United States Patent

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[54] **CONSTRUCTION OF CONCRETE ROAD WITH EXPANSION JOINTS**

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[51] **Int. Cl.**.....**E01c 7/00**

[58] **Field of Search**.....94/8, 17, 18, 22

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[57] **ABSTRACT**

A support apparatus for constructing a concrete road with expansion joints includes a plurality of like-oriented parallel-spaced inverted U-shaped cross members and at least one pair of support members connecting together the cross members with one of the support members being connected to each of the legs at an intermediate point on one side of the cross members and the other of the support members being connected to each of the opposite legs at an intermediate point on the opposite side of the cross members. In constructing a concrete road with expansion joints the support apparatus is first placed on a roadbed in general alignment with the desired location of a particular expansion joint, self-oiling dowel bars are secured adjacent the cross members with the dowel bars resting on the support members and being aligned generally with the longitudinal axis of the road, the concrete is poured for finishing the road, and a groove is then cut in the upper portion of the concrete, prior to the time when the concrete commences to shrink, to a depth sufficient to sever the central elements connecting the legs of the inverted U-shaped cross members but not to a depth sufficient to contact the dowel bars.

8 Claims, 5 Drawing Figures

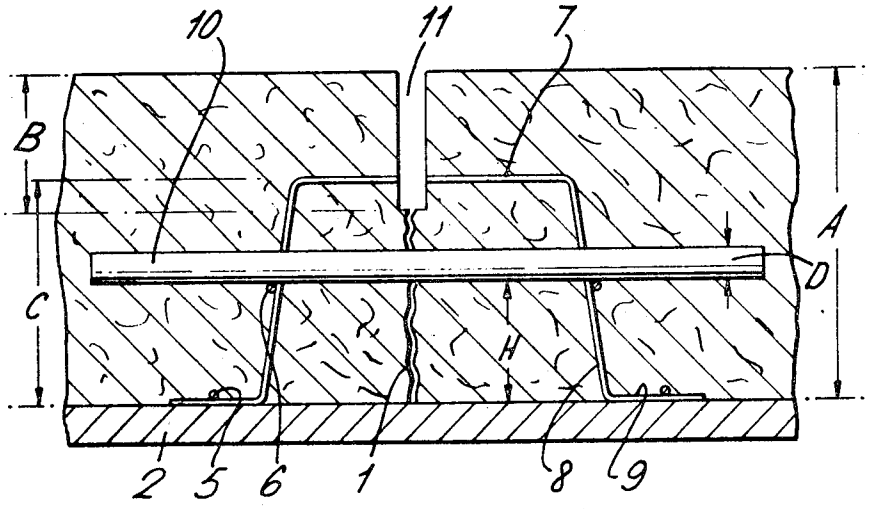

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Fig. 1.

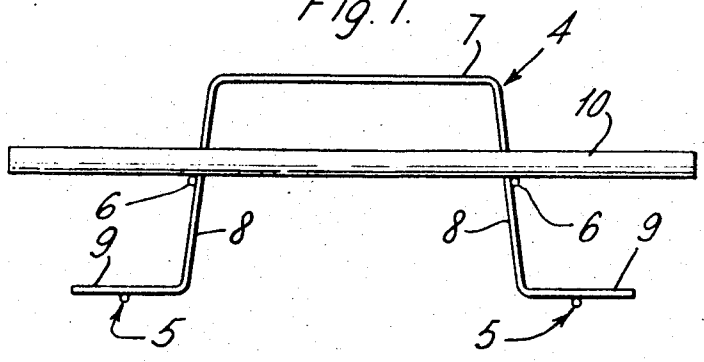

Fig. 2.

