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CONCRETE STRUCTURE AND METHOD OF PRODUCING,
MORE PARTICULARLY ROADWAYS AND THE LIKE
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1,955,421

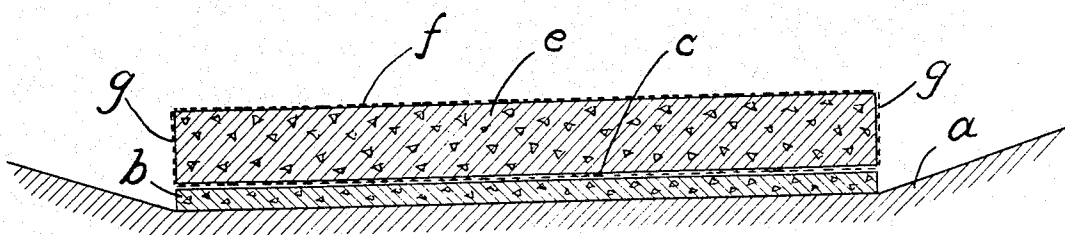


FIG. 1.

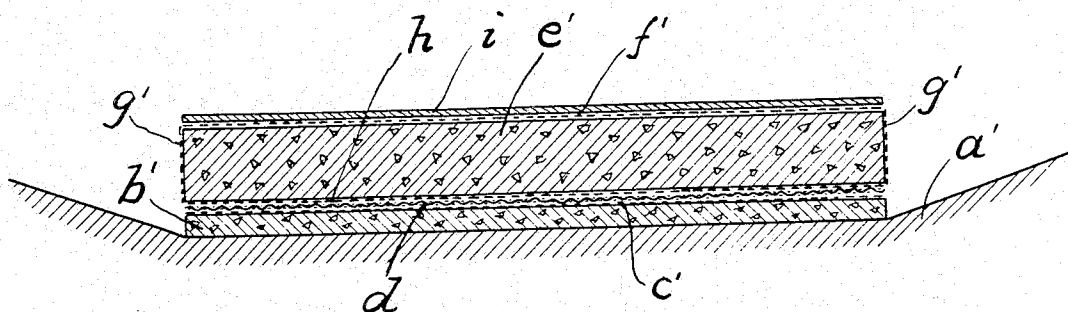


FIG. 2.

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UNITED STATES PATENT OFFICE

1,955,421

CONCRETE STRUCTURE AND METHOD OF
PRODUCING, MORE PARTICULARLY
ROADWAYS AND THE LIKEHarold P. Hayden, Woodbridge, N. J., assignor to
The Barber Asphalt Company, Philadelphia,
Pa., a corporation of West VirginiaContinuation of application Serial No. 319,445,
November 14, 1928. This application May 9,
1933, Serial No. 670,153

14 Claims. (Cl. 94-9)

My invention relates to an improvement in concrete structures and more particularly relates to concrete structures in which the concrete is formed in slabs, as in roadways, sidewalks, platforms, floors, and the like.

Heretofore concrete structures of the character to which my invention more especially relates have been relatively ineffective due to inefficient curing and to variation in moisture content of the concrete after curing.

The efficient curing of concrete is a matter of the greatest importance to the character of the concrete and more particularly to its strength and wear resisting qualities. If the concrete be inefficiently cured it will be relatively soft and will not effectively withstand loading or wear. In the curing process, which involves the hydration of the cement content of the concrete, it is essential that sufficient water be retained in, or supplied to the concrete mixture to enable the effective hydration of the cement, and, at the same time, the surface of the concrete must be protected against rapid drying out in order to avoid hair cracking.

Concrete after it has been properly finished and cured is porous to a degree such that it will absorb or lose moisture depending upon moisture conditions in the subgrade and the atmosphere, and it has been determined that concrete will expand and contract to a considerable extent as a result of either increase or decrease in the moisture content thereof. This expansion or contraction can, of course, be absorbed in properly designed expansion joints as far as the slab as a unit is concerned, but as most concrete used in highway construction or the like is reinforced with steel which remains of constant length regardless of the moisture content of the concrete such changes in moisture content result in the development of stresses which frequently result in the rupture of the slab. It is therefore desirable to maintain the moisture content of the slab constant throughout its life. In addition to stresses developed between the concrete and the reinforcing steel as a result of changes in the moisture content of the former, there is also a tendency for the distortion of the slab, due to variations in the moisture content from top to bottom of the slab, particularly when such slabs are used in roadway, platform, sidewalk or floor construction. The moisture of the subgrade tends to maintain the bottom of the slab in a relatively saturated condition, whereas exposure to a dry atmosphere and solar heat tends to materially reduce the moisture content of the up-

per portion thereof. Under these conditions the bottom of the slab tends to expand and the upper portion of the slab tends to contract with the result that the ends and edges of the slab are raised slightly with respect to the body thereof, leaving the ends and edges in an unsupported conditions with respect to the subgrade. Under the load and impact of modern traffic this frequently results in the rupture of the slab, particularly near the ends thereof.

