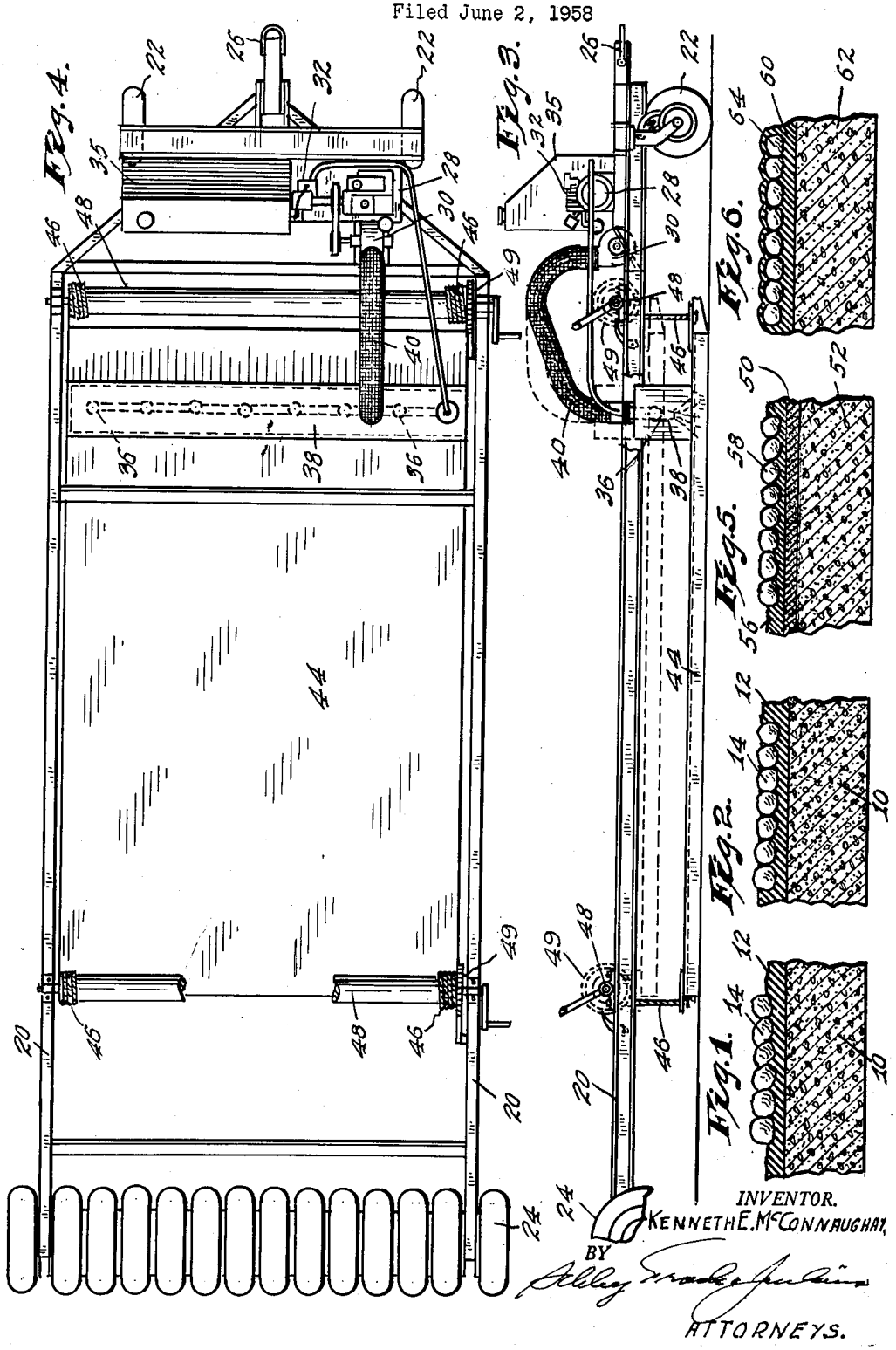
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METHOD OF PAVING

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METHOD OF PAVING

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This invention relates to a method of paving, and more particularly to a method of producing a bitumen-aggregate road surface.

It is an object of my invention to provide a method of paving which will produce a bitumen-aggregate road surface of uniform quality and composition throughout irrespective of the bitumen employed, which will cause said road surface to firmly adhere to the subgrade upon which it is laid, and in which a firm bond between the aggregate and the bitumen will exist. It is a further object of my invention to provide a method of producing a bitumen-aggregate road surface which can be quickly completed so as to minimize traffic inconvenience, and which can be economically produced in situ.