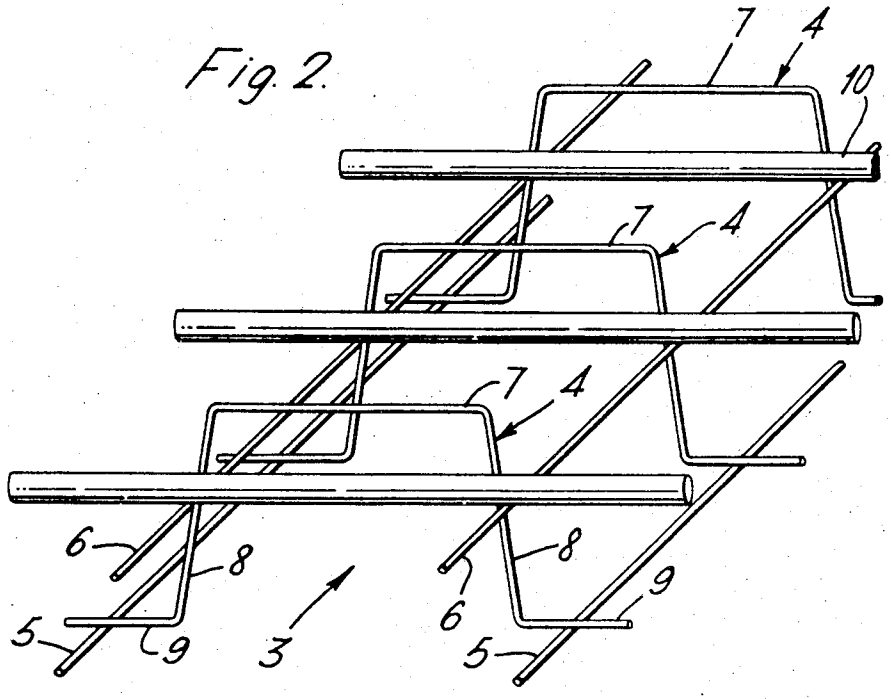

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Fig. 3.

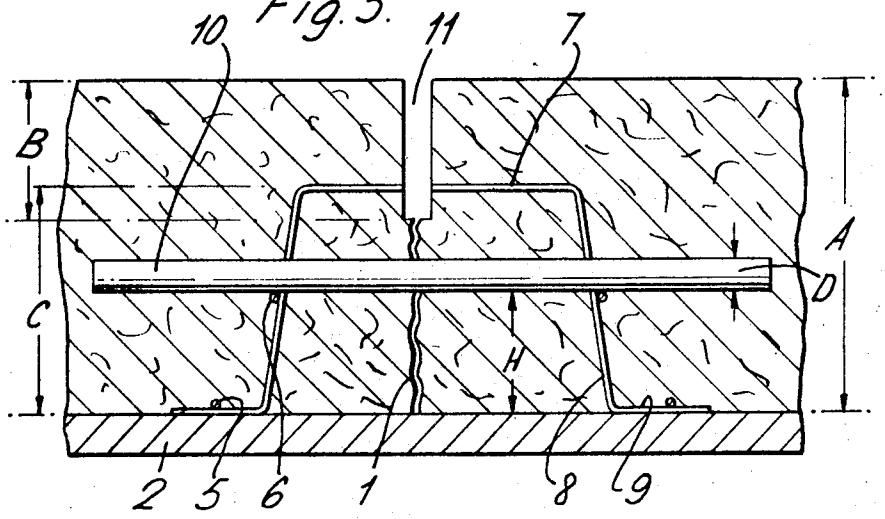


Fig. 4.

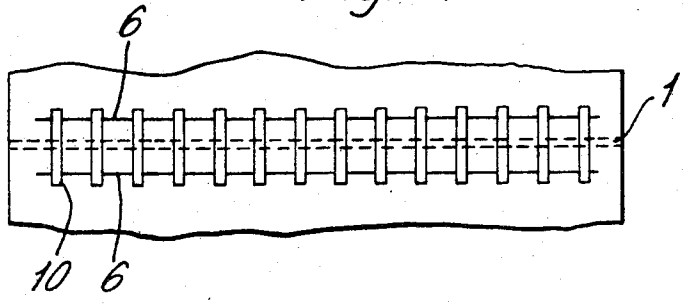
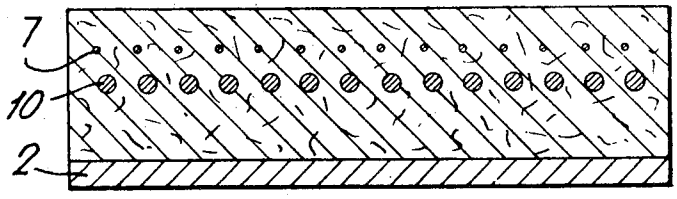


Fig. 5.