In the curing of concrete by methods generally used heretofore, it has been customary, or example to cover the surface of freshly laid concrete with burlap which is maintained wet by sprinkling, until the concrete has set, or become hard enough to stand a substantial weight without marring, after which the burlap is removed and the surface of the set concrete is covered with earth, straw, or the like. Other methods of curing concrete have, for example, involved the building of a dike about the concrete and maintaining a pool of water on the surface; covering the surface of the concrete with tar after it has set and in accordance with the method disclosed in United States Letters Patent No. 1,684,671, dated September 18, 1928, obtained by me, involving the application of a water impervious film to the exposed surface of the concrete as soon as the surface is finished, or before the concrete has set, i. e., reached a condition such that it will bear any substantial weight, such as that of a man, without marring.

Heretofore the protection of concrete after curing for the stabilization of its moisture content has had little attention, the only method for such purpose known to me being that of United States Letters Patent No. 1,684,624, dated September 18, 1928, obtained by me and which is directed to a method involving encasing concrete, when poured, with a water impervious material adapted to remain permanently affixed to the concrete, thus protecting the concrete during the curing period and operating to stabilize its moisture content thereafter.

Now, it is the object of my present invention to provide a concrete structure and method for its production, the structure being more especially adapted for use as a roadway, platform, floor, or the like, and of such a character that the concrete will be adequately protected during the curing period, to insure its efficient curing, and to insure that thereafter its moisture content will be stabilized at a point and to such an extent that it will be substantially free from expansion and contraction due to changes in the

moisture content and consequently free from strains caused thereby.

In accordance with my invention, I provide for the efficient curing of a concrete structure, such as a roadway, platform, sidewalk, floor, or the like, where the concrete is laid in slab form and, at the same time, for the permanent stabilization of its moisture content. In carrying out my invention in a practical manner, the base upon which the main concrete slab is laid is thoroughly and permanently waterproofed so that the main concrete slab when laid is laid upon a thoroughly waterproof base. When the main slab is laid, provision is made for its efficient curing, and at the same time, for the protection of its exposed surfaces, so that the main slab when laid is, as it were, encased by waterproofing material adjacent all its surfaces and of such a character adjacent the various surfaces as to most adequately afford permanent protection in view of the particular use for which the slab may be intended. My invention thus contemplates provision for the retention of requisite moisture in the concrete for the efficient curing of the concrete and, at the same time, for the stabilization of the moisture content of the concrete after it has cured. As a result of the practical application of my invention, concrete structures are produced having maximum strength and, at the same time, free from stresses and strains arising as the result of changes and variations in the moisture content thereof.

As will be obvious, my invention is capable of wide variation in practical adaptation and may be applied to concrete structures for various uses. By way of illustration of the practical adaptation of my invention, I will now describe its application to the production of roadways, though it will be understood that the structures described are adaptable for other uses, as, for example, platforms, floors, and the like, where the concrete may be formed in slabs.

For example, in the production of a roadway in accordance with my invention, the usual excavation is prepared and a subgrade is formed by compacting the bottom of the excavation as with a roller, or by providing and compacting a layer of crushed stone on the bottom of the excavation, or otherwise as may be dictated by the character of the soil, or by usual practice.

Upon the sub-grade is laid a preliminary slab of concrete, which desirably is of sufficient thickness to support a concrete mixer for use in laying the main roadway and may be, for example, about two inches thick. As soon as practical after the preliminary slab is poured and in any event before it has set, or reached a condition in which it will support a substantial weight, as of a man, without marring, the surface of the slab is coated with a water impervious film, which may be formed of a bituminous paint-like material, as, for example, asphalt cut with a suitable solvent, or a water-external-phase bituminous emulsion. The film may be formed, for example, by spraying the paint-like substance, or bituminous emulsion, upon the surface of the slab, as, for example, is disclosed by United States Letters Patent No. 1,684,671. The preliminary slab is then left to cure.

