Aug. 25, 1953 J. N. HELTZEL 2,649,720

DRAINAGE SYSTEM FOR AIRPORTS AND HIGHWAYS

Filed March 4, 1947 2 Sheets-Sheet 1

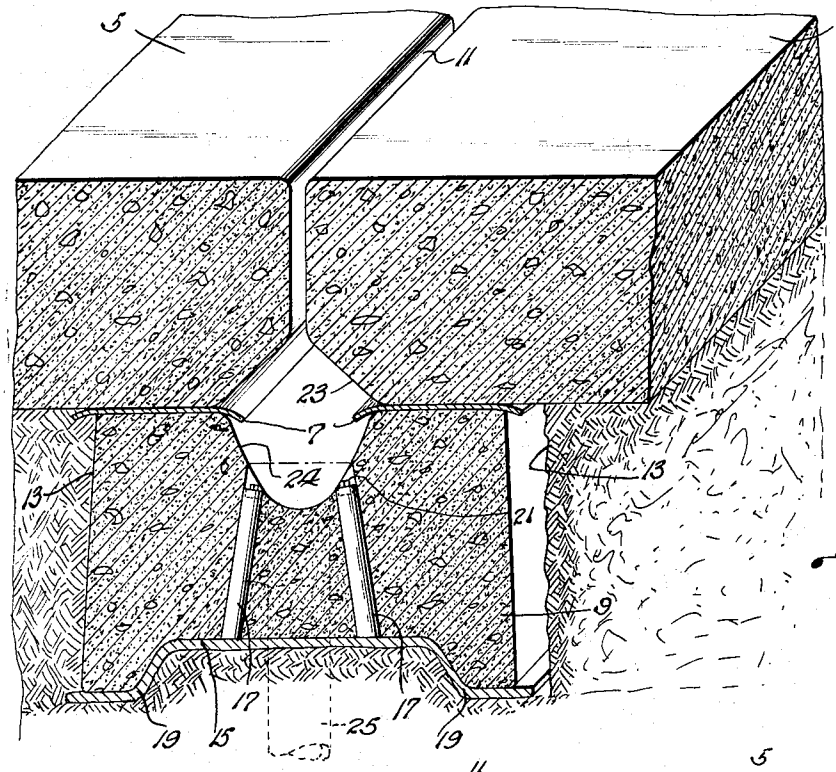


Fig. 1.

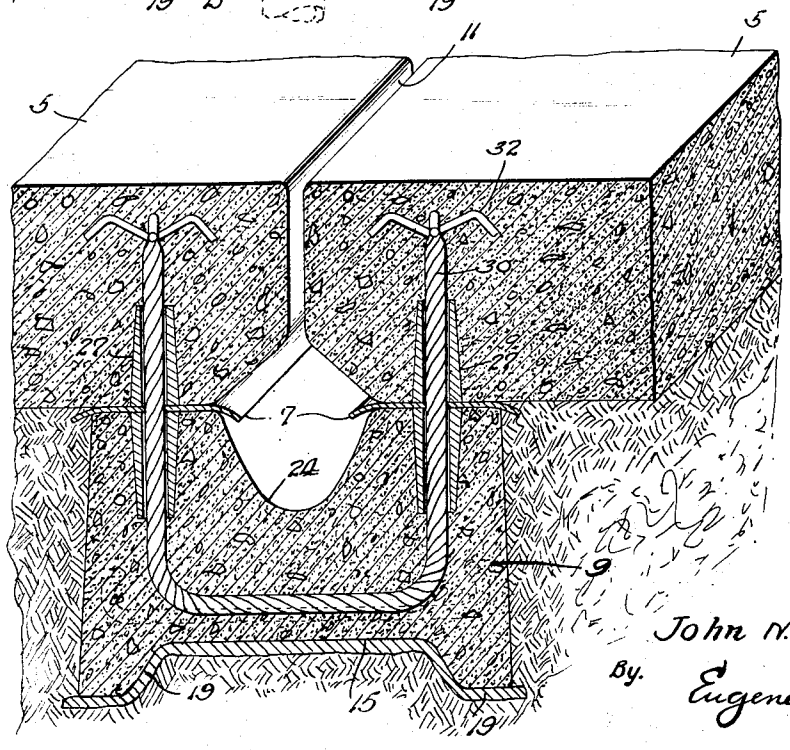


Fig. 2.

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Fig. 3.