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CONSTRUCTION OF CONCRETE ROAD WITH EXPANSION JOINTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus and method for constructing a concrete road with expansion joints and to the concrete road so produced.

2. Description of the Prior Art

The basic method for constructing a concrete road with expansion joints is well-known. Generally self-oiling steel pins or dowel bars, with the aid of supporting elements, are set up parallel to each other and to the longitudinal axis of the road within the space into which the concrete is to be poured and along a line on which the planned expansion joint is to be formed. After the final layer of concrete his been poured and before shrinking of the concrete commences, a groove of sufficient width and depth is made in the upper part of the concrete layer so that when the concrete shrinks during the hardening process, the expansion joint will originate by cracking at the required place corresponding to the aforesaid groove. The pins or dowel bars which are disposed at predetermined positions at certain distances from each other in the concrete sections prevent a mutual sagging of adjacent concrete sections of the road. The pins are made self-oiling by coating them with an oil film or similar material such as a bituminous painting compound.

Heretofore the steel pins or dowel bars have been supported by several techniques. In one of these prior art techniques the pins are embedded in a narrow concrete strip with wooden shutterings and aligned with the position of the desired expansion joint. When the concrete of this strip is sufficiently hard the wooden shutterings are taken away and the adjoining part of the concrete road is poured using vibrators for compacting and spreading the concrete. This particular technique has several disadvantages. For example, the placement and removal of the shutterings requires a considerable amount of labor. Also, the hardening time required for the concrete strips hinders the general progress of the construction operations. In addition, the connection between the concrete strips and the subsequently poured concrete is often faulty. Further, the concrete strips interfere with the passage of the vibrating needles of the concrete pouring machine.

In another technique of supporting the steel pins or dowel bars, a support or wire cradle which consists of wires welded together is placed along each side of the place where an expansion joint is to be formed. Thereafter, the pins or dowel bars are placed in the required positions and at the required distances from each other above the wire supports. Both supports must be precisely fixed on the under-layer of the concrete road. A serious disadvantage of this particular technique is that two wire baskets must be used for each expansion joint and in addition their placement involves a considerable amount of time-consuming and precise work.

SUMMARY OF THE INVENTION

The support apparatus employed in the present invention for constructing a concrete road having expansion joints includes a plurality of like-oriented substantially parallel-spaced inverted generally U-shaped cross members and at least one pair of substantially parallel-spaced support members disposed substantially perpendicular to the planes of the U-shaped cross members and connecting together the cross members, wherein one of the support members is connected at a point intermediate the ends of each of the legs on one side of the cross members and the other support member is connected at a point intermediate the ends of each of the legs on the other side of the cross members. The method of the present invention for constructing a concrete road with expansion joints includes the steps of placing the aforementioned support apparatus on a roadbed in general alignment with the desired location of the expansion joints, prior to pouring concrete for finishing the concrete road, securing self-oiling dowel bars adjacent the cross members with the dowel bars resting on the support members and being aligned generally with the longitudinal axis of the road, pouring concrete for finishing the road to a depth exceeding the height of the support apparatus, and cutting a groove in the upper portion of the concrete prior to the time when the concrete commences to shrink to a depth sufficient to sever the central elements connecting the legs of the cross members but not to a sufficient depth to contact the dowel bars.

It is an object of the present invention to provide a simpler, less expensive and faster method for constructing concrete roads having expansion joints.

It is a further object of the present invention to provide a concrete road with expansion joints which is less susceptible to undesired formation of cracks.

