention is the provision of structural devices of the kind described, adapted to provide expansion and contraction joints which are durable, simple and inexpensive, easily installed and satisfactory for their intended purposes.

Many of the objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the disclosures herein given.

To this end, my invention consists of the novel construction and arrangement and combination of parts herein shown and described and more particularly shown in the claims.

Referring now to the drawings:

Fig. 1 is a diagrammatic view of a highway pavement providing devices embodying the principles of the invention shown in Figs. 2 to 5, inclusive;

Fig. 2 is a sectional view along the line 2—2 of Fig. 1, drawn to a larger scale;

Fig. 3 is a perspective view of the device shown in cross-section in Fig. 2;

Fig. 4 is a cross-sectional view through a device adapted either as a longitudinal or a contraction joint;

Fig. 5 is a view along the line 4—4 of Fig. 1, drawn to a larger scale;

Fig. 6 is a plan view, partially in section, of an alternative form of construction providing a longitudinally extending joint;

Fig. 7 is a view along the line 15—15 of Fig. 6, showing the construction as embedded in a slab.

Referring now more particularly to the drawings,

Fig. 2 shows in cross-section a preferred construction adapted to form a space 21 and to provide an expansion and load transmitting joint between concrete slabs 20. A rigid plate 22 extending the full length of the joint closes the space 21 at the bottom. The plate 22 may be

reinforced, if desired, by longitudinal and/or transverse ribs. Plates 23 and 24, constructed of relatively thin metal, provide side walls abutting the adjacent ends of the slabs 20. A plurality of lengths of corrugated plates 55 are provided to hold the plates 23 and 24 in spaced apart vertical relation while the concrete is being poured. The plates 55 are fastened to the plates 23 and 24 by screws or bolts 56. The lower end of the plate 24 is turned outwardly and rests upon and projects beyond the plate 22 to provide an apron forming a clearance space 25 between the slab and the sub-base 41. The bottom of the plate 23 is also turned outwardly, resting upon and projecting beyond the other edge of the plate 22 to provide an apron forming a clearance space 25.

The upper portion of the joint space 21 is sealed by a member 47 comprising bituminous material. The member 47 is carried by a plate 27 forming an additional seal for the top of the space 21. The plate 27 is preferably constructed of noncorrosive metal, and has its mid-portion forming a trench 28, projecting downwardly between the plates 23 and 24. The plate 27, adjacent the trench 28, extends laterally beyond the plates 23 and 24 to form members 29 projecting into the adjacent concrete slabs. The plate 27 extends downwardly and inwardly from the members 29 into contact with the adjacent plates 23 and 24 and has its edge portions bent outwardly and slightly upwardly to form flanges 30. The edges of the flanges 30 provide beads 31 which are operatively engaged by clips 26, integrally formed with the plates 23 and 24 by cutting the latter along closely spaced parallel lines and bending the intervening material outwardly as shown. Pressure exerted upon the member 47 will force the projections 29 outwardly into contact with the slabs, and any foreign material that might possibly work down between the member 47 and into the trench 28 will further tend to maintain the members 29 in closely spaced position relative to the slabs. The flanges 30 are embedded in the concrete a substantial amount and combine with the members 29 to provide a double seal making it impossible for any moisture or foreign material to enter the space between the plates 23 and 24 or the slabs and the plates from the top of the pavement.

A plurality of bars 32 embedded in the slabs 20 provide reinforcement for the slabs and also provide means for transmitting loads from one slab to another through the plate 22. The lower ends of the bars 32 are threaded and project through oval apertures 35 formed in the plate 22 on opposite sides of the joint. In assembling the device, the bars 32 are fastened to the plate 22 between upper collars 33, threaded to the position shown and nuts 34 and washers 36 on the under side of the plate. As the slabs 20 expand or contract the bars 32 are correspondingly moved in the apertures 35 leaving the plate 22 stationary. The bars 32 are inclined upwardly and outwardly away from the joint in the general direction of the resultant of the stresses in the slab. The bars are shown as providing loops with their intermediate portion extending horizontally a short distance ben ath the upper surface of the slabs. The loops may be omitted and anchors 32 used singly with a nut 34 and washers 33 and 36. The anchors either looped or single may have a head upset on their lower ends instead of being threaded and using nuts. Obviously, any load upon either of the slabs will be carried downwardly and a portion transmitted through the plate 22 into the bars 32 embedded in the adjacent slab and the over-hanging portion of the plate, thereby maintaining the surfaces of the slabs constantly in alignment. The slabs in expanding and contracting carry with them the plates 23 and 24. The prescribed construction of the seal plate 27 is such that the corrugation 28 yields to permit contraction and expansion of the slabs due to temperature changes. The plates 23 and 24 may be made of any sheet metal and should the same disintegrate by corrosion, the plate 22 will continue to function as a seal for the bottom of the space 21 and the plate 27 will similarly function throughout the normal life of the pavement.

