

March 25, 1952

L. COFF

2,590,685

PRESTRESSED CONCRETE STRUCTURE

Filed Dec. 4, 1947

FIG. 1

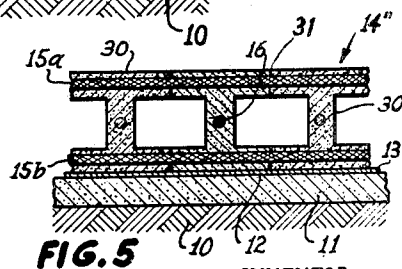
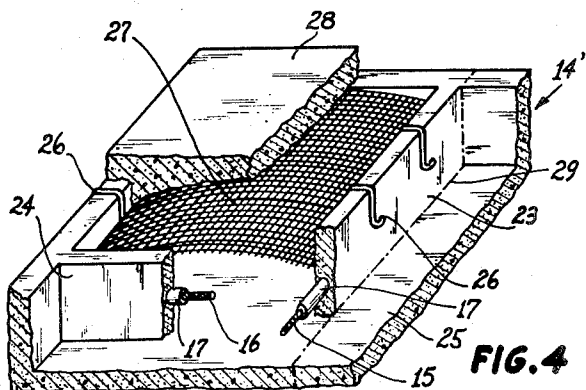
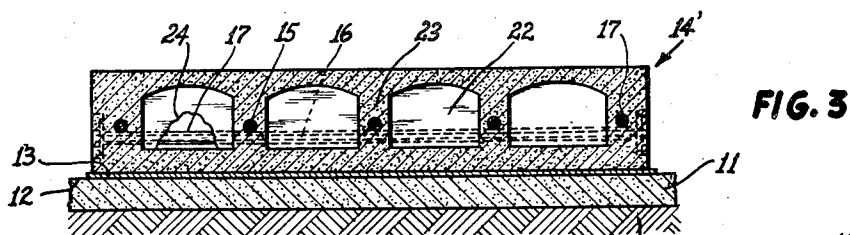
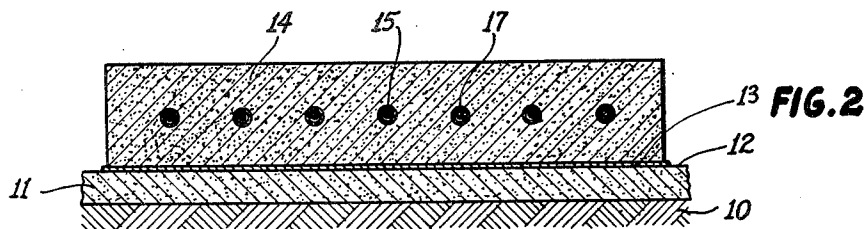
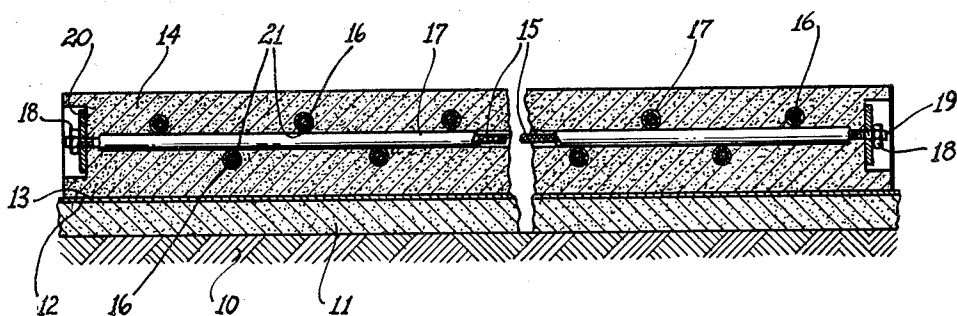


FIG. 5

INVENTOR.

LEO COFF

BY

Karl F. Ross
AGENT

UNITED STATES PATENT OFFICE

2,590,685

PRESTRESSED CONCRETE STRUCTURE

Leo Coff, New York, N. Y.

Application December 4, 1947, Serial No. 789,704
In Great Britain February 6, 1947

5 Claims. (Cl. 94-4)

1 The present invention relates to concrete road slabs as used for automotive highways, airfield runways and the like.

The contraction and expansion of road slabs under varying atmospheric conditions has always given rise to difficulties. While expansion, alone, does not ordinarily present a problem provided sufficient end play is available to prevent warping, contraction (whether due to temperature changes or to shrinkage) will generally lead to the formation of undesirable cracks. This phenomenon is due to the so-called subgrade drag, which opposes to the free contraction of the slab a tensile force proportional to the weight of the contracting portion plus any load thereon and also to the coefficient of friction between the slab and the ground. Since concrete can take but little tension even if conventionally reinforced, cracks will result; although the reinforcements will tend to prevent these cracks from widening, they may still become the seat of appreciable quantities of moisture which, particularly under freezing conditions, may lead to the early deterioration of the slab.

