Oct. 20, 1953 | E. FREYSSINET | 2,655,845

CONCRETE PAVEMENT

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Fig. 2

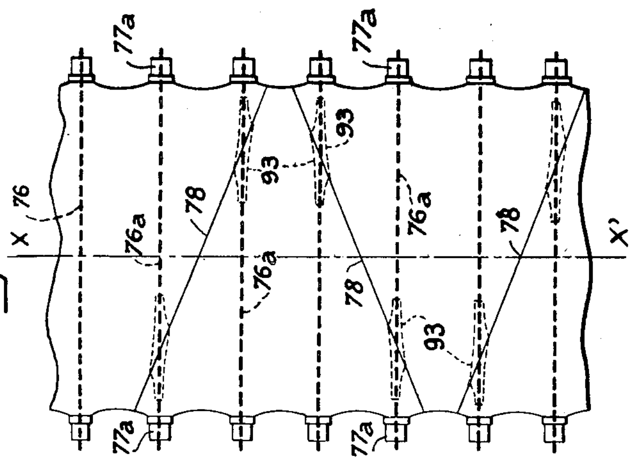


Fig. 3

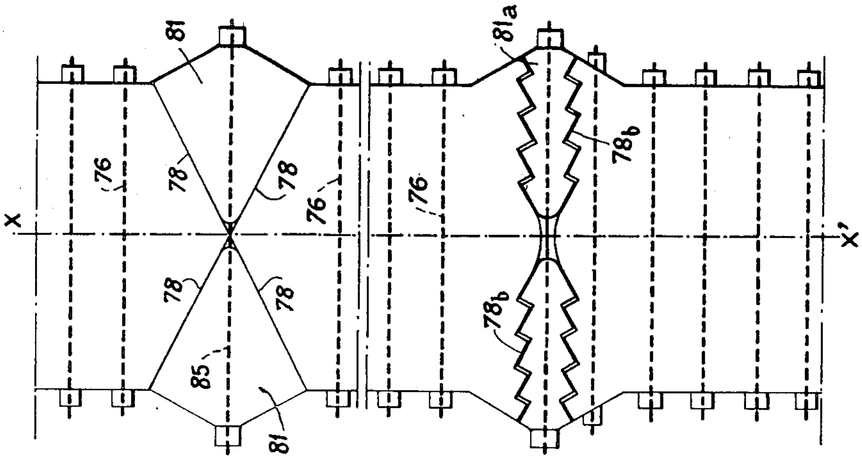
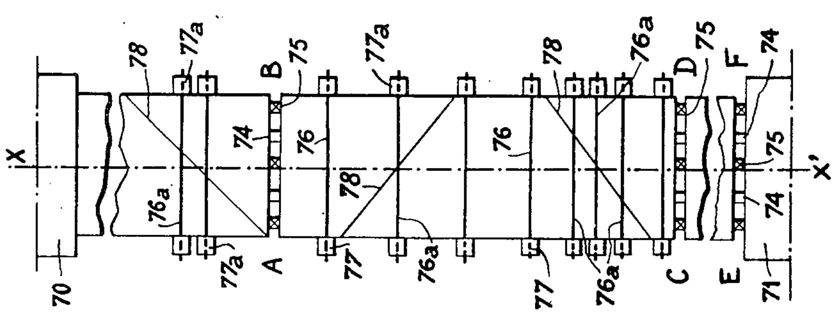


