My invention relates to the forming of joints in concrete roads or the like, and while it is hereinafter described as employed in the forming of either longitudinal or transverse joints in concrete to form weakened lines or division between the sections of concrete, it is capable of use in various other concrete structures where weakened lines or expansion joints are desired, as for instance in concrete tank structures.

In the construction of longitudinal joints in concrete pavements, two methods have been commonly employed. By one method, a slot is formed in the pavement before the concrete is hardened and a precast strip or slab of asphaltic material is then inserted in the slot. By the other method, the slot is formed and is filled by pouring a molten asphaltic material into the slot, after the concrete has dried. Both of these methods are open to various objections.

The pre-cast filler is expensive to manufacture and is difficult of installation, particularly if the slot has become partially filled with dirt or other foreign matter during the period which must elapse while the concrete is drying. If the joint is forced into place while the concrete is plastic, deformation and breaking of the concrete may result.

In the method involving the pouring of a joint by the hot asphaltic material, the concrete must be thoroughly dry or steam will develop in the slot, which will result in the presence of voids in the joint. Furthermore, the slot frequently becomes filled with foreign matter that prevents entry of the joint material. In the making of transverse joints employing a pre-cast filler, the filler is expensive to manufacture and is difficult of installation, it requiring considerable care to support it in its proper position during the operation of deposing and finishing the concrete.

Another objection to the older method of pouring joints arises from the fact that the slots must be made of considerable width in order to insure that the molten mixture will completely fill the same, since in narrow slots the hot mixture becomes chilled and will not flow clear to the bottom of the slot. Various objections incident to the poured joint may be of course overcome, as by cleaning the slot before pouring, and by repouring the joint to fill in cavities which may have developed through the presence of moisture in the concrete, but such operations involve additional expense.

One object of my invention is to provide a method whereby a joint may be poured with cold material immediately after the slot has been formed in the concrete, thus saving the time which would otherwise be required for drying of the concrete previous to pouring the filling material.

Another object of my invention is to provide a means and a method whereby it is possible to form joints that are much narrower than those herefore deemed to be possible in connection with the use of asphaltic fillers either pre-formed or cast.

Another object of my invention is to provide a joint wherein there is better adhesion between the filler and the concrete, thus making for greater permanence of the joint material.

A further object is to enable one to form and seal a tongue-and-groove or interlocked joint without the use of a permanent form which must be left in place.

Still another object of my invention is to simplify and improve generally the making of joints in concrete.

Some of the ways in which my invention may be practiced are shown in the accompanying drawings wherein Figure 1 is a cross sectional view of a portion of a pavement showing one form of slot poured by my method; Fig. 2 shows another form of slot; Figs. 3, 4 and 5 show still other forms; Figs. 6 and 7 show end and side elevational views respectively of a tool whereby a slot may be formed for the joint of Fig. 2; Fig. 8 is an end elevational view of a tool for forming slots similar to those of Figs. 3, 4 and 5; Fig. 9 shows a preliminary step in forming a wide joint for the full depth of the concrete; Fig. 10 shows a further step in the forming of such a joint; Fig. 11 shows a joint slot ready for filling; Fig. 12 shows the joint after filling; Fig. 13 shows the completed joint with the sheet metal plates of Fig. 12 removed; Fig. 14 is a perspective view of the form plate or board of Fig. 9, and Fig. 15 is a perspective view of one of the plates of Fig. 10.

Referring to Fig. 1, the concrete pavement is indicated by the numeral 10. A slot of the desired width is formed therein in various well-known ways, as by the use of form plates or slotting tools. This slot is shown as filled with joint material 11 that is composed of sand or gravel particles and a plastic filler such as emulsified asphalt or emulsified heavy oil. The joint is first filled with the granules, which may be in the form of gravel or coarse sand and the emulsified mixture containing asphalt or heavy oil as then poured into the slot, in a cold condition, and preferably while the concrete is still wet but after it has set sufficiently to be self-sustaining.
The cold liquid will flow down past the granules to the bottom of the slot and completely fill the slot. The water in the emulsified mixture has an affinity for the water or moisture of the concrete so that the joint material will unite with the walls of the slot. When the water has dried out of the filling material, such material will be of a soft plastic consistency similar to the consistency of ordinary elastic joint material.

The granular material is graded so that the grains are of substantially similar size, thus leaving voids through which the emulsified mixture may readily flow to completely fill the slot. The permissible financial outlay for the granular material will, of course, depend upon the consistency of the filling material. The granules could be composed of large and small sizes, but the voids would, in some cases, be too small to permit free flow of the liquid material. On grades, the granules will tend to hold the mixture from flowing out of the slot.

Elastic granules of cork, rubber or sawdust can be employed instead of the sand or gravel, so that they will be compressible and expandable during expansion and shrinkage of the pavement. It will of course be understood that the granules may be omitted and the slot completely filled with the plastic material, if desired.

The pavement 12 of Fig. 2 is shown as having a joint 13 that is of much narrower width than the joint of Fig. 1, and may be as small as 4 inch in width. This joint may extend clear to the bottom of the concrete, or be of only partial depth, as shown, to provide a weakened line that will confine cracks which may be formed in the concrete as indicated in Fig. 4, and as well-known in the art. The slot at 13 is filled by pouring in a hydrated permix or other mix as in the case of Fig. 1, while the concrete is still wet.

The presence of the water in the emulsified mixture facilitates its flowing to the bottom of the narrow slot. If an ordinary hot mixture were employed, it would not readily flow to the bottom of the slot because in case the pavement were damp, steam would be formed, while in any case the hot plastic material would become chilled and stiffened before it reached the bottom of the slot.

