E. M. CHADBOURNE.

CONCRETE ROADWAY.

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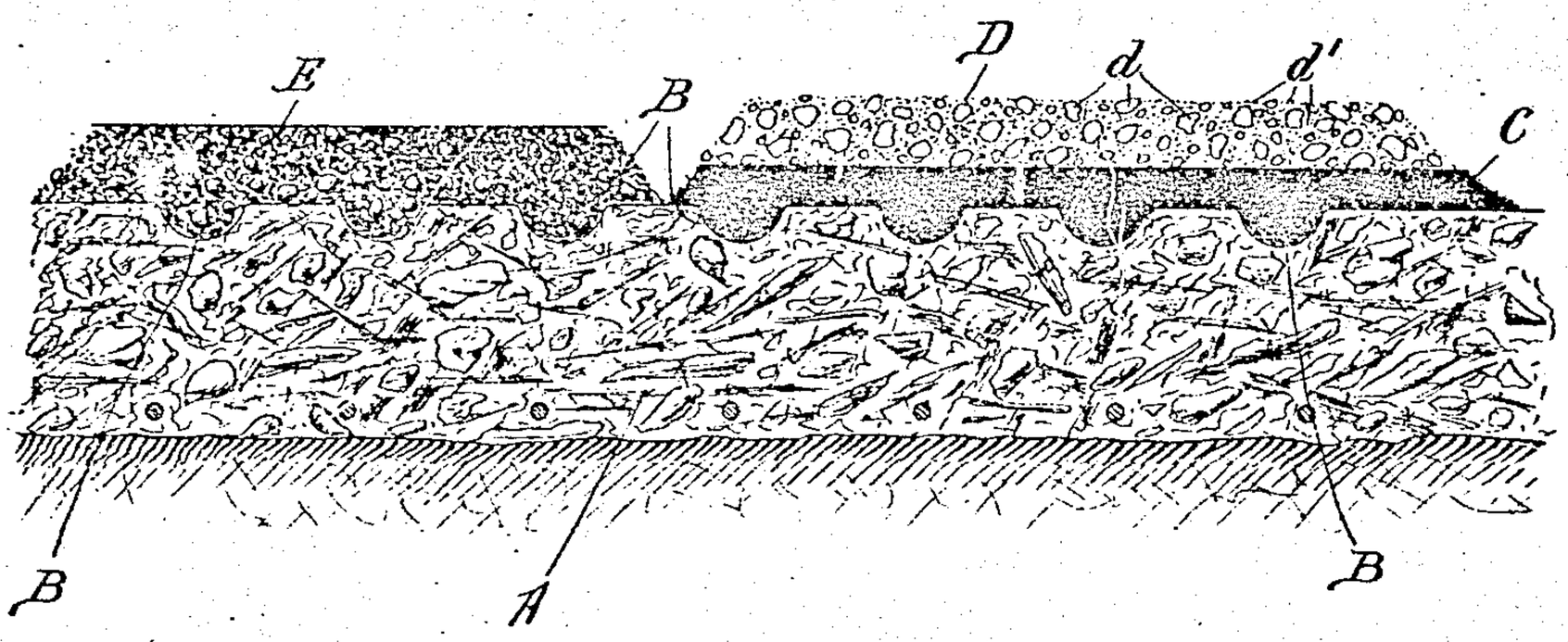

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CONCRETE ROADWAY.

994,092. Specification of Letters Patent. **Patented May 30, 1911.**

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To all whom it may concern:

Be it known that I, EDWARD M. CHADBOURNE, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented a certain new and useful Improvement in Concrete Roadways; and I do hereby declare the following to be a full, clear, and exact desdription of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

This invention relates to the construction of pavement for roadways and more especially to that type wherein the surface is formed by a rock or stone aggregate combined with an asphaltic binder which is substantially non-fluid at ordinary temperatures, but capable of being rendered limpid or liquid by heat. The surface layer is usually supported by a suitable foundation, such as cement concrete; approved practice indicating the desirability of forming the surface of the base with pockets or irregularities as set forth, for instance, in my prior Patents Nos. 956,940, 965,562 and 982,247, and the present invention will be described under the assumption that a foundation of the character stated, is employed.

In so far as the pavement produced is concerned, it is the object of the invention to form a surface layer which will be a homogeneous mass, substantially free from voids and with such proportions of aggregate and binder as will afford a maximum resistance to wear and displacement under traffic conditions and at the same time conform to approved practice with respect to surface conditions and resiliency for absorbing shock and vibration without disintegration.

In so far as the process of producing the pavement is concerned, the objects of the invention are, to reduce the number of steps and machinery necessary for handling and combining the ingredients; to bring the ingredients together in such manner that the voids in the aggregate are filled by capillary action from below, whereby the trapping of air or the formation of sealed cavities is prevented, and to permit the use of a cheap and easily prepared or obtained aggregate.

Attempts have been heretofore made to produce a homogeneous layer of aggregate and asphaltic binder for roadway surfaces. For instance, it has been proposed to grade the aggregate and to combine the graded material in certain proportions and sizes, and to mix the binder therewith by agitation and heat, the completely mixed aggregate and binder being carried to and deposited on the roadway where it is spread and rolled, but such operations do not result in a homogeneous mixture, as the particles stick together, forming masses, some or all of which have larger proportions of certain sizes of the aggregate than others, and the binder is caused to drain out because of its hot liquid state, or to accumulate in larger per cent. in portions of the mass, where it suddenly cools. When laid and rolled not only is it impossible to prevent the leaving of a percentage of voids, but owing to the irregularity of the mixture, the surface layer will wear and disintegrate irregularly. It has also been proposed to pour a hot asphalt binder over a layer of aggregate, but owing to the rapid cooling of the binder, very irregular penetration results; furthermore, air is trapped in the layer of aggregate forming spaces or voids.