To counteract this tendency to crack, it has been the practice to subdivide each slab into numerous portions each of relatively small weight, whereby the aforementioned tensile stresses will be reduced. The joints existing between adjacent portions, however, have proved a new source of trouble, requiring considerable maintenance and care. The filling of these joints with mastic or similar substances has never been fully satisfactory, resulting in surface irregularities at both high and low temperatures. Also the transfer of forces at the joints, effected in most cases by dowels, has proved unsatisfactory.

An object of the invention is to provide a method of making concrete slabs of relatively large area, without the need for subdividing the slab into portions spaced horizontally.

Another object of the invention is to provide a slab in which the aforesaid joints are eliminated or at least substantially reduced in number.

A further object of the invention is to provide a road slab for a highway or airfield runway presenting a substantially unbroken surface over a wide area.

In accordance with the invention, the problem of preventing the subgrade drag from cracking the concrete is solved not by reducing the weight of the concrete through the provision of vertical joints, but by reducing the coefficient of friction between the slab and its support, as a first step, and by increasing the tensile strength of the concrete, as a second step. To carry out the first measure, I provide a foundation or base of suit-

2 able material which rests on the ground and may expand and contract at will, any cracks developing therein being unimportant since they will not be exposed. On top of this base I place the slab, and between the base and the slab I insert an agent which will reduce the coefficient of friction of the concrete with respect to the material of the base. Such an agent may be a layer of paraffin to which may be added a layer of tar paper or the like bonded to the slab but slidable on the paraffined foundation; yet the coefficient of friction may also be reduced by the insertion of one or more metal sheets or the like. In this manner it will be possible to reduce the force opposing contraction to tolerable magnitudes, even where the weight of the slab is relatively great.

In order to increase the tensile strength of the slab, the latter may be prestressed by various methods in either one or two directions. This may be accomplished by means of wire strands imbedded in the concrete, these strands being placed under initial stress as by mechanically tensioning the sheathed strands (e. g. at the ends) and anchoring the ends of the wires to the slab, and/or by the use of expanding concrete. Alternatively, the wires can be tensioned against outside anchors before pouring the slab, and released against the concrete after the latter has hardened. It should be noted that the base or foundation may likewise be either reinforced or prestressed, if desired, for the purpose of minimizing or avoiding crack formations in the latter.

The above and other features and objects will become more fully apparent and the invention will be better understood from the following description, taken in conjunction with the accompanying drawing in which:

Fig. 1 is a longitudinal sectional elevation of a road slab according to the invention;

Fig. 2 is a transverse sectional elevation of the slab shown in Fig. 1;

Fig. 3 is a view similar to Fig. 2, showing a modified slab;

Fig. 4 is a fragmentary perspective view of the slab shown in Fig. 3, illustrating a method of making the same; and

Fig. 5 is a view similar to Fig. 1, showing a further modification.

As shown in Fig. 1, there is supported on the ground 10 a base or foundation 11 having a sliding surface 12. The base 11 may be a screed of cinder concrete, a layer of evenly aligned terracotta tiles and so forth. The surface 12 is preferably paraffined and carries a layer 13 which may be tar paper bonded to the slab 14 resting thereon. The layer 13 may also be a metal sheet. The

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provision of this layer 13 on the sliding surface 12 prevents the slab 14 from bonding to the foundation 11 and reduces to a minimum the coefficient of friction between the latter and the slab.

Figs. 1 and 2 show how the slab 14 may be prestressed in two directions by a set of longitudinal wires 15 and a set of transverse wires 16. The wires 15, 16 run in sheaths or pipes 17 so as not to be bonded to the concrete, and are maintained under tension by means such as nuts 18 engaging the threaded ends 19 of the wires. Anchor plates 20 serve to distribute the compressive force exerted upon the slab by the tendency of the wires to regain their original length.

According to a further feature of the invention, buckling of the slab 14 under pressure from the anchor plates 20 may be prevented by placing the transverse wires 16 alternately above and below the longitudinal wires 15 so as to form points of contact 21 therewith. Experiments have shown that this expedient reduces the effective buckling length of the slab to the distance between adjacent points of contact 21, thus preventing buckling even for relatively great longitudinal stresses.

