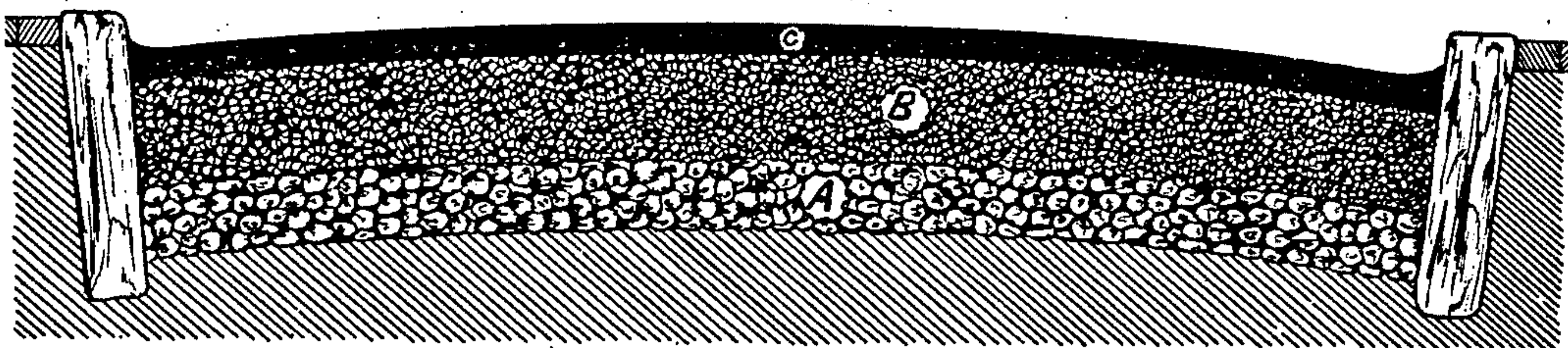


A. K. LEE.

CONCRETE PAVEMENT.

No. 188,645.

Patented March 20, 1877.



Witnesses

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188,645

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## UNITED STATES PATENT OFFICE.

ARCHIBALD K. LEE, OF PHILADELPHIA, PENNSYLVANIA.

## IMPROVEMENT IN CONCRETE PAVEMENTS.

Specification forming part of Letters Patent No. 188,645, dated March 20, 1877; application filed February 17, 1877.

*To all whom it may concern:*

Be it known that I, ARCHIBALD K. LEE, of the city and county of Philadelphia, in the State of Pennsylvania, have invented a certain new and useful Concrete Pavement, of which the following is specification:

The object of my invention is to provide a pavement which shall possess the qualifications of economy in first cost, durability in use, imperviousness to moisture, effectual resistance to variations of temperature, and the presentation of a desirable surface; to which ends my improvement consists in the combination of a bed or lower layer of broken stone, an intermediate layer of concrete, and an upper layer or facing of an asphaltic concrete, all as hereinafter fully set forth.

Various mixtures or conglomerates have been heretofore proposed for paving and roofing purposes, and a large number have been made the subject of Letters Patent both in the United States and Europe. So far as my knowledge extends these compounds have consisted of substances such as sand, wood, and coal-ashes, cinders, charcoal, iron slag, road-dust, clay, rubber, &c., the binding or cementing ingredients being coal-tar, dead-oil, rosin-oil, pine-tar, pitch, or like material.

Many so-called "asphalt pavements" have been experimented with in this and other countries as substitutes for the natural asphalt, and most of them will be found to embody some of the ingredients above specified. In some, asphalt is used in combination with coal tar, Richie mineral, Albertite pitch, rosin, rosin-oil, petroleum, dead-oil, or like materials, but in none, so far as I am aware, is asphalt, *per se*, recommended or prescribed. None of these pavements, however, have gone into very general use, and, while a certain degree of success has been attained in some of them, nearly all fail to satisfactorily stand the test of time and wear, showing evidences of disintegration and periodically requiring repair or refacing, and hence opposition and prejudice against concrete pavements have arisen which tend materially to impede the progress of improvement in this direction.

Among the causes which have operated to produce such failure may be stated the following: First, the natural principle that no

loose, hard material can remain long distributed among substances of a softer nature. Every tread upon a pavement of this composition tends to force away the soft substance, and the effect of this is to leave the hard matter less and less perfectly cemented; and the soft substance (coal-tar or pitch) is so readily affected by the heat of the sun, and "comes and goes" with each variation of the temperature, thereby reducing its adhesive and cohesive qualities; for, although the solar heat is sufficient to loosen, it is not sufficient to fuse the soft material together again. Another reason is that most of these compositions contain considerable quantities of ashes and silicious sand, from which they derive the property of cracking and crumbling when trodden upon. There seems to be so little affinity between silicious matter and bitumen that their parts separate from one another by a very small disruptive force. Again, it is well known that gas-tar or pitch, generated by the action of fire at a high temperature, becomes soft at 115° Fahrenheit, while the natural asphalt sustain a heat of 170° Fahrenheit without injury. Concrete composed of gas-tar or pitch has also the property of decomposition by the joint agency of air and water, whereas the natural asphalt is known to remain for ages without alteration. Bituminous coal, from which the coal-tar and pitch are made, has in itself but little cohesive power, and it is well known that upon exposure to the air, and by the attrition of handling, a large percentage is lost in fine dust. Nor is there anything in the operation of coking the coal to obtain illuminating-gas, or in the subsequent process of distillation by fire of the coal-tar, which overcomes the inherent tendency to crack and crumble when in concrete. In point of fact, such process, instead of diminishing only increases this action toward disintegration.