In accordance with the present invention, the foundation is prepared preferably of cement concrete, and suitable provision at the top surface such as pockets or irregularities to retain the binder and bond the surface to the base more securely. Upon this foundation there is spread a layer of binder containing a large percentage of asphalt, said binder being substantially non-fluid at ordinary temperatures, but capable of being rendered limpid or fluid by heat. It is usually spread on the base while hot enough to flow somewhat, but requires spreading to insure a uniform depth or distribution over the foundation.

The aggregate with which the binder is to combine is composed of broken or natural stone, the larger pieces of which are of less diameter than the thickness of the layer of which they form a part, thus in a two inch layer the larger sizes of the aggregate are preferably such as will pass a three-fourth inch or a one inch mesh. With this larger size aggregate there is mixed a sufficient quantity of sand or small size aggregate to surround the larger pieces. The surrounding small size aggregate or sand should be

such that it has from 25% to 40% voids, as it is within these limits that effective capillary action will operate to draw the binder up and cause the same to spread uniformly through the mass or layer of aggregate. Should the percentage of voids be larger, the interstices are too large to be filled, or for capillarity to act effectively, and should the percentage of voids be smaller the capillary action is blocked, probably because the finer particles float on or in the binder and close the passage ways or render the binder too viscid to feed by capillarity. The aggregate preferably employed consists of 50% broken stone such as will pass a three-quarter or one inch mesh mixed dry with 50% sand having between 25% and 40% of voids. This aggregate is heated to a high temperature and distributed in an even layer over the layer of asphaltic binder. The layer of aggregate preferably approximates in thickness the thickness of the surface layer desired and the thickness of the layer of binder is such that approximately the whole of it will be absorbed by the heated aggregate. In other words, the binder equals the void volume in the aggregate. The proportions to employ may be easily determined for any given aggregate, for example .62 of an inch depth of binder will fill and be practically completely absorbed by a layer of aggregate containing 31% of voids when the aggregate is of a height or thickness of 2 inches, whereas, if the aggregate contains 40% of voids it should be only 1.55 inches thick for the same depth of binder. The practical result of the action of the hot aggregate on the binder is to render the latter limpid and in condition to feed by capillary action into the aggregate. This action takes place almost immediately, and although there is a large volume of binder to be melted in proportion to the volume of each of the finer particles of the aggregate, the stored heat due to the presence of the larger pieces of the aggregate is sufficient to effectively melt the binder and prevent the same from solidifying as it penetrates the mass of aggregate. The larger particles or pieces in the aggregate, as just pointed out, perform an important function in the process, for without them the stored heat would be insufficient.

The limits within which the capillary action will be effective in causing a normally non-fluid asphaltic binder to be effectively absorbed, it is believed is fairly well defined by the percentage of voids in the aggregate and to lie, as before stated, between 25% and 40%. To bring the percentage of voids within these limits, a comparatively rough grading is all that is necessary with any crushed rock or gravel and the addition of ordinary sand is usually sufficient to either reduce the percentage of voids when too great or to increase the percentage of voids when too small.

The accompanying drawing shows a section of a roadway and illustrates the process of laying the same.

In said drawing, A is the cement concrete base having pockets or irregularities B in its upper surface.

C is a layer of normally non-fluid asphaltic binder spread on the base to a practically uniform depth.

D is a hot layer of aggregate having approximately 50% of large particles d and 50% of smaller particles d', the latter having between 25% and 40% of voids.

E is a finished section in which the layer of binder has fed up by capillary action into the layer of aggregate so as to completely fill the voids therein.

After the binder has been melted and absorbed, and the layer is partly cool, the surface is preferably smoothed and evened by rolling with a smooth roller.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. The method of pavement construction, which consists in providing an aggregate composed of a mixture of wear resistant stone of such size as to have a large percentage of voids and sand or equivalent having a smaller percentage of voids, the interstices in the sand being of such size as to exert capillary attraction on a limpid but normally non-fluid asphaltic binder, then heating the mixture of stone and sand and filling the interstices therein from the bottom by capillary action, with a normally non-fluid asphaltic binder rendered limpid by the heat of the mixture of stone and sand, whereby a homogeneous layer is produced having no excess of either binder or aggregate.

2. The method of pavement construction, which consists in spreading a body of asphaltic binder capable of being rendered limpid by heat on a suitable supporting foundation and in applying thereto a layer of heated aggregate having from 25% to 40% of voids and containing a large proportion of relatively large size aggregate whereby the stored heat of the aggregate available for rendering limpid the necessary percentage of binder to fill the voids by capillary action is increased.

3. The method of pavement construction, which consists in spreading a body of asphaltic binder which is substantially non-fluid at ordinary temperatures and in applying thereto a layer of heated aggregate having a percentage of voids substantially equal in volume to the volume of binder, the size of the interstices between the particles of aggregate being within the limits of capillary attraction for the binder when

rendered limpid by the heat of the aggregate, whereby a homogeneous layer of aggregate and binder is produced.

4. The method of pavement construction, which consists first in preparing a foundation impervious to non-fluid binder, secondly, spreading on said foundation a layer of normally non-fluid binder containing a large percentage of asphalt and capable of being rendered limpid by heat, thirdly, spreading over said layer of binder a layer of heated aggregate having not less than 25%, nor more than 40% of voids, and said voids being of a size to cause the binder when limpid to penetrate the aggregate and fill the voids by capillary action whereby a solid homogeneous layer is produced, and finally rolling surface of the layer.

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