The provision of the water-impervious film on the surface of the preliminary slab will insure the retention in the slab during the curing period of the requisite moisture to effect efficient curing and the slab when cured will possess relatively great strength, all of which is more par-

ticularly described in Letters Patent No. 1,684,671.

After the preliminary slab has sufficiently cured, which may require from several days to several weeks after pouring, a waterproofing system is formed on the surface of the slab. The waterproofing system may be formed by merely mopping hot waterproofing asphalt, or other suitable bituminous material, on the surface of the slab to which it will adhere through the intermediary of the bituminous film thereon. Preferably, however, the waterproofing system is formed by first mopping hot waterproofing asphalt on the surface of the slab and then applying a layer of waterproofing fabric or saturated felt, such as a bituminously saturated fabric or felt, over which is applied a second mopping of hot waterproofing asphalt.

In forming the waterproofing system on the surface of the preliminary slab where, for example, waterproofing fabric or saturated felt is used in addition to the application of waterproofing asphalt, the fabric or felt should be laid on the surface in strips, the edges of which should substantially overlap and on the application of waterproofing asphalt to the fabric or felt care should be exercised to insure that the overlapping edges of the fabric or felt are thoroughly sealed.

After the formation of the waterproofing system, the main roadway slab is laid thereover by, for example, the pouring of concrete to form such slab in the usual manner. The waterproofing system should be protected against damage from construction traffic or the movement of the concrete mixer thereover by suitable means; as, for instance, dusting the surface of the waterproofing system with stone dust or Portland cement to prevent its adherence to truck wheels, and covering temporarily with boards or sheets of steel to prevent damage from contact with the wheels of the concrete mixer. As soon after the pouring of the main slab as is practical and, in any event, before the main slab has set, or reached a condition such that it will support a substantial weight, as of men walking on it, without marring, the upper surface of the main slab is coated with a water-impervious film of bituminous paint-like material, such as was applied to the surface of the preliminary slab. As in the case of the preliminary slab, the film may be formed on the surface of the main slab by spraying thereon asphalt, or other suitable bituminous material cut with a suitable solvent, or a water-external-phase bituminous emulsion, for example, formed with asphalt or other suitable bituminous material. As soon as feasible the forms are removed from the edges of the slab and the exposed edges thereof are coated with a suitable bituminous material such as was used for coating of the upper surface of the slab. The main slab is then permitted to cure and will cure efficiently due to the maintenance of the requisite water content for efficient hydration of the cement by the water impervious film.

When the main slab has cured, it may be put into use and its water content will be stabilized, or, in other words, its water content will not be affected by changes in the moisture content of the atmosphere or sub-grade due to the presence of the water impervious waterproofing system, which will be effective to prevent loss of moisture from the slab and absorption of moisture by the slab under changes in the moisture content of the atmosphere or sub-grade.

If use of the slab involves subjecting its upper surface to substantial wear, as in the case of a roadway, the water impervious film applied to the

top surface of the slab may be made of substantial thickness and care should be taken during the life of the slab to effect repair of the film from time to time as wear occurs. Where the slab is subjected to substantial wear, such as would require frequent repair of the film, and in any event, if desirable, the film on the upper surface and also on the edges of the slab may be supplemented. For example, after the slab is cured the edges may be mopped with hot waterproofing asphalt, and, if desired, after the mopping, waterproofing fabric, or saturated felt, may be applied to the edges and provided with a coating of waterproofing asphalt. The film on the upper surface of the slab may be supplemented by, for example, the application of a wear surface, which may be of any well known character, as, for example, a layer of sheet asphalt, asphaltic concrete, or other bituminous material.

The structure above described, it will be noted, involves a main slab constructed on an effective waterproof base, which serves to waterproof the underside of the slab. The slab when laid is protected from loss of moisture during the curing period, with the result that the cement is efficiently hydrated and a slab of great strength produced. The slab is further permanently protected against changes or variations in the moisture content thereof by the waterproof base and by the film which has been applied to its exposed surface, which film, as indicated, may be maintained by repair or supplemented for protection against wear or deterioration by the use of a membrane waterproofing system at the edges of the slab and by providing its upper surface with a waterproofing and wear-resisting system.