In carrying out my invention in its preferred form, a layer of bitumen is distributed over a subgrade or base. The subgrade or base may constitute a layer or layers of clay, rock, gravel, a worn pavement surface, etc. After the bitumen has been distributed over the subgrade, a layer of aggregate is spread thereon, and the bitumen and aggregate are subjected to a heat treatment which raises their temperature and reduces the viscosity of the bitumen. This temperature elevation of the bitumen coupled with its reduced viscosity causes the bitumen to flow around the aggregate to form an adhesive matrix of substantially uniform thickness which expands around and bindingly retains the aggregate components in the matrix and firmly affixes the matrix to the subgrade. Desirably, while the bitumen and the aggregate are still in this heated condition, they are subjected to a rolling operation which firmly kneads the aggregate into the bitumen to form a bitumen-aggregate paved surface of substantially uniform thickness.

The accompanying drawings illustrate my invention. In such drawings:

FIG. 1 is a vertical section through a road surface being formed in accordance with my invention;

FIG. 2 is a vertical section of road surface shown in FIG. 1, but showing said road in a finished state;

FIG. 3 is a side elevation of an apparatus adapted to carry out my invention;

FIG. 4 is a plan view of the apparatus shown in FIG. 3;

FIG. 5 is a vertical section showing another type of road surface formed according to my invention; and

FIG. 6 is a vertical section showing still another type of road surface formed according to my invention.

As illustrated in the drawings, the usual type of bituminous road surface is built upon a base or subgrade 10 of clay, rock, or gravel, upon which a layer of concrete is sometimes laid. Upon this subgrade 10 is distributed a layer of bitumen 12 which desirably covers the entire subgrade surface. Any desired bituminous material or materials, such as pure asphalt, cut-back asphalt (a mixture of asphalt and a solvent), tar, emulsified asphalt, an asphalt mastic, or the like, may be employed.

After the bitumen has been spread over the subgrade, and preferably while it is still in a fluid or semi-fluid state, a layer of aggregate 14 is spread thereon. The aggregate may be crushed stone, slag, gravel, coarse shell, sand, or the like. In most applications where gravel or crushed stone is employed it is desirable to put down only a single layer of rocks, preferably rocks of substantially the same size.

The amount of bitumen distributed over the subgrade is dependent upon the size, quantity, and type of aggregate

employed. An excess or deficiency of bitumen will produce a paved surface having undesirable characteristics. For example, when the bitumen-aggregate ratio is too high, the bitumen completely covers the aggregate and produces a slick surface creating a traffic hazard. And when the bitumen-aggregate ratio is too low the aggregate will not be firmly bound to the bituminous matrix with the result that the aggregate sloughs off and is easily removed by traffic wear.

As previously employed in the production of pavement surfaces, each of the different bituminous binders previously described has certain faults and presents certain problems. For example, in using an emulsified asphalt the asphalt content of the emulsion must be sufficiently high to keep the material from flowing from the subgrade, as where the subgrade has a high crown or a steep grade. However, when the asphalt content is too high, the emulsion becomes too viscous to pump and spray uniformly over the subgrade. This lack of uniformity in the sprayed emulsion produces streaks and blotches of the emulsion on the subgrade with the thicker streaks of emulsion accepting and holding more of the aggregate cover which results in an uneven and nonuniform surface. Another problem in the use of an emulsified asphalt is the lack of adhesion of the emulsion to the subgrade and the aggregate cover when the subgrade or the aggregate is wet. This lack of adhesion permits the aggregate to be easily sloughed off and removed as by erosion, traffic wear, etc.

These same basic problems are present in the use of a cut-back asphalt, particularly with respect to its viscosity and sprayability. In order to obtain a continuous matrix over the surface of the subgrade, the cut-back asphalt must contain a considerable amount of solvent such as naphtha or kerosene. If an insufficient amount of solvent is used the asphalt does not remain adhesive for a sufficient length of time to properly adhere to the subgrade and aggregate. This is particularly true when the aggregate or subgrade are wet. Further, when an insufficient amount of solvent is employed the asphalt does not pump and spray uniformly with the result that streaks and blotches are produced. Conversely, if too high a percentage of solvent is employed the asphalt is too fluid and tends to flow from elevated portions of the subgrade, such as from crowns or steep grades.