Other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side-elevational view of a preferred embodiment of a support section of the present invention with its corresponding dowel bar;

FIG. 2 is a perspective view of a preferred embodiment of a section of a support apparatus of the present invention and corresponding dowel bars;

FIG. 3 is a partial cross section of a concrete road at the location of an expansion joint embodying a modification of the support apparatus of FIGS. 1 and 2.

FIG. 4 is a schematic top plan view of FIG. 3, but shown on a reduced scale; and

FIG. 5 is a transverse cross section of FIG. 3, but shown on a reduced scale, taken along the line of the expansion joint.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Apparatus for constructing a concrete road in accordance with the present invention, including an expansion joint 1 and an under-layer or roadbed 2, is illustrated in the drawings (see FIG. 3). The support apparatus 3 of the present invention includes a plurality of inverted generally U-shaped cross elements 4 which are welded together with a pair of longitudinal support members 5 and a pair of longitudinal support members 6. Each U-shaped cross element 4 includes a central or middle part or element 7 and two legs 8 connected at one of their ends to central element 7. The legs 8 are

tapered slightly outwardly from top to bottom. Each of the legs 8 at its other end is connected to an arm 9 disposed substantially parallel to the central element 7 and extending in a direction outwardly from central element 7.

The two longitudinal support members 5 reinforce the arms 9 which are attached to the legs 8. The support members 5 are disposed horizontal and parallel to each other substantially perpendicular to the planes of the cross members 4. One of the support members 5 is connected to each of the arms 9 on one side of support apparatus 3 and the other support member 5 is connected to each of the arms 9 on the opposite side of support apparatus 3. The support members 5 may be welded to the undersides of arms 9 as illustrated in FIG. 1 and 2, or to the upper sides as illustrated in FIG. 3.

The other pair of elongated support members 6 are affixed horizontally and parallel to each other at an equal distance under the central element 7. The horizontal support members 6 serve to support the steel pins or dowel bars 10. The pair of support members 6 are disposed substantially perpendicular to the planes of the U-shaped cross members 4 with one of the support members 6 being connected to each of the legs 8 on one side of support apparatus 3 at a point intermediate the ends of the legs 8 and the other of the pair of the support members 6 being connected to the legs 8 on the opposite side of the support apparatus 3 at a point intermediate the ends of these legs 8. The support apparatus 3 thus includes a plurality of substantially parallel-spaced cross members 4 which are each generally oriented in the same direction as the others of the cross members 4. The cross elements 4 constructed in this way facilitate a quick and stable placing of the support apparatus 3 on the under-layer 2 of the concrete road.

In carefully selecting the spacing between the U-shaped cross members 4 of support apparatus 3, it is possible to automatically obtain a constructionally exact placing of the pins or dowel bars 10. The pins or dowel bars 10 can easily and quickly be affixed or secured on the support apparatus 3 by resting them in the corners between the cross members 4 and the longitudinal support members 6 and can be fixed in an adjustable manner in these corners, for example, by means of binding wire. The dowel bars 10 are normally pre-coated with an oil or grease coating. The longitudinal support members 6 are affixed at a predetermined distance below the central element 7 so as to provide a sufficient spacing between central element 7 and the top of the dowel bars 10 to accomplish the purposes of the present invention as will be described hereinafter in further detail.

In carrying out the method of the present invention, the support apparatus 3 is first placed on the under-layer or roadbed 2 in general alignment with the desired location of the expansion joint to be formed, prior to pouring the concrete for finishing the concrete road. The elongated support members 6 are aligned generally parallel with the desired expansion joint 1, with one support member 6 being disposed on one side of the planned expansion joint 1 and the other support member 6 being disposed on the other side of the planned expansion joint 1. The pins or dowel bars 10 are then placed adjacent to each cross member 4 with each dowel bar resting on the support members 6 and being generally aligned with the longitudinal axis of the road.