As an illustration of an alternative adaptation of my invention to practice, an excavation having been prepared and a suitable sub-grade formed by compacting, or by the application of a layer of crushed stone and compacting, a preliminary concrete slab is poured and levelled off to (say) 1" in thickness. As soon as the preliminary slab has been leveled off and roughly surfaced, its surface is covered with strips of asphalt saturated, or asphalt saturated and coated, felted or woven fabric. The strips are preferably cut into suitable lengths to extend transversely across the width of the slab in order that the extent of the slab which may be poured by the mixer from one position may be rapidly covered with the felted or woven fabric. The strips of felted or woven fabric are laid with their edges substantially overlapping and are desirably secured together by, for example, any suitable bituminous cement material. After a section of the preliminary slab is laid and covered with felted or woven fabric, the reinforcing steel for the main slab is placed in position and the main slab then poured in the usual manner without moving the mixer.

In pouring the main slab care should be taken to avoid completely covering the felted or woven fabric nearest to the mixer, in order that when the mixer is moved for the pouring of a continuation of the preliminary slab, the felted or woven fabric placed thereover may be overlapped with the felted or woven fabric covering the previously poured section of the preliminary slab. After the main slab has been poured, and as soon thereafter as practical, in any event before the main slab has set or reached a condition in which it will withstand substantial weight, as, for example, that of workmen walking on it, without marring the upper surface of the slab is coated

with a film of bituminous material as hereinbefore described. As soon as practical the forms are removed and the side edges of the slab are coated in a similar manner. The main slab is then left to cure and after curing may be put into use, care being taken to maintain the bituminous film by repair when necessary, or the film may be supplemented by providing a waterproofing system for the edges of the slab and a waterproofing and wear resisting system for the top surface of the slab, as hereinbefore described. It will be understood that supplementing of the film may be effected after the roadway has been completed.

While the provision of a preliminary slab of concrete laid over the sub-grade and provided on its upper surface with a waterproofing system such as has been described and upon which the main slab is laid and subsequently waterproofed, as described, constitutes a preferable form of construction, the provision of the preliminary slab may not always be necessary, for example, as in cases where the character of the material forming the sub-grade is such as to afford in itself an adequate support for the waterproofing system. For example, where the sub-grade is formed by excavating in a soil which when compacted by means of a roller will afford an adequate support for a waterproofing system, a waterproofing system will be formed by laying strips of bituminously impregnated, or impregnated and coated fabric or felt, directly upon the sub-grade, the strips being overlapped and the overlapping edges sealed, a sealing coat of, for example, waterproofing asphalt being applied to the upper surface of the strips. The main slab may then be poured directly upon the waterproofing system.

In other cases where the nature of the material forming the sub-grade is of a character such that it will not form an adequate base for the waterproofing system and where it is desired to avoid the expense of the provision of a preliminary slab of concrete, a suitable sub-grade for the support of the requisite waterproofing system may be produced by making the original excavation somewhat deeper than normally and covering the bottom thereof with a layer of crushed stone, which, after compacting, if the stone used is of substantial size and does not present a sufficiently smooth surface, may be provided with a coating of stone chips, gravel, or sand rolled into the surface of the layer of larger stone. A waterproofing system such as has been described may then be constructed directly upon the prepared sub-grade and the main slab poured upon the waterproofing system. In other cases where, for example, the soil upon which the roadway is constructed consists of dry sand, or loam, which even though compacted with a roller of substantial weight would not be sufficient to support the waterproofing system, a suitable sub-base may be prepared by rolling stone of substantial size into the bottom surface of the excavation. The stone rolled into the bottom of the excavation will, in connection with a sand or loam soil, form a sufficiently stable sub-grade for the laying of the waterproofing system directly thereon.

The construction or laying of the main concrete slab in cases where the preliminary concrete slab is omitted because of, for example, lack of necessity therefor due to the nature of the soil forming the sub-base, or due to stabilization of the sub-base, or from motives of economy, is effected in the usual manner as, for example, by the laying

of the usual reinforcing steel over the waterproofing system and the pouring of the concrete in sections from a mixer, care being taken in the pouring of each section to leave sufficient of the waterproofing system exposed in order to permit the waterproofing system for the next adjoining section to be laid and sealed to that of the prior section, so that in the completed road the waterproofing system will be continuous. After pouring the main slab the upper surface thereof is coated with a water impervious film for effecting its curing and as soon as feasible the side forms are removed and the edges of the slab are coated in a similar manner in order to effect the curing of the slab. The continuity of the impervious film is subsequently maintained by repair when necessary or may be supplemented as by the provision of a waterproofing system for the protection of the edges of the slab and by the provision of a waterproofing and wear-resisting system on its surface, all as has been described.