Pure asphalt is generally not considered as a satisfactory material for use in combination with aggregate coverings because it depends upon being hot to accept and hold the aggregate cover in place. In some instances, the asphalt is applied to the subgrade and the aggregate is dried and heated at a central plant after which it is applied to the asphalt. However, by the time that the aggregate is distributed over the asphalt, both the asphalt and aggregate have cooled sufficiently so that the asphalt will not accept and hold the aggregate.

Tars of the heavier grade, such as RT–12, are similar to pure asphalt in their aggregate holding characteristics, but if the tar is emulsified it will react in much the same manner as emulsified asphalts, or if it contains lighter fractions it will react in substantially the same manner as cut-back asphalt.

My method of producing a bitumen-aggregate road surface uses any desired bituminous material and overcomes the difficulties and problems described above. In carrying out my invention in its preferred form, the layers of bitumen and aggregate are distributed over the subgrade and then subjected to a heat treatment to distribute the bitumen uniformly over the subgrade and to cause said bitumen to rigidly bind the aggregate in place. In order to carry out such a heat treatment I employ a device of the type illustrated in FIG. 3 which comprises a generally rectangular frame 20 supported on forwardly and rearwardly disposed wheels 22 and 24 and provided at its for-

ward end with a hitch **26** adapted to be connected to a draft vehicle. Adjacent the forward end of the frame **20** is a motor **28** adapted to drive a blower **30** and an oil pump **32**. The oil pump **32** is connected to an oil reservoir **35** for pumping the oil from said reservoir to one or more burner nozzles **36** mounted in an air chamber **38**. The blower **30** is connected to the air chamber **38** by a flexible conduit **40** which transmits a turbulent blast of air from the blower into said air chamber.

The air chamber **38** is mounted on the upper face of a hood **44** supported from the frame **20**. Preferably, the hood **44** is vertically adjustable with respect to the frame **20**. To this end, the forward and rearward ends of the hood **44** are supported on cables **46** mounted on axles **48** which are rotatable by means of winches **49** mounted on the frame **20**. Thus, the winches **49** can lower the hood into a position in which it lies immediately above the bitumen-aggregate surface. In this lowered position the flame from the oil that is atomized and ignited by the burners **36** will be directed against said bitumen-aggregate surface with the heat from said flame being retained on said surface by the hood **44**. The air turbulence created by the blower **30** creates a turbulent heated blast within the confines of the hood **44** so as to increase the heating efficiency of the burners. Thus, as the unit moves over a bitumen-aggregate mixture the bitumen will be subjected to the direct heat from the burner flames and to the heated turbulent air blast within the extent of the hood.

I further contemplate, of course, the use of a hood **44** which is laterally adjustable so that the heating unit can move down an ordinary highway to its work location in its laterally collapsed position, and then be extended so that the hood will cover one complete lane of the highway or road.

The apparatus above described is especially well suited for a road-surfacing operation supplying a bituminous emulsion. While emulsions suitable for use may vary widely in character, I have found that an asphalt emulsion of the following composition is particularly well adapted for producing a paved road surface having excellent wear and binding characteristics.

	Percent
Asphalt of 150 penetration (A.S.T.M. specification B5–25)	60
Crude tall oil	1.8
Caustic soda	0.25
Water	37.95

In producing a pavement formed from an emulsified asphalt and a gravel-type aggregate cover according to my invention the following sequence of operations are performed: The asphalt emulsion **12** is sprayed over the surface of the subgrade **10** in quantity proportional to the size of the aggregate to be applied, as set forth more particularly below. A single layer of aggregate **14** is then distributed over the emulsion matrix with about the lower one third of the individual rocks of the aggregate being embedded in the emulsion matrix, as shown in FIG. 1. The heating unit illustrated in FIG. 3 is then passed over the emulsion-aggregate mixture with its hood **44** in a lowered position immediately above the surface of said mixture. The heat from the burners **36** is directed on the emulsion and the aggregate to raise the temperatures thereof. This heat treatment expands the water-asphalt emulsion and causes the asphalt to flow around the individual rocks comprising the aggregate to produce a uniform thickness of asphalt on the subgrade. Any streaks or blotches in the emulsion coating are thus removed and the entire surface of the subgrade is covered with uniform coating of asphalt. As the moisture leaves the emulsion under the influence of the applied heat, the asphalt that remains climbs upwardly around the aggregate to hold them in the asphalt matrix as illustrated in FIG. 2. The reduced moisture content of the emulsion also causes the asphalt to become more adhesive to increase its binding strength both with respect to the aggregate and to the subgrade.