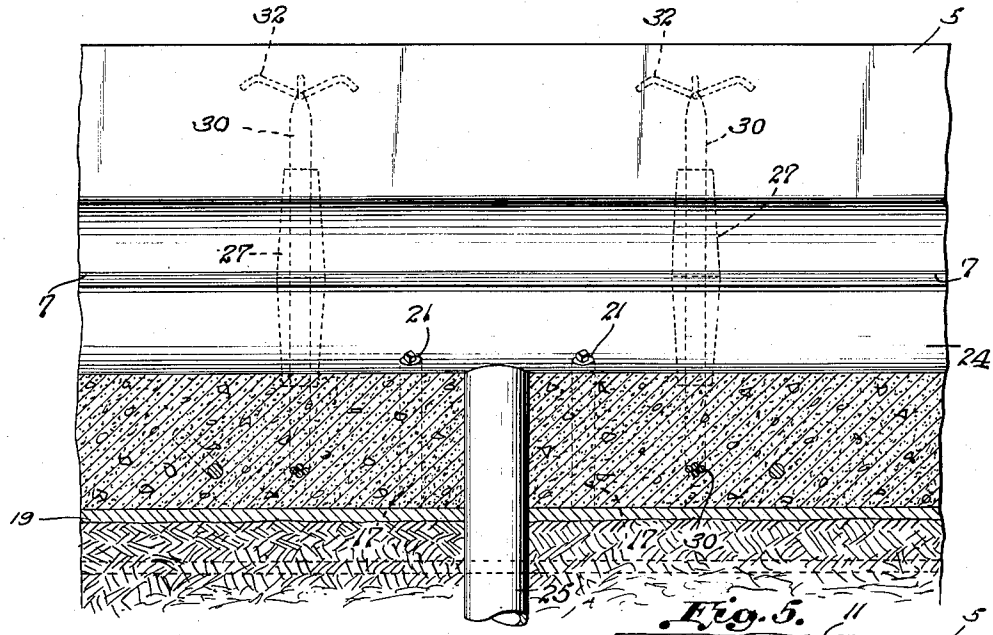


Fig. 4.

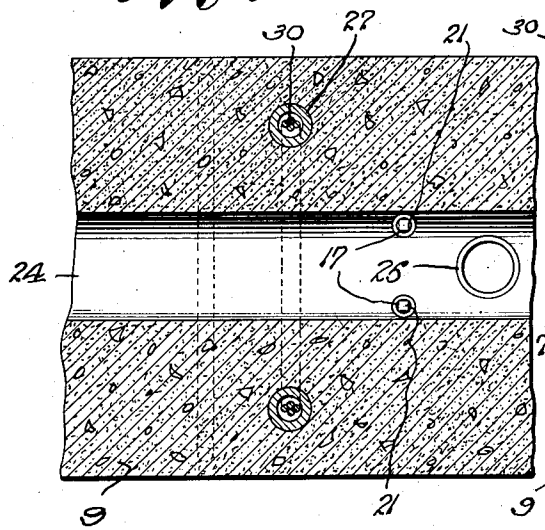
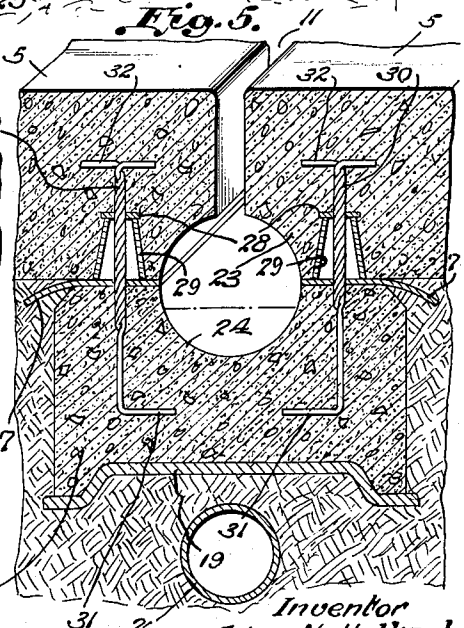


Fig. 5.



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DRAINAGE SYSTEM FOR AIRPORTS AND HIGHWAYS

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11 Claims. (Cl. 94—33)

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This present invention relates to improvements in drainage means used in connection with expansion joints of sectional concrete road construction for highways or airports.