It is by these characteristics that we account for the disappointments so commonly experienced in pavements, which at first appear firm and beautiful, but which soon become disintegrated and unsatisfactory. The admixtures and distillations from coal-tar have hitherto been relied upon as the base for an artificial asphalt, on account of a sup-



posed resemblance to the true asphalt. This idea is not sustained by scientific tests. Seen in thin layers under the microscope, the true asphalt—the color of which is of a brownish black—shows a transparent yellowish mass, while coal-tar or pitch is visible as a mass of incoherent deep black points on an orange-colored ground. This investigation of the mastic suffices to account in the one case for the qualities of toughness, impenetrability, tenacity, plasticity, binding-power, adhesiveness, and durability; in the other, that of brittleness and an inherent tendency to crumble. Coal-tar concrete, upon exposure to the cold, cracks and bulges up in unsightly lumps, while asphalt-concrete pavements are known to have stood all the various destructive agencies and vicissitudes of climate from Bombay to St. Petersburg.

Asphalt-concrete pavements, in their smooth, seamless face, not affording any escape to the terrestrial heat through joints, are kept warm and open from below in most cases, while block pavements present an icy surface. They are clean and fit for traffic a few hours after being laid, while stone pavements, either new or repaired, must always be covered for months with a heavy coat of sand, to be drifted by every breeze in dry weather, and add to the mud in rainy spells. Another important consideration in their favor is that repairs upon them can be made in dry cold days in winter, while the defects in stone pavements must be endured till spring.

In my improved pavement, a section of which is shown in the accompanying drawing, I have sought to render available at as low a cost as is practicable, the valuable properties of natural asphalt, and to avoid impairing its usefulness by the admixture of elements which have been demonstrated by experiment and practice to be detrimental.

My improved pavement is constructed as follows: The roadway is first to be excavated to a depth of about twelve inches, graded, and well rolled, in order to present a proper surface for the bed or lower layer A of stone or rock, which consists preferably of broken rock of irregular form, of the average size of a hen's egg. This layer should be, say, four inches thick, and, after being spread evenly, is to be well rolled with heavy rollers, and its upper surface thoroughly coated with fluid asphalt.

The asphalt which I prefer to use for this purpose, and elsewhere when required, in my pavement, as hereinafter to be specified, is that which has been reduced to the liquid form without the aid of heat, as described in Letters Patent of the United States, No. 162,394, granted and issued to me under date of April 20, 1875; but I do not wish to limit myself thereto.

Upon the prepared bed A I next place an intermediate layer, B, of concrete, having the following composition, to wit: Twenty-five yards broken stone, broken small; nine cubic

feet sand; two barrels cement; four hundred pounds hydrate of lime; ten pounds powdered alum.

These ingredients are to be well mixed with a sufficient quantity of water or oil, to form a plastic mass, a layer of which, to the thickness of, say, six inches, is to be spread upon the bed A and well rolled. After sufficient time has been allowed to permit the concrete layer B to dry thoroughly it is to be well coated with fluid asphalt, and, while this coating is still wet, an upper layer facing, C, of asphaltic concrete is to be spread over it, to a thickness of, say, two inches or more.

The composition of the asphaltic concrete is as follows: Nine cubic feet clean gravel; nine cubic feet pulverized stone, preferably limestone; six cubic feet fine sand; two barrels cement; one barrel plaster of paris; four hundred pounds hydrate of lime; twenty pounds pulverized glass; twenty-five pounds litharge; thirty pounds black oxide of manganese.

In the preparation of the concrete last above stated the ingredients are to be thoroughly incorporated in a suitable machine or mixer, and to be heated to expel carbonic acid and moisture. The composition thus constituted is in a dry pulverulent state, and is applicable to use as a facing for my improved pavement, or for other purposes, by being converted into a plastic mass, which, upon hardening, is firm, durable, water-proof, and possessed of ample power of resistance to changes of temperature.

When used to form an artificial stone the requisite plasticity to enable it to be made into the shape required is imparted by adding a proper quantity of liquid silicate of soda, oil, or water. Other cementing ingredients might likewise be employed under certain circumstances, but I consider those that I have named as best adapted for the purpose.

For use as a facing for my improved pavement the composition is to be heated, and, while the mass is hot, liquid asphalt is to be added to and mixed with it, in the proportion of about forty-five gallons, more or less, to each cubic yard, and it is to be stirred until it forms a homogeneous mass. For this purpose I prefer asphalt which has been liquefied without the aid of heat, as, for example, the described in my Patent No. 162,394, dated April 20, 1875. In this condition it is to be placed upon the layer of concrete B, to the thickness of two inches or more, as before stated, and to be well rolled down and allowed to dry, when the pavement will be complete.

The mixed ingredients, in their pulverulent state, may be barreled and transported, and the liquid asphalt subsequently added, if such procedure should be found more convenient than the preparation of the complete concrete at one operation.

I claim as my invention, and desire to secure by Letters Patent—



1. A concrete compositior, consisting of gravel, pulverized stone, fine sand, cement, plaster-of-paris, hydrate of lime, pulverized glass, lime, and black oxide of manganese, substantially as set forth.

2. The combination, in a pavement, of a lower layer of stone, with an intermediate

layer of concrete, and an upper layer or facing of concrete composition, as above set forth, cemented with liquid asphaltum.

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Witnesses:

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