Patented June 24, 1930

1,767,830

UNITED STATES PATENT OFFICE

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PAVING MATERIAL AND METHOD OF PREPARING SUCH MATERIAL

No Drawing. Application filed April 2, 1928. Serial No. 266,868.

This invention relates to a new and improved paving material and to a method of preparing such a material. It relates more particularly to the preparation of a material from natural rock asphalt and to such material which is adapted to be spread and compacted in a cold state.

The preferred basic material for use in our method to produce our product is a natural rock asphalt such as the Uvalde rock asphalt found in Uvalde County, Texas, although other generally similar materials may be used. This Uvalde rock asphalt consists of a comparatively porous, shell limestone impregnated naturally with asphalt which thoroughly fills the pores and minute cavities in the rock.

This rock asphalt has long been used as a material for floors or pavements, but the general methods of using it have involved heating and have required a considerable preparation plant adjacent to the work, as the prepared mass solidifies or tends to cake and set when it becomes cold, even if not compacted.

Several cold mixing processes have been developed and used in one of which the crushed rock asphalt is mixed cold with a natural oil containing both a solvent for the asphalt in the rock and additional asphalt which serves as a flux. In another later method the rock asphalt is first treated with a solvent such as gasoline or kerosene and is then treated with a normally adhesive flux such as asphalt oil which is preferably heated.

While such processes produce a mixture in which the rock asphalt is not heated and which can be laid cold, the mixture tends to set or cake as the volatile solvents evaporate and cannot be transported successfully for very great distances from the mixing plant. In a third method an attempt has been made to delay the evaporation of the solvent by applying porous limestone finely crushed and mixed with the asphalt rock. Even in this case, however, the major portion of the volatile content evaporates in a comparatively short time and when transported by rail, the continued jars incident to such travel, cause the mass to cake or set and it must be broken up with pick axes or similar tools before removal from the cars. This adds very greatly to the expense and these methods are therefore not commercially practical for producing a mix to be used at any considerable distance from the mixing plant.

Our present invention is in the nature of a modification and improvement upon our invention covered in our prior application, Serial No. 200,306, filed June 20, 1927.

According to our present invention the crushed rock asphalt is treated with a natural crude oil which combines the functions of solvent and flux. Water may be added to delay the set of the material and this water may be acidified, if desired. A further feature lies in the addition of relatively larger sizes of crushed asphalt rock to the balanced mix of rock. These larger pieces may be added before or after the treatment with the oil.

It is an object of the present invention to provide a new and improved paving material or the like and method of preparing the same.

It is an additional object to provide such a material which may be mixed and handled without the application of heat and which may be handled and transported without serious caking.

It is a further object to provide a method and mixture in which the tendency to set is retarded by elements present in the mixture and in which the retardation of the set may be controlled by the amount and relation of the elements of the mixture.

It is also an object to provide a paving material which will be relatively soft when first laid and which gradually becomes harder through a period of weeks or months.

Other and further objects will appear as the description proceeds.

The basic element in our improved paving material is a natural rock asphalt such as the Uvalde rock asphalt which has been referred to above. This material consists of a relatively soft, porous shell limestone thoroughly impregnated with asphalt or bitumen in its natural state. The asphalt forms from

about eight to twelve per cent of the total material as commercially used. The asphalt rock is pulverized or crushed preferably with a swing hammer type of crusher, although other types of crushers may be used. Such a crusher has been found to crush and pulverize the material in such manner that the sizes as they come from the crusher are so proportioned as to furnish a mixture which has a substantial minimum of voids. Such a mixture is known as a balanced mix and affords a compact pavement or the like substantially impervious to water and without air pockets. If a more exactly balanced mix is desired, the material may be ground and separated and the proper proportions of the various sizes again mixed together. This adds greatly to the expense, however, and has not been found necessary in the use of this rock asphalt.