The principal object of the invention is to provide proper drainage in airport construction. The now prevailing practice of drainage is to seal all the joints between the sections of the construction with a view of preventing the infiltration of water from the top surface of the airport. According to my invention the sealing of the joints is entirely eliminated and open joints are provided through which the water on the top surface is drained off and which function as expansion joints and permit the free movement of the slabs in all directions. Therefore, the joints are made wide enough to avoid their total closing when the slabs are in a state of maximum expansion. Thus, the surface water or laitance flows through the open joint and into a drainage pit extending parallel to the joint. Access to the pit may be had to flush the same when desired by water conducted through the drainage pit and then discharged into suitable storm sewers to be thereafter disposed of.

Another object of the invention is to provide means for rapidly and completely draining water from a surface and for eliminating the possibility of the formation of small pools on such surface. Thus, there is no longer any necessity of providing gutters in the surface which may be constructed level.

A further object of the invention is to dispense with the compressible material which under the prevailing system is intended to seal the joints to prevent water from escaping therethrough. This compressible material projects, in times of high temperature, above the surface of the roadway or airport and forms a protuberance which causes a terrific impact when a heavily loaded wheel passes thereover. This impact results in a pounding action on the joints and causes the subgrade to produce a capillary attraction commonly called "pumping" at the joints. This pumping action deteriorates the subgrade and undermines the slabs at their ends. My improved construction prevents the surface water from penetrating to the subgrade and corrects the pumping action.

A still further object of the invention is to provide a simple and inexpensive construction having the advantages above pointed out.

With these and other objects in view which will become apparent as the invention is fully understood, the same resides in the novelty of construction, combination and arrangement of elements hereinafter described in their specific details and claimed in the subjoined claims.

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The description should be read in connection with the accompanying drawings forming part of this specification and illustrating the preferred embodiment of the invention and wherein:

Fig. 1 is a vertical section transverse of the joint and perspective view of a roadway or airport runway according to my invention;

Fig. 2 is a view similar to Fig. 1 but showing slab-carried connecting means for a joint-supporting beam;

Fig. 3 is a vertical section taken longitudinally of the joint;

Fig. 4 is a horizontal section; and

Fig. 5 is a vertical section transverse of the joint and perspective view of the roadway or airport runway according to a modified form of my invention.

In the drawings in which like characters of reference designate like or similar parts, numeral 5 denotes one of the spaced airport or roadway slabs each of which rests on a suitable asphaltic impact or cushion strip 7. The same serves to lessen the resistance to the horizontal movement of the slab resting on the cushion strip, insures a complete separation of the bottom of the slabs and the top of the beams and furthermore functions as a lubricant during the expanding or contracting movement of the slabs, and as shock absorber of a loaded wheel passing the joint 11.

The cushion strips 7 (which may or may not be preformed) are supported by a beam member 9 which extends parallel to the joint 11 formed by the spacing of the slabs, and is located in a depression formed in the subgrade 13. This beam may be precast and is channeled at the bottom as indicated by 15 with a view of maintaining the portion of the subgrade in the channel 15 dry. Thus the capillary attraction and pumping action referred to in the objects of the invention is partially corrected.

To further solidify the subgrade as a bearing surface, openings 17 may be provided in the beam 9 and a lean mixture of concrete or other suitable filler or bearing material may be forced through these openings down under the beam to fill any interstices within the confines of channel 15 and in the subgrade and to form an auxiliary bearing 19.

If desired, pressure plugs 21 may be used in the openings 17 which plugs would tend to level or buoy the beam member up to proper grade before the slabs 5 are poured.

Pressure plugs will be necessary to pressure fill under the beam to buoy up the entire structure in case the beam and slab ends may recede simultaneously due to traffic impact.

After forming the subgrade, a suitable collapsible form or forms will be used for forming the

expansion joint 11 and the chamfered corners 23. After the concrete has sufficiently hardened, the form or forms are removed.

The chamfered corners 23 bound a drainage conduit also bounded by a channel 24 formed in the beam. In the bottom of the channel 24 is one or several drain conduits 25 (see Figures 3 and 4) leading to a storm sewer (not shown in Figures 1–4).

Further resistance to movement of the slabs in any direction is eliminated by the provision of cushion members 27 each positioned in the lower portion of a slab and the adjacent upper portion of the beam. The cushion members are of compressible material and frustro-conical shape and, if positioned in a slab, have the smaller end at the top and, if positioned in the beam, have the smaller end at the lower end. In order to facilitate their ready application to the tension members 30 the cushion member may be split or comprise identical halves lying on either side of the diametrical plane of symmetry.

Each of the tension members 30 is U-shaped and acts as a reinforcement of the beam 9 and a tie between the latter and the ends of the pair of slabs separated by the joint 11. Thus, curling of the slab ends will be presented, also the moving up and down of these ends during the passage of wheels over the open joint.