By way of illustration of a further modification of the practical adaptation of my invention, for example, on a suitable sub-grade made by compacting the bottom of the usual excavation with or without the addition of stone, a suitable waterproofing system may be formed by placing on the sub-grade a foundation or layer of bituminous concrete, for example, composed of aggregate and a suitable bituminous binder. Such layer may be similar, for example, to the bituminous concrete customarily laid in street construction as a foundation for a wear surface of sheet asphalt. In the preparation of a waterproofing system involving the use of bituminous concrete, care should be taken to proportion the mixture of aggregate and asphaltic binder so as to give a dense waterproofing base after suitable compaction by means of a roller. Where the waterproofing system involves a layer of bituminous concrete, the bituminous concrete may be mixed, for example, in a paving plant and subsequently laid, or the foundation layer may be constructed in place as, for example, by the so-called penetration method comprising the application to the sub-grade after partial compaction of suitably crushed stone, followed by the application of hot asphalt, which penetrates into the interstices between the particles of the aggregate, the asphalt being then covered with stone chips and the whole compacted by means of a roller. By such procedure the asphalt penetrating the interstices of the aggregate will upon compaction bind the aggregate. If desirable, where the so-called penetration method is used, the material after final compaction may be given a surface coating of hot asphalt, which in turn may be coated with stone chips, if desired. Where the waterproofing system involves the laying upon the sub-grade of a layer of bituminous concrete, the construction of the main concrete slab may be carried out as heretofore described, the concrete being laid directly upon the bituminous concrete waterproofing structure.

As a still further practical illustration of the adaptation of my invention, a suitable waterproofing system may be constructed on the sub-grade where, for example, the sub-grade is composed of a mixture of clay, sand and gravel, by the application to the sub-grade of a relatively fluid type of bitumen as, for example, a fluid type of cold road oil, or tar. Where the composition of the sub-grade is substantially porous, the fluid bitumen, as road oil, may be applied to the sub-grade in such quantity that it will be absorbed into the

sub-grade to a substantial depth to provide a waterproofing base. If desired, and conditions warrant, the sub-grade to a reasonable depth may be stirred, for example, with a grading machine or with hand tools, during the application of the oil to effect thorough admixture of the materials composing the sub-grade with the oil, and after the admixture has been accomplished to a sufficient depth, the sub-grade may be compacted, as with a roller.

Where the waterproofing system is produced by penetration or penetration and admixture of cold oil with the materials composing the sub-grade, the main slab is poured upon the sub-grade, after compaction, in the usual manner and the main slab is coated with a bituminous film to effect its curing, which film for the subsequent stabilization of the moisture content of the slab is maintained by repair or supplemented by the construction of a waterproofing system at the edges of the slab and by a waterproofing and wear-resisting system on its surface as has been described.

In the accompanying drawing there has been illustrated for the purpose of clarity illustrative preferred embodiments of this invention.

In the accompanying drawing Figure 1 is a cross-sectional view of an embodiment of this invention. Figure 2 is a cross-sectional view of a modification of the embodiment of this invention shown in Figure 1.

Referring to Figure 1, *a* indicates a sub-grade or sub-base prepared by leveling and compacting the ground upon which a roadway is to be constructed. The sub-base or sub-grade as described herein may be treated to render it water-impervious as desired, depending upon the nature of the roadway structure to be constructed thereon.

b indicates a slab of concrete poured upon the sub-grade. Upon the top of the slab of concrete *b* before it has set is formed a water-impervious film *c*. As described, the water-impervious film may, for example, be formed by application to the top of the slab of a bituminous emulsion. If desired, a second film may be superimposed over the film *c* as, for example, by applying a coating of hot bitumen thereto. Upon the slab *b* having its top surface coated as described, a second slab of concrete *e* is poured and the top surface thereof coated with a water-impervious coating *f*. The water-impervious coating may be formed on the top surface of the slab *e* by the application thereto, for example, of a bituminous emulsion. The edges of the slab *e* are likewise coated with water-impervious coating *g*, the edge coating *g* being desirably joined to the top coating *f* and joined to the coating *c* on the under slab or to the sub-base *a*.

In forming the structure shown in Figure 1, the slab *b* may be relatively thin as compared to the slab *e*. It will also be appreciated that the water-impervious coatings on the slabs *b* and *e* may be formed in any desired manner and by use of any desired material, though a coating or film of bitumen will be preferred.