The crushed rock asphalt is next treated in our improved process with an oil or other fluxing agent which has a relatively high gravity in the Baumé scale and which contains a relatively high percentage of volatile constituents evaporating below 325° F. This Baumé oil is one preferably having a gravity varying from twenty to forty degrees. This oil may be a paraffine, semi-asphaltic or asphaltic base oil. This type of flux differs materially from those used in previous methods of fluxing rock asphalt, as in such previous methods the fluxing agents have had a much lower Baumé gravity and have had a comparatively small content of atmospherically volatile constituents. Oils have been used which have been topped or from which a considerable portion of the volatiles have been removed. In other processes a mixture of a small proportion of light volatile oil and a large proportion of heavy oil or flux have been used, and in some cases the light oil and heavy oil have been applied in successive steps. In all such methods, however, the volatiles have consisted of very light oils such as kerosene or gasoline which evaporate rapidly and at points well below 325° F. It will be understood that the material sets up and cakes as soon as the volatiles are evaporated and in prior methods these volatiles have evaporated rather quickly since they have been of a highly volatile nature.

The fluxing agent which we consider the most staisfactory for our purpose contains a number of volatile fractions which volatilize at progressive temperatures up to 325° F. This distinguishes further from prior methods in which substantially all of the volatile content evaporated very materially below 325° F. We have found the best results are obtained with a natural oil which contains from ten to forty per cent of volatile constituents, the distillation or boiling points of which vary more or less uniformly from 60° F. to 325° F. The exact percentage will depend upon the length of time which it is desired to delay the final setting of the material. If such an oil is not available as a natural product, it may be manufactured synthetically by the combination of the desired percentages of a heavy base and volatiles having boiling points throughout the desired temperature range.

The pavement made from such a mixture when originally compressed and rolled into place, will still be fairly soft although adapted to support and carry traffic. It will gradually harden as the higher boiling fractions evaporatae slowly and this hardening and final setting may extend over a period of weeks or months, depending upon the quantity and character of the volatiles and the temperatures and traffic conditions. Such a road surface is highly desirable where it is laid upon foundations which have not finally settled or upon frozen or partly frozen ground, as it will adjust itself to the movements or changes of its supporting foundation without cracking.

As an additional feature, when the material must be transported a considerable distance before being used or when the weather is so hot as to cause rapid evaporation, we find it desirable to add water to the mixture.

As a further means of delaying the final setting up of the mix, the water which was added may be somewhat acidified with acids forming carbon dioxide by combination with the carbonates in the asphalt rock. This carbon dioxide is heavier than air and tends to remain in the voids in the material and thus delay evaporation of the volatiles and slow up the setting of the material. If the water is acidified with hydrochloric acid it will also form calcium chloride by combination with the calcium in the rock and this calcium chloride is hygroscopic and therefore holds the water in the mixture, thus serving as an additional element in delaying the set of the material.

A further element which we may incorporate in our paving material consists in a crushed rock which is harder than the limestone rock asphalt. This crushed rock may be a rock such as trap rock or hard limestone and is preferably screened so as to eliminate the smaller particles. We have found that the most satisfactory results will be obtained by using a one-size crushed trap rock substantially the same size as the larger portions of the rock asphalt aggregate. In laying pavements of ordinary thickness, this size would be from one-fourth to one-half inch. The crushed hard rock when added to the crushed rock asphalt serves to unbalance the total mixture; that is, it will give to the total mixture a preponderance of larger aggregate so that the smaller aggregate and

fine particles present will not be sufficient to fill up all voids in the mixture. This fact tends to retard the set of the material as it will cause the particles to be largely separated by air spaces.

When the material is laid and compacted, however, the hard rock will be forced into the particles of rock asphalt and these particles will be further crushed so that a solid and compact pavement will result. It is essential to the durability and long life of the pavement that the barren rock used for unbalancing the mixture, thereby creating air pockets, be a rock that is hard and tough. As previously stated, the mixture is unbalanced and consequently the paving contains unfilled spaces which are planes of weakness. The initial rolling or compression, and later the continual pounding of traffic will cause an internal crushing action as the excess large size aggregate is rubbed together. If the rock asphalt particles are crushed, no damage is done as each rock asphalt particle is impregnated throughout with bitumen. On the other hand, if the barren rock is crushed, the paving will disintegrate sooner or later as there will be no coating of asphalt on the crushed particles to cement them together. Therefore, the barren rock must be harder and tougher than the asphalt rock. It was the discovery of this principle that made possible the use of an unbalanced mixture for the purpose of having air pockets help prevent the mixture from setting up. The hard rock which extends throughout the paving gives a surface which is efficient in preventing skidding.