After securing the dowel bars 10 to the support apparatus 3, as above described, the concrete is poured over the under-layer or roadbed 2 to the desired height, which as indicated in the drawings is represented by the reference letter A. After the concrete has been poured, but before the shrinking of the concrete commences, a groove 11 of sufficient width and depth B is made or cut into the concrete in the upper layer of the concrete above the middle, or approximately, the middle of the pins or dowel bars 10. In making the groove 11, central element 7 of support apparatus 3 is transversely severed or cut. In this way when the shrinking of the concrete occurs during its hardening process, the required expansion joint 1 originates along the line where support apparatus 3 with pins or dowel bars 10 has been placed. Although it will be understood that the support apparatus of the present invention may include more than one pair of longitudinal support members, i.e., other than the pair of support members 6, and that the cross section of cross members 4 may be varied, it is an essential feature of the present invention that in making the groove 11, the support apparatus 3 be longitudinally severed along the transverse axis of the central elements 7 of the cross members 4.

In constructing a concrete road in accordance with the present invention the following design considerations will be followed. When the total height of the support apparatus 3 is C and the diameter of the pins 10 is equal to D and when these pins 10 are supported by longitudinal support members 6 affixed at height H, then the condition is

$$H+D<A-B<C<A.$$

On account of structural considerations, such as the need to obtain a satisfactory relationship between the maximum depth $A-(H+D)$ in which the vibrators can enter into the concrete and the thickness A of the concrete layer on the one hand and the groove 11 depth B on the other hand the following conditions are preferred:

$$\tfrac{1}{4}A<H+D<\tfrac{3}{4}A<A-B<C<A.$$

More particularly, the following values are preferred in practice for a concrete road surface having, for example, a thickness A of 23cm.

Support height C	=	19cm
Supporting height of pin H	=	11cm
Pin diameter D	=	2.5cm
Pin length	=	60cm
Diameter of cross element wire	=	6mm
Diameter of longitudinal wires	=	5mm
Distance between the pins (FIG. 1)	=	30cm
Thickness of under-layer (2)	=	7cm
Length central part (7)	=	24cm
Length end (9) of cross element	=	10cm
Width underside of cross element	=	49cm
Depth B of groove (11)	=	5cm
Width of groove (11)	=	8cm

As will be appreciated from the foregoing description and the accompanying drawings, the present in-

vention offers a number of advantages over prior art designs. More particularly, use of the present invention increases the speed of construction since only one support must be arranged in place for each expansion joint. A further advantage of the present invention is a substantial savings in construction materials. Thus, in the case of the present invention there is approximately a fifty percent savings in support material required as compared with prior art techniques which utilize two wire baskets. The present invention also permits the concrete pouring machine with its vibrating needles to pass without interference over each row of pins to a greater degree than in the case of certain prior art techniques. Further, in the case of the present invention, after the central portions **7** of the cross members **4** are cut or severed, the two support structures reinforce the concrete against undesired crack formation at the corresponding ends of the two respective sections. The present structure also provides connections between the adjacent concrete sections through pins **10** permitting longitudinal shifting of the two adjacent concrete sections while preventing mutual sagging of adjacent concrete sections of the road. In addition the design of the present invention provides an absolutely accurate and simple technique for fixing the pins in the support angles formed by the cross members **4** and the longitudinal support members **6**.

The support apparatus **3** as shown in the figures may be stacked and very easily transported in a compact form. For example, if the transporting of the support apparatus of the present invention in stacked arrangement is a major consideration, the longitudinal support members **6** may be welded to the U-shaped cross members **4** on the interior side of the U, as contrasted with the design shown in the figures in which the support members **6** are welded on the exterior surface of the U-shaped cross members **4**. Also, to facilitate the stacking characteristics of the support apparatus, spot welds may be made at a higher pressure than normal so that the wires at the cross over points are compressed completely into one another and so that the spot weld is not thicker than the wire diameter.