As indicated above, the quantity of binder applied to the subgrade is preferably proportional to the size of the aggregate. I have achieved excellent results using the quantities of emulsified asphalt in combination with single layers of aggregate as set forth below.

Emulsified asphalt, gal./sq. yd.	Rock size, inches
0.15–0.20	⅛
0.25–0.30	¼
0.35–0.40	½
0.60–0.70	¾

For most purposes I prefer to employ one-quarter inch aggregate and to apply the emulsion at the rate of 0.25 to 0.30 gallon per square yard of subgrade.

The height to which the asphalt expands and climbs on the aggregate is dependent upon the amount of heat that is employed. In the preferred example just described, movement of the heating unit over the emulsion-aggregate mixture at a rate of travel of twenty feet per minute using one burner will cause the asphalt to expand and climb upwardly on the individual rocks comprising the aggregate to about two thirds of their height. A slower rate of travel and/or the use of more burners will, of course, cause the asphalt to climb proportionately higher on the rocks.

It is desirable to roll the asphalt-aggregate mixture immediately after it has been heated so as to firmly knead the rocks into the asphalt matrix and to remove any gross projections on said rocks. To this end, the heating unit may be provided with a plurality of rear wheels **24** extending across the back of the frame **20**. In order to produce a thicker layer of pavement, it is merely necessary to repeat the sequence of operations described. This produces alternate layers of asphalt and aggregate of the desired depth.

Another type of road construction that may be produced by my invention is illustrated in FIG. 5 wherein a layer of bitumen **50** is applied to the subgrade **52** and a thin layer of sand is spread thereon. This mixture is then heated and rolled in the manner described above and excess sand is removed in any convenient manner, such as by sweeping. A second layer **56** of bitumen is then sprayed over the sand and a covering of coarse aggregate **58** is spread thereon. The heating and rolling operations are then repeated to knead the aggregate into the bitumen-sand mixture with the bitumen being distributed in a continuous film on and around the sand and below and around the coarse aggregate.

Still another type of road construction that may be produced in accordance with my invention is illustrated in FIG. 6 wherein a coating of bitumen **60** is distributed over the subgrade **62** and a layer of coarse aggregate **64** previously coated with bitumen is spread thereon. The two layers of material are then subjected to a heat treatment which causes the bitumen **60** to expand around the aggregate **64** and to adhere to said aggregate and to the subgrade. Desirably, after the heating operation the surface is rolled to firmly knead the aggregate **64** into the bitumen coating **60**.

In any of the procedures described, water may be added to the bitumen-aggregate mixture prior to heating so that upon heating the water-asphalt mixture will boil causing the asphalt to expand and climb to a higher level on the aggregate than it would if the water were not present. This procedure is particularly well adapted for producing a road surface in which the aggregate is completely covered by the asphalt.

I claim as my invention:

1. A method of producing a paved surface, comprising the steps of distributing a coating of emulsified asphalt over a subgrade, spreading a layer of aggregate on said emulsified asphalt, and after such application of emulsion and aggregate to the subgrade heating said emulsion and

aggregate from above by a substantially instantaneous flame blast immediately followed by a more prolonged blast of hot air to heat said emulsion and aggregate to a temperature sufficient to cause said emulsion to start to break and to expand the asphalt upwardly around the individual components constituting the aggregate and form a continuous subgrade cover of substantially uniform thickness bonded to said aggregate and subgrade, said heating of the emulsion and aggregate being conducted while the emulsion and aggregate are free from applied pressure.

2. The method as set forth in claim 1 in which said aggregate comprises a substance selected from the class consisting of crushed stone, gravel, slag, sand, coarse shell, and combinations thereof.

3. The method as set forth in claim 1 in which said aggregate comprises a single layer of rocks.

4. The method as set forth in claim 1 in which said asphalt emulsion is distributed over the subgrade at a rate of .1 to .75 gallon per square yard and the individual aggregate components have a diameter in the range of from one-eighth inch to three-quarters of an inch.

5. A method of producing a paved surface, comprising the steps of distributing a coating of bitumen over a subgrade, spreading a layer of aggregate on said bitumen, spraying said bitumen and aggregate with water, and heating the same from above by the direct application of burning gases to boil said water and cause said bitumen to cover said aggregate and flow into a continuous subgrade cover of substantially uniform thickness bonded to said subgrade and aggregate, said heating of the bitumen and aggregate being conducted at least in part while the bitumen and aggregate are free from applied pressure.

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