Fig. 1



Inventor
Eugene Freyssinet
By Watson, Cole, Grindle & Watson
Attorneys

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Fig. 4

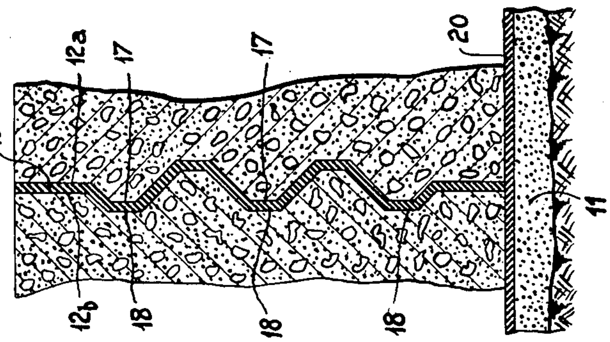


Fig. 5

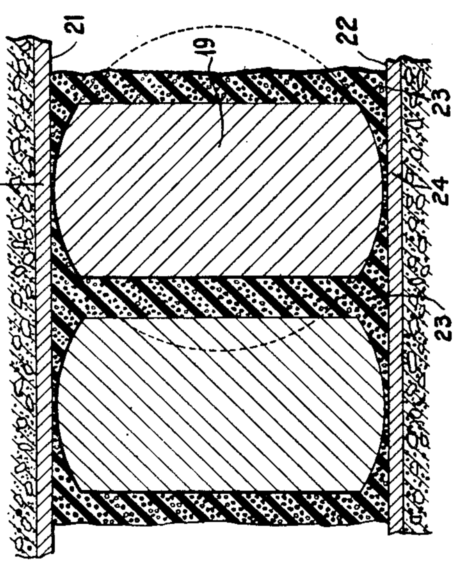
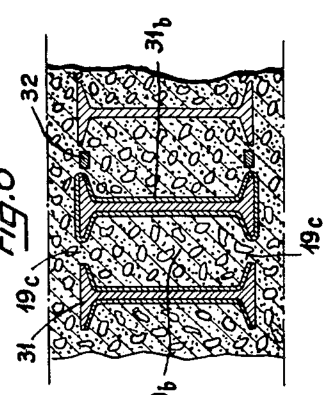


Fig. 6



Inventor
Eugene Freyssinet

Oct. 20, 1953 E. FREYSSINET 2,655,845

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Fig. 7

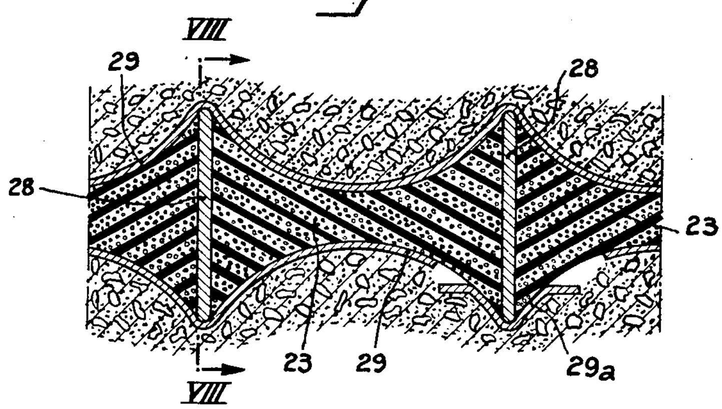
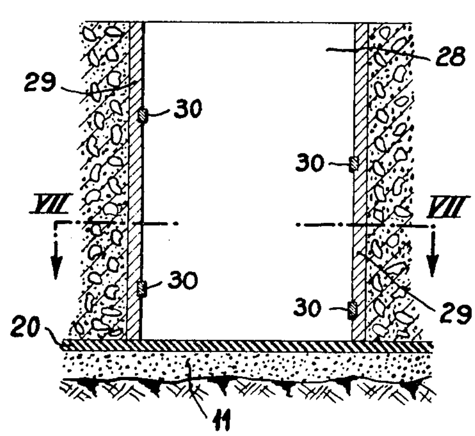


Fig. 8



Inventor
Eugene Freyssinet
By Watson, Cole, Grindle & Watson
Attorneys

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UNITED STATES PATENT OFFICE

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CONCRETE PAVEMENT

Eugène Freyssinet, Neuilly-sur-Seine, France

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In France August 14, 1945

4 Claims. (Cl. 94—8)

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The present invention relates to a method of producing concrete pavements intended to be applied to the surface of the ground in order to create areas of large dimensions capable of receiving heavy loads. It also relates to areas produced by this method and in particular landing strips for heavy airplanes.

It is known that an uninterrupted pavement is capable of withstanding localized moving loads under much better conditions than a pavement having interruptions or gaps (either provided in advance or resulting from the breaking of the pavement), due to the considerable stresses which develop in the pavement when the load passes over such an interruption.

The object of my invention is the provision of a concrete pavement which, although having gaps which allow for expansion, behaves as a continuous pavement under loads.

In accordance with my invention, the pavement is prestressed by being subjected to permanent compressive stress in two different directions, and in said pavement there is provided at least one interruption forming a gap which is oblique with respect to the directions of compressive stress, the two parts of the area located on either side of the said gap being urged against each other by the compressive stress and being capable of sliding with as low a friction as possible with respect to each other.

Preferably, the pressure is exerted positively along one direction, for instance by means of armatures under tension parallel to the surface of the area which pass through the gap surface or surfaces, while the precompression in the other direction is a result of the first precompression and is obtained by abutment of the parallel ends of the area against rigid supports firmly anchored in the ground.

Due to the breaking up of the area by the gap surfaces, the dimensions of the parts of this area divided by the gaps are capable of varying under the action of the temperature or the humidity while the members which are intended to assure the permanent compression of this area behave like springs and permanently maintain the edges of these parts applied against each other, thus assuring the continuity of the surface of the pavement.

The different parts intersected by the gaps are preferably wedge-shaped, the apices being arranged opposite each other in pairs. Upon the expansion of the members, these wedges tend to move away from each other while, if the members contract, the wedges approach each other.