Another variation of this process consists in substituting rock asphalt for the hard barren rock, which rock asphalt has been crushed and screened to a uniform size so that when it is added to the mixture it will cause said mixture to be unbalanced, thereby creating air pockets which help prevent the mixture from setting up. There will be no disintegration of the pavement due to the internal crushing of the large size aggregate by rolling or by traffic for the reason that each particle of rock asphalt that is crushed will be permeated and coated with natural bitumen.

We have found that a very material difference may be made in the rate of set of the material, not only by varying the quantities of the several elements, but also by varying the order in which the elements are mixed together. For example, the crushed rock asphalt may first have added thereto the flux and water thoroughly mixed together. In this case the flux is merely thinned or emulsified by the water and its action therefore retarded since it is rendered less sticky. The action will be further retarded if the water is first added to the rock asphalt which is thus thoroughly wetted with the water before the flux is applied. The asphalt rock will not be permeated by the flux until the water has largely evaporated as the oil will not penetrate through the water.

Another manner in which the materials may be mixed is by applying the oil or flux to the crushed rock asphalt, then wetting the crushed hard rock or larger pieces of rock asphalt with water and mixing the damp rock with the treated rock asphalt. The dampness of the rock prevents it from being immediately coated with the solvent and flux and serves to separate the particles of rock asphalt and to retard the set. If desired, the rock asphalt and hard rock may be mixed together and the flux and water may be added in the form of an emulsion. In some cases where long delay of set is desired, it may be found advisable to wet both the rock asphalt and rock before applying the flux and mixing the mass together.

It will be apparent therefore that our materials may be mixed together in a variety of ways and that the method and order of mixture may be adapted to the particular needs of the temperatures present and the length of time and the distance required for transportation. These elements will preferably be so adjusted that when the material is spread out in a thin layer on the surface being covered, the lightest part of the volatile constituents and any water present will be sufficiently evaporated in a short time, such as one-half hour, so that the material may be compacted by a heavy steam roller or the like and formed into a dense water-proof surface.

While the several elements of our mixture may be widely varied in proportion, the mixture will generally consist of from ten to thirty-three per cent of hard rock, where hard rock is used, from sixty to ninety per cent rock asphalt, and from one to five per cent flux; and, where water is used, from one-half to two per cent or more of water.

While our material is particularly adapted for paving purposes in paving streets and roadways, it will be understood that it is also capable of many other uses. For example, it may be used to pave sidewalks or floors in buildings and may also be used in covering roofs. In view of its impermeability, it has also proved of value in covering the bottoms of reservoirs or chambers for holding liquid. The material is also efficient in dampening vibrations and is therefore particularly useful in bridge coverings, industrial flooring, railroad platforms and crossings, and engine foundations.

While we have given by way of example, certain preferred methods of mixing and preferred proportions, our invention is capable of wide modification, and we contemplate such changes and modifications as

come within the spirit and scope of the appended claims.

We claim:

1. The method of preparing a paving composition which comprises crushing rock asphalt, and treating said rock asphalt with a flux and with water acidified with an acid combining with the rock to form carbon dioxide.

2. The method of preparing a paving composition which comprises crushing rock asphalt, and treating said rock asphalt with a flux and with water acidified with an acid combining with the rock to form carbon dioxide and calcium chloride.

3. The method of preparing a paving composition which comprises crushing rock asphalt, and treating said rock asphalt with a flux comprising a heavy oil, and with water acidified with an acid adapted to combine with the rock to form a heavy gas.

4. The method of preparing a paving composition which comprises providing a balanced mix of crushed natural rock asphalt, and adding to said mix a flux, and crushed rock asphalt in larger sizes adapted to unbalance the mix.

Signed at San Antonio, Texas, this 17th day of March, 1928.

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