Referring now to Figure 2, *a'* indicates a sub-grade upon which is poured a concrete slab *b'*. On the top surface of the slab *b'* before it is set is applied a water-impervious coating to form a film *c'*, as by the application to the top surface of the slab of bituminous emulsion. Over the film *c'* is laid a layer of waterproofed fabric *d*. The waterproof fabric may, for example, be bituminated felt, as, for example, a felt impregnated with asphalt. Over the layer of water-

proofed fabric is laid a coating of water-imperious material, as, for example, a coating of bitumen *h*, which may be formed by coating the fabric with, for example, hot asphalt. Onto the water-imperious coating *h* is poured a second slab *e'* and the top surface thereof is coated with water-imperious material to form a water-imperious film *f'*. To the edges of the slab *e'* is applied a water-imperious material, as, for example, asphalt, to form a water-imperious coating *g'*, which coating is desirably joined to the top coating *f'* and to the coating *d* over the waterproofed fabric *h*, upon which the slab is poured.

If desired, a wear surface *i* may be applied to the top surface of the slab *e'*, the wear surface being superimposed on the water-imperious coating *f*.

Concrete structures, in accordance with my invention, such as roadways, platforms, sidewalks, floors, and the like, where the concrete is laid in slabs, have very distinct advantage over similar structures as heretofore produced, in that the concrete forming the main slab, as well as the concrete forming the preliminary slab, where such is involved in the construction, is effectively and positively protected during curing by the application of a water-imperious film for the prevention of evaporation of moisture during the curing period, which results in the production of a concrete of maximum strength, and due to the fact that the moisture content of the concrete, especially of the main slab, is stabilized during the life of the concrete by the complete encasement of the concrete of the main slab in a waterproofing system, which on the underside of the slab is of a substantially permanent nature, and which on the edges and upper surface of the slab will desirably be of a permanent nature, but the permanency of which may be insured by repair when necessary.

The structures in accordance with my invention will have maximum strength due to efficient curing and will be free from stresses and strains causing cracking, as the result of changes in the moisture content thereof, which are due to changes in atmospheric humidity or the moisture content of the sub-grade, or other variable moisture conditions without the structure; or distortion resulting from local variations in the moisture content due to differences of the moisture content of the sub-grade with respect to the atmosphere or other differential moisture conditions without the structure.

This application is filed as a continuation of application Serial No. 319,445, filed November 14, 1928.

What I claim is:

1. The method of constructing a roadway which includes forming a subgrade, pouring Portland cement concrete on the subgrade to form a relatively thin slab, applying a water impervious film to the upper surface of the slab before it has set, pouring concrete on said relatively thin waterproofed slab to form a relatively thick slab and applying a water impervious coating to the surface of said relatively thick slab before it has set and applying a water impervious coating to the edges of the slab, the edge coating being joined to the water impervious film on the upper surface of said thin slab and to the surface coating of said thick slab.

2. The method of constructing a roadway which includes forming a subgrade, pouring Portland cement concrete on the subgrade to form a

relatively thin slab, applying to the upper surface of said slab a covering of waterproofed fabric, pouring concrete on said relatively thin slab to form a relatively thick slab and applying a water impervious coating to the surface of said relatively thick slab before it has set and applying a water impervious coating to the edge of the slab, the edge coating being joined to said waterproofed fabric and to the said surface coating so that the slab is completely encased.

3. The method of constructing a roadway which includes forming a subgrade, pouring concrete on the subgrade to form a relatively thin slab, applying a water impervious film of bitumen to the upper surface of the slab before it has set, applying a coating of hot bitumen over said film after said slab has set, applying a covering of bituminously saturated fabric over said coating, applying a coating of hot bitumen over said covering, pouring concrete on said latter coating of bitumen to form a relatively thick slab and applying a water impervious coating to the surface of said relatively thick slab before it has set and applying a water impervious coating to the edges of the slab, said edge coating being joined to said bituminous coating and the said surface coating so that said slab is completely encased.