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In order to facilitate the relative movement of the divided parts, the surface of the ground is conditioned in such a way as to reduce as much as possible the friction of the pavement with respect to the ground. For this purpose, the surface of the ground may, for instance, be previously covered with a layer of fine sand on which there is spread, before applying the pavement, a sheet of paper or felt impregnated with bitumen or asphalt.

One of the great advantages of the prestressed areas of my invention is that they can be produced, due to their mechanical continuity, with concrete thicknesses much lower than the thicknesses customary in non-prestressed areas.

In the attached drawings there have been shown by way of example a few embodiments of concrete pavements in accordance with the invention, as well as some examples of gaps between parts of these pavements.

Figure 1 is a general plan view of an elongated area, for instance, a runway for heavy airplanes.

Figures 2 and 3 show variants of concrete areas partially in plan view, Figure 3 illustrating alternative wedge arrangements.

Figure 4 is a vertical section of a first example of a gap between two pavement parts.

Figure 5 is a section through a horizontal plane of a variant of a gap.

Figure 6 shows a method of forming concrete rollers.

Figure 7 is likewise a section along a horizontal plane (corresponding to the line VII—VII of Figure 8) of another variant of a gap.

Figure 8 is a section along line VIII—VIII of Figure 7.

The concrete area shown in Figure 1 has the shape of a very elongated rectangle oriented along the direction XX'. At its two ends, this area rests against two abutments **70** and **71** anchored in the ground. This area is transversely compressed by cables **76** and **76a** anchored at their ends on the edges of the area at **77** and **77a**. Sections parallel to the abutments **70** and **71**, such as AB, CD, EF, are provided in this area, in which are provided jacks **74** which permit the compressing of the area in longitudinal direction, the thrusts obtained from the jacks **74** being maintained by wedges **75**. Oblique gaps **78**, which are at an angle to the axis XX', divide this area into trapezoids. The two portions of the area adjacent each other along a gap **78** are applied against each other by the pressure exerted by the cables **76a**, but these two adjacent portions are capable of sliding parallel to gap 78 with respect to each other.

Various embodiments illustrative of this type of gap are described with reference to Figures 4 to 8.

As shown in Figure 2, the area portions divided by the gap 78 can be of triangular shape. In this case, all the cables 76a pass through the planes of the gaps.

Upon varying the dimensions of two neighboring parts separated by a gap 78, these two parts tend, in the examples shown in Figures 1 and 2, to move perpendicularly to the general direction XX'. In this movement, the cable 76a which passes through the gaps are elongated and behave as springs and tend to return the elements into their original position.

In order to permit the two parts of the cable located on opposite sides of a gap 78 to give in case of variations in dimension of the elements, these cables near the place where they pass over the gap can be housed in sleeves having an expanded portion in the vicinity of the gap, such as 93 in Figure 2, which sleeves can be filled with plastic material such as bitumen.

Instead of arranging the wedge-shaped elements side by side, they can be arranged in such a way that the apices thereof are opposite each other as shown in Figure 3. The two wedge-shaped elements 81 are connected by a cable 85. Other cables 76 assure the compression of the surface in the direction perpendicular to XX' without passing through the gaps 78. The elements 81 may furthermore be replaced by elements such as 81a, the edges of which are saw-toothed and cooperate with gaps 78b, also saw-toothed.

In the case shown in Figure 1, by the action of the jacks 74 there is developed in the concrete a compression in the direction XX' and at the same time the opposing trapezoids which constitute the area tend to move away from each other, perpendicularly to XX', thus increasing the distance between the anchoring means 77a at the end of each cable 76a which intersects a gap 78; since this cable is not directly embedded within concrete, but extends through a plastic sheath, and is only fast with the concrete through its anchored ends, it will be tensioned throughout (the cables 76, which do not pass through the gaps, must be tensioned directly). On the other hand, if abutments such as 70, 71 in Figure 1 are provided at the ends of the area, the tensioning of cables 76a or 85 suffices to impose upon the area a prestressing not only in the transverse direction but also in the longitudinal direction since, due to the tension of these cables, the wedge-shaped elements are brought closer to each other.

The gaps 78 may be treated in various ways.

In the simplest gap or joint, the two opposite edges may be flat, smooth and vertical and may be in contact with each other through the intermediary of any lubricant whatsoever. In order to permit resistance to shearing stresses, this gap must be supported on a foundation.

The use of a foundation can be avoided by making the gap, as shown in Figure 4, in the form of two grooved surfaces which telescope into each other. Thus, in this figure, the grooves 18 provided in the edge of one of the members receive ribs 17 provided in the other member. The faces 12a and 12b of these members may be lined with sheet metal (for instance, anti-frictional metal), the contact surfaces being lubricated to facilitate relative sliding. There can also be provided in the gap a rubber sheet 13 capable of transmitting the compression forces from one member to the other and permitting the relative displacement in direction parallel to the gaps of the two members. It will be noted that the pavement is supported on the ground by a layer of sand 11 and a sheet of asphalt paper 20.