According to still another feature of the invention, the subgrade drag may be reduced by diminishing the weight of the slab without, however, resorting to vertical jointing. This may be accomplished, as shown in Fig. 3, by providing the slab 14' with a plurality of cavities 22 which are formed between longitudinal ribs 23 and transverse ribs 24. The ribs 23, 24 may have imbedded therein the sheaths 17 for the wires 15 and 16, respectively, as best seen in Fig. 4, although it is to be understood that these wires may also extend across the cavities 22.

Fig. 4 illustrates a method of manufacturing the slab 14' shown in Fig. 3. It will be seen that the slab is originally formed with a bottom layer 25 carrying the intersecting ribs 23, 24, said ribs being provided with stirrups 26 to accommodate permanent forms of wire lath 27 of convex shape. The forms 27 serve as a support for the upper layer 28 which is poured last.

The members 23, 24, 25 of the slab 14' may be either poured or precast, it being understood that in the latter case the slab may be composed of sections (as indicated by the chain-dotted dividing line 29) which are subsequently joined together by the common poured top layer 28, whereby a monolithic structure is formed.

Furthermore, a slab of the type disclosed in Fig. 3 may be composed of separate wide-flange sections, such as I-sections or channels, stressed together by wires or strands so as to coact monolithically. Such an arrangement is shown in Fig. 5.

In this figure, a plurality of wide-flange I-sections 30 are placed alongside one another to form the slab 14''. Wires 15a, 15b, running longitudinally of the slab as before but extending transversely of the sections 30, serve to hold the sections together while at the same time prestressing the slab in one direction, the prestressing in a direction perpendicular thereto being accomplished by the wires 16 extending within the webs of respective sections. Generally, the members 30 will be precast in which case no sheathing of the wires will be necessary. It is to be understood that the abutments 31 between adjacent slabs are distinct from the vertical joints previously mentioned, since the sections 30 are not spaced from one another but are firmly

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stressed together whereby the layer 14'' will act like the monolithic structure shown in the preceding figures.

Although the concrete structure in accordance with the invention has been described in the foregoing as comprising a slab supported on a foundation or base, it will be understood that the invention may also be considered as providing a method of making an extended, substantially unbroken concrete surface by forming a slab, dividing said slab along a horizontal plane (12) to form two superposed portions (11 and 13, 14), and reducing the coefficient of friction between said two portions. The upper portion 15 may be made hollow to reduce the weight thereof, as by the provision of cavities 22, and may be prestressed in any suitable manner.

Furthermore it is emphasized that the embodiments shown and described serve merely for purposes of illustration rather than limitation, numerous modifications and adaptations thereof being possible without exceeding the spirit and scope of the invention as defined in the objects and in the appended claims.

I claim:

1. A concrete structure comprising a solid foundation having an even horizontal surface, a substantially unbroken concrete slab resting on said surface, said foundation being at least coextensive with said slab, anti-friction means substantially coextensive with said slab and interposed between said foundation and said slab, and prestressing means in said slab maintaining same under horizontal compression.

2. A concrete structure comprising a solid foundation having an even horizontal surface, a substantially unbroken concrete slab resting on said surface, said foundation being at least coextensive with said slab, anti-friction means substantially coextensive with said slab and interposed between said foundation and said slab, and first and second prestressing means in said slab maintaining same under horizontal compression, said first and second prestressing means extending at substantially right angles to each other.

3. A concrete structure comprising a solid foundation having an even horizontal surface, a substantially unbroken concrete slab resting on said surface, said foundation being at least coextensive with said slab, said slab being provided with internal cavities, anti-friction means substantially coextensive with said slab and interposed between said foundation and said slab, and prestressing means in said slab maintaining same under horizontal compression.

4. A concrete structure comprising a solid foundation having an even horizontal surface, a plurality of elongated concrete members positioned on said surface alongside one another, prestressing means extending transversely of said elongated members and stressing same together, thereby effectively forming an unbroken slab, said foundation being at least coextensive with said slab, and anti-friction means substantially coextensive with said slab and interposed between said foundation and said elongated members.

5. A concrete structure comprising a solid foundation having an even horizontal surface, a plurality of elongated concrete profiles having coextensive upper and lower flanges, said profiles being positioned on said surface alongside one another with corresponding flanges abutting, prestressing means extending transversely of said elongated profiles and stressing same together, thereby effectively forming an unbroken slab

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having internal cavities, said foundation being at least coextensive with said slab, and anti-friction means substantially coextensive with said slab and interposed between said foundation and said profiles.

LEO COFF.

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