Each of the tension members 30 may be a solid rod or a flexible member comprising a plurality of twisted rods forming a cable-like structure. The latter type of tension member 30 will lessen the resistance to slab movement and also prevent fracture due to flexing or vibration. The material of the tension member 30 may be galvanized or other rust or corrosion-proof metal.

In the preferred embodiment of Fig. 2, each cable-like tension member 30 has its upper portion terminating in radially spaced hook-like ends 32, each formed by one of the strand rods of the member and serving as anchorages in the concrete bodies of slabs 5.

In the modification of Fig. 5, the slabs 5, separated from one another by a joint 11, rest each on a separating sheet or strip 7, which may be rubber, tar paper or asphalt-coated paper. The same provides lubrication for the slab during its movement on beam 9 and keeps moisture out of the crevice between the slabs 5 and the beam 9. The sheet or strip 7 separating the slabs 5 from the beam 9 also takes up the shock of an impact of a load passing over the joint. This shock absorbing function of the sheet 7 is important in that it prevents a pumping action on the subgrade as it is called in the art. This pumping action tends to undermine the supports of the subgrade in which the beam is embedded.

The casting of the beam 9 may be done on the job or the beam may be precast and hauled to the job.

The employment of a precast beam will almost inevitably lead to cavities and irregularities between the bottom of the beam and the subgrade. Neglect of these cavities and irregularities will deprive the beam of uniform support throughout its length and the ends of the slabs 5 will lack proper support.

n order to remedy such a situation, steps are taken similar to those outlined in the description of the preferred embodiment of Figures 1–4.

The slabs have their adjacent corners cut away as at 23 forming part of a drainage conduit, the other part of which is formed by a depression 24 in the beam and which is in communication with a storm sewer 26. The passage or cutaway under portion 23 of the slabs may be produced by any desired type of removable form, as, for instance, an inflatable tube which may be carried by an element which is interposed between the slabs to provide the joint 11.

The form for casting the slabs may be supported by the beam and could be collapsible so that the form, after setting of the slab, may be removed through the joint 11.

In each slab is a compressible cushion member 29 forming a hollow frustum of a cone with a top 28 for the passage of a tension member 30 which takes the form of a twisted rod or cable-like member. This member is horizontally bent at the lower end 31 in the beam and its strand rods are horizontally bent in opposite directions at the upper ends 32 in the slab.

While I have hereinbefore described and the drawings show the details of a preferred and modified form of my invention, I desire it to be understood that variations of these details may be resorted to within the scope of the appended claims without departure from the spirit of the invention.

What I claim is as follows:

1. In a road or airport runway construction or the like including subgrade-supported slabs spaced from one another to provide an expansion joint therebetween; the combination of a beam embedded in the subgrade below and paralleling the joint between the slabs, said beam having a lineally extending trough in its top surface below said joint, the bottom of said beam having a lineally extending channel, there being lineally extending side shoulders defining said channel and embedded in the subgrade, the top of the beam lying substantially flush with the bottom of the slabs, and injection passageways for filler or bearing material and extending from said trough to said channel whereby filler or bearing material can be injected into the channel at the bottom of the beam.

2. The combination set forth in claim 1, and anti-friction material interposed between the beam and the respective slabs adjacent said joint, whereby to permit relative horizontal movement of the slabs and beam.

3. The combination set forth in claim 1, and relative horizontal movement permitting tie means connecting said beam and slabs, there being an inwardly opening recess in at least one of the opposed beam and slab surfaces through which said tie means extends, said recess providing a shift-permitting space for said tie means at opposite sides thereof in a plane substantially normal to said expansion joint, whereby to maintain the beam in contact with the under surface of the slabs at opposite sides of the joint so as to assure of drainage through the joint getting into the beam-provided trough.

4. The combination set forth in claim 1, and relative horizontal movement permitting tie means connecting said beam and slabs, there being an inwardly opening recess in at least one of the opposed beam and slab surfaces through which said tie means extends, said recess providing a shift-permitting space for said tie means at opposite sides thereof in a plane substantially normal to said expansion joint, whereby to maintain the beam in contact with the under surface of the slabs at opposite sides of the joint so as to assure of drainage through the joint getting into the beam-provided trough, drain means in said subgrade below the plane of said beam-pro-

vided trough, and said beam providing drain passages communicating from said trough to said drain means.