These narrow joints are desired in some localities in preference to wider joints, and furthermore permit a more convenient pouring of joints on hills or grades, since the extreme narrowness of the slot prevents the material from flowing out of the slot. The top of the slot is shown as widened as a result of smoothing the corners at 14 by a finishing tool. This widening of the slot also makes it easier to pour the joint material. Gravel or sand is placed in the widened portion of the slot to prevent the liquid from flowing away from it during drying, and to provide a macadam-like wearing surface on the filler through compaction of gravel.

In Fig. 3, the pavement has a slot 16 formed therein which is curved in a vertical direction instead of being straight as is the slot of Fig. 2. This joint will be poured and finished in substantially the same manner as the joint 13, the emulsified mixture readily flowing down the tortuous path in the damp concrete.

In Fig. 4, I show a pavement 17 that contains reinforcing bars or dowel pins 18 and wherein the joint 19 extends only to the bars 18. This joint is similar to the joint of Fig. 5, but is of sufficient depth to provide a weakened line in the concrete so that any further cracks will develop only in the same vertical plane as the slot, as indicated at 20.

In Fig. 5, I show a structure wherein a corrugated metal form 21 is placed in the concrete below dowel pins 22 and wherein a joint 23 similar to the joint 19 is provided above the dowel pins.

In Figs. 6 and 7, I show a hand tool or cutter 25 for forming narrow slots in concrete, such as the slot of Fig. 2. This tool is provided with a cutting blade 26, and finishing and troweling surfaces 27 for smoothing and rounding off the corners of the concrete at the upper portion of the slot.

Fig. 8 shows a similar tool 28, but which has a curved plate 29 for forming slots similar to those shown in Figs. 3, 4 and 5.

With further reference to narrow joints such as shown in Fig. 2, filling material can in some instances be dispensed with. For example, the blade 26 of the tool 25 may be moved back and forth in the slot to smooth the walls thereof, while the concrete is still plastic, but nevertheless is of such stiffness that it will not flow readily.

Upon removal of the tool, the walls of the slot will ordinarily settle into contact with one another, but will not firmly unite with one another. Furthermore, there is usually water on the surface of the concrete during the smoothing operation, which will flow into the slot and maintain separation of the walls thereof. Although the walls of the slot may unite at some points nevertheless a weakened line is present along which cracks in the finished concrete will be confined.

The slot is of such narrow width (perhaps only one-sixteenth of an inch) that no cracks will develop in the concrete through movement of the walls together.

The back and forth movement of the slotting tool tends to bring water to the surface of the concrete, which water may flow into the slot as above-explained. After removal of the tool 25, the surface of the concrete in the vicinity of the slot may be smoothed as by a floating action or by the exertion of some slight pressure to reunite the walls of the cleft at their upper portions, thus producing an unbroken surface, while the line of the cleft is still distinct below the surface, although the walls of the cleft may be in contact with one another throughout their depth. It has been found that this construction constitutes a plane of weakness which is perhaps as effective as if a foreign filling material had been installed in the joint.

In Figs. 9 to 15, I show a manner in which wide joints similar to those of Fig. 1, but extending for the full depth of the concrete may be formed. A sub-grade or road bed is indicated by the numeral 30 and the concrete pavement by the numeral 31.

The method of forming the joints as shown in these figures is particularly applicable to joints disposed transversely of the roadway, although the same procedure may be followed in forming longitudinal joints. In the case of transverse joints, a form board or metal plate 32 is placed on the sub-grade to each side of the center line of the roadway and extending transversely of the center line. These boards or form plates are supported on the road bed in any suitable manner and the concrete 31 is poured against the sides thereof and thereafter smoothed.

After smoothing and finishing of the concrete, 150
and while the concrete is still plastic, metal plates 33 preferably toothed at their lower edges are pushed into place with their lower edges extending into the sub-grade 30, as shown more clearly in Figs. 11 and 12. The plates 33 have flanges 34 at their upper edges to stiffen the same and to protect the corners of the concrete at the form plate 32.

After the plates 33 are in place, the forming board is removed, leaving the slot open as shown in Fig. 11, whereupon granular material such as sand, gravel, cellular rubber or other elastic material, etc., as shown in Fig. 12, and emulsified asphalt, heavy oil or other suitable sealing liquid is poured into the joint. Thereupon, the plates 33 are removed leaving the completed joint 35 as shown in Fig. 13. The pouring is done preferably while the concrete is still wet, so that the water in an emulsified sealing fluid will be readily taken up by the soft concrete before the concrete stiffens. I find that upon final drying of the concrete and the joint material, the slot remains perfectly filled from top to bottom.

I claim as my invention:

1. The method of forming a joint or plane of weakness in concrete which comprises cleaving the material along a predetermined line and simultaneously smoothing the walls of the cleft, while the concrete is still plastic, the cleft being of such narrow width that the walls thereof may move into contact with one another without cracking of the concrete body, and introducing a cold liquid filling material into the cleft.

2. The method of forming a joint in concrete which comprises cleaving the material along a predetermined line while the concrete is plastic the cleft being of such narrow width that the walls thereof may be moved into contact with one another without cracking of the body, and introducing emulsified filling material into the cleft.

3. The method of forming a joint in concrete which comprises cleaving the material along a predetermined line while the concrete is plastic, the cleft being of such narrow width that the walls thereof may be moved into contact with one another without cracking of the body, and introducing a cold liquid filling material into the cleft while the concrete is wet.

WALTER S. EDGE.