A modified form of construction is shown in Fig. 4 wherein plates 38*a* and 38*b* are mounted on the plate 24 and form side walls for the adjacent slabs. This construction is adapted to provide contraction joints and also is adapted as a longitudinal joint by omitting the oval apertures 35 and substituting circular apertures of normal diameter. The lower portions of the plates 38*a* and 38*b* are positioned in contact and the upper portion of the joint is sealed by a plate 27 and a bituminous member 47, in the same manner as described for the construction shown in Fig. 2. This construction provides for a hinge action of the slabs 20 about the plate 24 as the slabs expand or contract along the joint. The bars 32, embedded in the slabs on each side of the joint, are provided as reinforcement for the slabs and to transmit loads from one section of the slab to the other.

Fig. 5 is a view of another form of construction adapted as a longitudinal joint. A single plate 37 has its lower portion turned outwardly and resting upon one edge of the plate 24 and its upper edge terminating near the top of the slab. Bars 32 are embedded in the slab 20 on each side of the joint and are fixedly fastened to the plate 24, thereby preventing expansion of the bottom portion of the slab and permitting a hinge action about the plate 24 as the slab contracts and expands. A plate 63 having its middle portion forming a close fold, is mounted on the upper edge of the plate 37 with its edges forming flanges projecting substantially into the concrete on each side. As the slab contracts, it will crack along its upper surface in a line coinciding with the plane of the plate 37. The folded portion of the plate 63 yields as the upper portions of the slab separate and provides a seal preventing surface moisture from passing below the plate. The cracks thus formed in the surface of the slab may be filled with bituminous material. By providing the oval apertures 35 indicated in dotted lines, the construction of Fig. 6 will function as a contraction joint. The construction of Figs. 4 and 5 perform the same functions, except that of Fig. 4 does not require subsequent filling with bituminous material and also provides more perfect hinge action.

It will be noted that the load-receiving and load-transmitting rigid plate 22 is a relatively heavy and therefore a permanent, structural element having a width sufficient to underlie the adjacent ends of the two slabs to an extent adequate to receive the load imposed vertically upon the overlying slab end without possibility of causing rupture of the slab. The exact lateral dimension of this plate, at right angles to the joint, will, of course, be dependent upon the loads which are to be imposed upon the slab, and, as will be readily understood by any competent en-

gineer, may be determined by proper computations according to methods well understood.

Referring to Fig. 2, and supposing a vertical load to be imposed upon the end of a left-hand slab, such a load will be transmitted by the left-hand slab vertically upon the left-hand edge of plate 22, thereby imposing a tension upon the reinforcing element 32 and a compression upon the under surface of the right-hand slab to the right of the connection between plate 22 and right-hand reinforcement 32. The lateral extent of the right-hand edge of plate 22 should, therefore, be such that the compression value of the superjacent slab, with a proper factor of safety, is not exceeded. The size and extent of the reinforcing element 32 is similarly determined by well-known methods. It will also be readily understood that the dimensions of plate 22 and the reinforcing elements 32 must be determined in view of the character of the subgrade, heavier resistance values in these elements being required where the subgrade is relatively soft.

It will also be noted that plate 22 serves to increase the bearing of each slab end upon the subgrade to the extent of the projection of said plate beyond that slab end.

It will also be noted that, in order that the plate 22 may properly function, in an expansion joint, it is essential that as to at least one of the slab ends there must be a capability of movement of plate 22 relative to that slab at right angles to the line of the joint, and consequently the concrete of one of the slabs must not contact the subjacent vertical edge of plate 22, as indicated at 25 in Fig. 2.

It will also be noted that because of the slotted connection between plate 22 and at least one series of the reinforcing elements 32, the amount of relative movement between plate 22 and the superjacent slab is limited. This is especially advantageous where a pavement is at a substantial angle because it serves to prevent a long series of slabs from cumulatively slipping downhill.