4. The method of constructing a roadway which includes forming a subgrade, pouring concrete on the subgrade to form a relatively thin slab, applying a water impervious bituminous film to the upper surface of the slab before it has set, applying a coating of hot bitumen over said film after said slab has set, applying a covering of bituminously saturated fabric over said coating, applying a coating of hot bitumen over said covering, pouring concrete on said latter coating of bitumen to form a relatively thick slab, applying a water impervious coating to the surface of said relatively thick slab before it has set, applying a water impervious coating to the edges of the slab and after the relatively thick slab has set applying a covering of bituminously saturated fabric to the edges thereof and applying a wear coat to the roadway surface thereof.

5. In a roadway, a sub-base, a slab of concrete superimposed on the sub-base, a substantially water impervious bituminous coating on the surface of said slab, a layer of bituminously impregnated fabric superimposed on said coating, a layer of bitumen superimposed on said fabric, a second slab of concrete superimposed on said layer of bitumen and a substantially water impervious bituminous coating on the edges and top of said second slab, the bituminous coating on the edges of said second slab being joined to the bituminous coating on the top thereof and to the layer of bitumen superimposed on said impregnated fabric.

6. In a roadway a sub-base, a slab of concrete superimposed on the sub-base, a substantially water impervious bituminous coating on the surface of said slab, a layer of bituminously impregnated fabric superimposed on said coating, a layer of bitumen superimposed on said fabric, a second slab of concrete superimposed on said layer of bitumen, a substantially water impervious bituminous coating on the edges and top of said second slab, and a wearing surface superimposed on the coated top of said second slab.

7. Method of constructing a roadway which includes forming a subgrade, forming upon the subgrade a slab of bituminous concrete, forming a slab of hydraulic concrete on said first mentioned slab, applying to the surface of said hy-

- draulic concrete slab before it has set a water-impervious coating and applying a water-impervious coating to the edges of said hydraulic concrete slab, said edge coating being joined to said bituminous concrete slab and to the surface coating on said hydraulic concrete slab.
- 5 8. Method of constructing a roadway which includes forming a subgrade, forming upon the subgrade a slab of bituminous concrete, forming a slab of hydraulic concrete on said first mentioned slab, applying to the upper surface of said hydraulic concrete slab before it has set a water impervious coating and applying a water impervious coating to the edges of said hydraulic concrete slab.
- 10 9. Method of constructing a roadway which includes forming a subgrade, forming upon the subgrade a slab of bituminous concrete, applying a water-impervious coating to the upper surface of said slab, forming a slab of hydraulic concrete on said first mentioned slab, applying to the surface of said hydraulic concrete slab before it has set a water-impervious coating and applying a water-impervious coating to the edges of said hydraulic concrete slab, said edge coating being joined to said bituminous concrete slab and to the surface coating on said hydraulic concrete slab.
- 15 10. Method of constructing a roadway which includes forming a subgrade, forming upon the subgrade a slab of bituminous concrete, applying a water-impervious coating to the upper surface of said slab, forming a slab of hydraulic concrete on said first mentioned slab, applying to the surface of said hydraulic concrete slab before it has set a water-impervious coating and applying a water-impervious coating to the edges of said hydraulic concrete slab, said edge coating being joined to said bituminous concrete slab and to the surface coating on said hydraulic concrete slab.
- 20 11. In a roadway, a sub-base, a slab of bituminous concrete superimposed on the sub-base, a substantially water-impervious bituminous coating on the surface of said slab, a layer of bituminously impregnated fabric superimposed on said coating, a slab of hydraulic concrete superimposed on said fabric and a substantially water-impervious bituminous coating on the edges and top of said second slab, said edge coating being joined to said fabric and to said coating on said slab of hydraulic concrete.
- 25 12. In a roadway, a subgrade, a thin hydraulic concrete slab superimposed on said subgrade, a water-impervious coating on the surface of said slab, a relatively thick slab of hydraulic concrete superimposed on said thin slab, a water-impervious coating on the surface and edges of said thick slab, said edge coatings being joined to the surface coatings on said slabs.
- 30 13. In a roadway, a subgrade, a bituminous concrete slab superimposed on said subgrade, a slab of hydraulic concrete superimposed on said bituminous concrete slab, a water impervious coating on the surface and edges of said last mentioned slab, said edge coatings being joined to the surface coating on said hydraulic cement slab.
- 35 14. In a roadway, a subgrade, a concrete slab on the subgrade, a hydraulic concrete slab superimposed on said first mentioned slab, a water-impervious coating on said hydraulic concrete slab, a layer of fabric impregnated with a waterproofing material interposed between said slabs and extending adjacent to the sides of said hydraulic concrete slab up to adjacent the surface thereof and adhered to said sides.
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