In order to facilitate the relative movement of the contacting faces of the gap, the sliding can be replaced by a rolling by inserting in the gap or joint members capable of rotating, for instance rollers, balls or rods.

In Figure 5, the two opposite faces of the members are coated with metal plates 24, between the surfaces 21 and 22 of which are arranged rollers 19, i. e., solid cylinders, or, as shown in Figure 5, portions of cylinders truncated by planes parallel to the cylinder axis.

Between two consecutive rollers a plastic protective substance may be introduced, such as bitumen, etc., indicated by 23 in Figure 5. The rollers may be of cast iron or of any hard material. In particular, it may be advantageous to make them with the same concrete as the area itself. In this case, the rollers 19b are obtained by providing, prior to the pouring of the concrete of the area, a row of cores 31 of I-shape which are removed after the setting of the concrete and for which there is substituted a filling of plastic material such as bitumen, impregnated porous wood, rubber, etc. Also, cores of such material, wrapped previously with a metal sheet such as 31b, can be provided, the cores remaining imbedded in the concrete after it has set.

The concrete of the tapered zones 19c deforms elastically and permits the relative displacement of the two parts of the area separated by the row of rollers 19b. The concrete of zones 19c may be reinforced by vertical reinforcements 32.

As shown in Figures 7 and 8, rods may also be used for the transmission of the compression from one side to the other of the elements in contact with each other. The facing edges are covered with a scalloped metal sheet 29 between which are arranged flat rods 28. The metal sheets 29 may furthermore be replaced by small members such as 29a. The space between the rods 28 is filled with plastic material 23.

The gaps shown in Figures 5 and 7 may serve as forms for the pouring of the concrete of the area. For instance, the entire unit consisting of the rollers 19, the plates 24 and the filling material can be made in advance. The concrete is then poured in contact with the outer faces of the plates 24. In the case of Figure 7, the rods 28 can be welded at 30, for instance to scalloped metal sheets 29. The assembly thus obtained, filled with plastic material 23, serves as a form. Upon the first displacement of the area, the weld points 30 break and do not prevent the free relative displacement of the members with respect to each other.

In view of the fact that a construction of this type does not run the risk of caving in, the precompression values can be lower than in the usual prestressed concrete structures. The precompressions may be of the order of 30 to 50 kg./cm.^{2} which is sufficient to prevent the progressing of cracks which may occur through the entire thickness of the pavement.

It goes without saying that various modifications may be made in the above described method, in particular by the substitution of equivalent technical means, without going beyond the scope of the present invention.

What I claim is:

1. A concrete pavement comprising at least two consecutive separate sections having spaced, contiguous, angular edges, having a gap therebetween, spacing means in said gap for reducing friction between said adjacent edges on reverse displacements of both sections along the direction of said gap, and two devices, at least one of which is elastic, for applying simultaneous permanent compressive force on said pavement in two directions substantially at right angles to one another, said elastic device obliquely crossing said gap, and extending parallel to the surface of said pavement, said spacing means comprising a plurality of rollers interposed between the consecutive sections, and means supporting said rollers for rotation on axes substantially perpendicular to the pavement surface.

2. The combination with two spaced apart abutments facing one another, of a concrete area interposed between and engaged at its opposite ends by said abutments, said area comprising at least two slabs disposed in end-to-end relationship, said slabs having contiguous planar ends exending from one side of said area to the other, said ends being spaced to provide a gap therebetween, said slabs having substantially undistortable wedge-shaped outlines which taper in opposite directions, whereby the slabs tend to move laterally of the area upon the application thereto by said abutments of compressive forces such as occur on expansion of the slabs, a stretched cable extending laterally of the area and crossing the gap between the contiguous ends of the slabs at an oblique angle, anchoring means for the ends of said cable, said anchoring means engaging the outer faces of the opposite sides of said area so as to maintain said slabs under permanent preliminary compression tending to oppose relative lateral displacement of said slabs; means for preventing bonding of said cable with the concrete, and spacing means in said gap for reducing friction between the contiguous ends of the slabs on relative lateral displacement of the slabs in the direction of said gap.

3. The combination as claimed in claim 2, wherein the spaced apart abutments include jacks adapted to apply compressive forces to the

concrete area longitudinally thereof thereby tending to cause lateral displacement of the slabs and further compression of same through the agency of the stretched cable.

4. The combination as claimed in claim 2, wherein the spacing means comprise a plurality of rollers interposed between the consecutive slabs, and means supporting said rollers for rotation on axes substantially perpendicular to the upper surface of the concrete area.

EUGÈNE FREYSSINET.

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