The above analysis of load transfer applied to the contraction joint illustrated in Figs. 6 and 7. Vertical load on the horizontal arm of the left hand angle 65 will be taken in part by the attached right hand angle, and the left hand end of element 67 will be put under tension.

Figs. 6 and 7 illustrate a modified form of construction, adapted to provide a longitudinal joint, comprising a plate 62 surmounted by a cap plate 63. A plurality of angles 65 are positioned on opposite sides of the plate 62 with their contiguous ends overlapping and fastened together by rivets or bolts 66. The horizontal legs of the angles 65 project away from the plate 62, and provide a base support for the construction with the rivets or bolts 66 of a size to effectively prevent spreading of the angles as the slab contracts. A rod 67, projecting through the vertical legs of the angles 65, at each joint provides a means for transmitting loads from one side of the construction to the other. The middle portion of the rod 34 is V-shaped and prevents the bottom of the slabs from separating when the concrete contracts, but permits the upper portion of the slab to separate so that the slab sections are hinged about the lower portion of the construction. The inclination of the V-shaped portion of the rods 67 substantially coincides with the resultant of the stresses in the slab sections and their extremities are preferably straight to provide additional anchorage. Upon contraction of the slab a crack will form along the line immediately above the plate 62 which can be filled with bituminous material to provide a waterproof seal. The base portion of the construction comprising the angles 65, fastened by the rivets 66, remains intact for all conditions of expansion or contraction of the joint and eliminates any possibility of sub-base material entering the joint.

Thus, it will be seen that I have provided a novel construction adapted to form joints in slabs or other concrete sections, and to transmit loads across the joints from one slab to another.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence I do not wish to be understood as limiting myself to the exact form, construction, arrangement and combination of parts herein shown and described or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

1. A joint for concrete slabs comprising a relatively-permanent load-carrying structure to substantially underlie adjacent edges of two slabs, load-transmitting embedible members projecting upwardly from said load-carrying structure on opposite sides of its medial line and each capable of transmitting slab loads from the load-carrying structure to the slab in which it is embedded, relatively weak non-load-transmitting slab-end defining-sheet material supported by said load-carrying structure between said embedible members.

2. A joint for concrete slabs comprising a relatively-permanent structure to substantially underlie adjacent edges of two slabs and capable of transmitting substantial vertically-applied loads, load-transmitting embedible members projecting upwardly and divergingly from said load-carrying structure on opposite sides of its medial line and capable of transmitting to their respective slabs loads from the adjacent slab downwardly applied upon said relatively-permanent structure, slab-end-defining sheet material supported by said load-carrying structure between said divergent members, and a transversely expansible and collapsible sealing-plate overlying said slab-end defining-means with edge portions thereof embedible in adjacent slab ends.

3. A joint for concrete slabs of the character specified in claim 1 wherein the connection between the load-transmitting embedible members and load-carrying structure to one side of the medial line of the load-carrying structure is such as to permit relative horizontal movement.

4. A joint for concrete slabs of the character specified in claim 2 wherein the connection between the load-transmitting embedible members and load-carrying structure to one side of the medial line of the load-carrying structure is such as to permit relative horizontal movement.

5. A joint for concrete slabs of the character specified in claim 1 wherein one edge of the load-carrying structure is overlaid by a relatively weak element projecting beyond said edge an amount sufficient to guard against deposit of concrete immediately adjacent said edge.

6. A joint for concrete slabs of the character specified in claim 2 wherein one edge of the load-carrying structure is overlaid by a relatively weak element projecting beyond said edge an amount

sufficient to guard against deposit of concrete immediately adjacent said edge.

7. A joint for concrete slabs comprising a relatively permanent load-carrying structure to substantially underlie adjacent edges of two slabs, two upwardly and oppositely divergent load-transmitting and reinforcing elements carried by said load-carrying structure and vertically immovable relative thereto, one of said load-transmitting members being shiftable relative to the load-carrying structure parallel to the slab plane, said two load-transmitting elements being spaced apart to accommodate vertically-extending relatively weak nonload-transmitting sheet material for slab end definition.

8. A structure of the character specified in claim 7 wherein slab-end-defining sheet material is extended beyond one vertical edge of the load-carrying structure to guard said edge from immediately embedding concrete.

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