5. In a road or runway construction comprising spaced slabs forming an expansion joint therebetween, a subgrade upon which the slabs are disposed, a beam embedded in the subgrade below and paralleling the joint between the slabs, said beam having a lineally extending trough in its top surface below said joint, a drain in the subgrade, means communicating from said beam-provided trough to said drain, the bottom of said beam having a lineally extending channel and having lineally extending side shoulders defining said channel and embedded in the subgrade, the top of the beam lying substantially flush with the bottom of the slabs and the top of the subgrade, passages extending transversely through said beam from said trough to said channel and the bottom of the beam, whereby to admit of the pumping of filling material therethrough and into the bottom beam-provided channel to provide support for the beam in case the subgrade provides an irregular surface presented to said beam channel, anti-friction material interposed between the beam and the respective slabs adjacent said joint, whereby to permit relative horizontal movement of the slabs and beam, aligned compressible material sleeves in the respective slabs and subjacent portion of the beam, and tie means embedded in the respective slabs and beam and extending through said sleeve means, whereby to connect the beam to each slab while permitting relative horizontal movement of the same as when the slabs expand and contract, and removable plugs closing the passage means between the drain trough of the beam and the under channel thereof.

6. In a road or airport runway construction or the like including subgrade-supported slabs spaced from one another to provide an expansion joint therebetween; the combination of a beam embedded in the subgrade below and paralleling the joint between the slabs, the bottom of said beam having a lineally extending channel, there being lineally extending side shoulders defining said channel and embedded in the subgrade, the top of the beam lying substantially flush with the bottom of the slabs, and injection passageways for filler or bearing material and extending from the upper portion of said beam to said channel whereby filler or bearing material can be injected into the channel at the bottom of the beam.

7. The combination set forth in claim 6 and anti-friction material interposed between the beam and the respective slabs adjacent said joint, whereby to permit relative horizontal movement of the slabs and beam.

8. The combination set forth in claim 6, and removable plugs closing the injection passageways at the upper ends thereof.

9. In a road or airport runway construction or the like including subgrade-supported slabs spaced from one another to provide an expansion joint therebetween; the combination of a beam embedded in the subgrade below and paralleling the joint between the slabs, said beam having a lineally extending trough in its top surface below said joint, the top of the beam lying substantially flush with the bottom of the slabs, and relative horizontal movement-permitting tie means connecting said beam and slabs, there being an inwardly opening recess in at least one of the opposed beam and slab surfaces through which said tie means extends, said recess providing a shift-permitting space for said tie means at opposite sides thereof in a plane substantially normal to said expansion joint, whereby to maintain the beam in contact with the undersurface of the slabs at opposite sides of the joint so as to assure of drainage through the joint getting into the beam-provided trough.

10. In a road or airport runway construction or the like including subgrade-supported slabs spaced from one another to provide an expansion joint therebetween; the combination of a beam embedded in the subgrade below and paralleling the joint between the slabs, said beam having a lineally extending trough in its top surface below said joint, the top of the beam lying substantially flush with the bottom of the slabs, and relative horizontal movement-permitting tie means connecting said beam and slabs, there being an inwardly opening recess in at least one of the opposed beam and slab surfaces through which said tie means extends, said recess providing a shift-permitting space for said tie means at opposite sides thereof in a plane substantially normal to said expansion joint, whereby to maintain the beam in contact with the undersurface of the slabs at opposite sides of the joint so as to assure of drainage through the joint getting into the beam-provided trough, drain means in the subgrade below the plane of the beam-provided trough, and said beam-providing drain passages communicating from said trough to said drain means.

11. In a road or airport runway construction or the like including subgrade-supported slabs spaced from one another to provide an expansion joint therebetween; the combination of a beam embedded in the subgrade below and paralleling the joint between the slabs, said beam having a lineally extending trough in its top surface below said joint and having its sides extending a substantial distance inwardly of the plane of the proximate joint-providing slab faces at times of maximum contraction of the slabs, the top of the beam lying substantially flush with the bottoms of the slabs, and relative movement-permitting tie means connecting said beam and slabs, there being an inwardly opening recess in at least one of the opposed beam and slab surfaces through which said tie means extends, said recess providing a shift-permitting space for said tie means at opposite sides thereof in a plane substantially normal to said expansion joint, whereby to maintain the beam in contact with the under surface of the slabs at opposite sides of the joint and trough so as to assure of drainage through the joint getting into the latter at all stages of expansion and contraction of the slabs.

JOHN NICHOLAS HELTZEL.

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