Inasmuch as the present invention is subject to many modifications, variations and changes in detail, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A method for constructing a concrete road with expansion joints which comprises

placing a support apparatus on a roadbed in general alignment with the desired location of an expansion joint prior to pouring concrete for finishing the concrete road,

said support apparatus including a plurality of substantially parallel-spaced inverted generally U-shaped cross members, each of said U-shaped cross members including a first leg on one side, a second leg on the other side and a central element connecting said legs and being generally oriented in the same direction as the others of said cross members, and a pair of substantially parallel-spaced support members disposed substantially perpendicular to the planes of said U-shaped cross members and connecting together said cross members, one of said support members being connected to each of said first legs at a point intermediate the ends of said first legs and the other of said support members being connected to said second legs at a point intermediate the ends of said second legs,

said support members being aligned generally parallel with the desired expansion joint with one support member being disposed on one side and the other support member being disposed on the other side thereof,

securing a self-oiling dowel bar adjacent essentially each U-shaped cross member, said dowel bars resting on said support members and being aligned generally with the longitudinal axis of said road,

pouring concrete for finishing said road to a depth exceeding the height of said support apparatus, and

cutting a groove in the upper portion of said concrete prior to the time when said concrete commences substantial shrinking to a depth sufficient to sever the central elements connecting said legs of said cross members but not to an extent to contact said dowel bars.

2. The invention of claim **1** wherein each of said legs at its other end has an arm connected thereto disposed substantially parallel to said central element and extending in a direction outwardly from said central element.

3. The invention of claim **2** including a second pair of substantially parallel-spaced support members disposed substantially perpendicular to the planes of said U-shaped cross members and connecting together said cross members, one of said second pair of support members being connected to each of the arms on one side of the cross members and the other of said second pair of support members being connected to each of the arms on the other side of the cross members.

4. The invention of claim **1** in which the dimensions of the construction are selected on the following basis:

$\frac{1}{4}A < H + D < \frac{3}{4}A < A - B < C$

wherein:

A = the depth of the final concrete layer

H = the height at which the lower edge of the dowel bars are supported above the roadbed

D = the diameter of the dowel bars

B = the depth of the groove

C = the height of the central elements of the cross members above the roadbed.

5. In a concrete road having expansion joints, the improvement which comprises

a support apparatus placed on a roadbed in general alignment with the location of each expansion joint and embedded in said concrete road

said support apparatus including a plurality of substantially parallel-spaced inverted generally U-shaped cross members, each of said U-shaped cross members including a first leg on one side, a second leg on the other side and a central element connecting said legs and being generally oriented in the same direction as the others of said cross members, and a pair of substantially parallel-spaced support members disposed substantially perpendicular to the planes of said U-shaped cross

members and connecting together said cross members, one of said support members being connected to each of said first legs at a point intermediate the ends of said first legs and the other of said support members being connected to said second legs at a point intermediate the ends of said second legs,

said support members being aligned generally parallel with the expansion joint with one support member being disposed on one side and the other support member being disposed on the other side thereof,

a plurality of self-oiling dowel bars secured adjacent essentially each U-shaped cross member, said dowel bars resting on said support members and being aligned generally with the longitudinal axis of said road, and

a groove cut in the upper portion of said concrete road to a depth sufficient to sever the central elements connecting said legs of said cross members but not to an extent to contact said dowel bars.

6. The invention of claim 5 wherein each of said legs at its other end has an arm connected thereto disposed substantially parallel to said central element and extending in a direction outwardly from said central element.

7. The invention of claim 6 including a second pair of substantially parallel-spaced support members disposed substantially perpendicular to the planes of said U-shaped cross members and connecting together said cross members, one of said second pair of support members being connected to each of the arms on one side of the cross members and the other of said second pair of support members being connected to each of the arms on the other side of the cross members.

8. The invention of claim 5 in which the dimensions of the concrete road are selected on the following basis:

$\frac{1}{4}A < H + D < \frac{3}{4}A < A - B < C$

wherein:

A = the depth of the concrete layer

H = the height at which the lower edge of the dowel bars are supported above the roadbed

D = the diameter of the dowel bars

B = the depth of the groove

C = the height of the central elements of the cross members above the roadbed.

* * * * *