

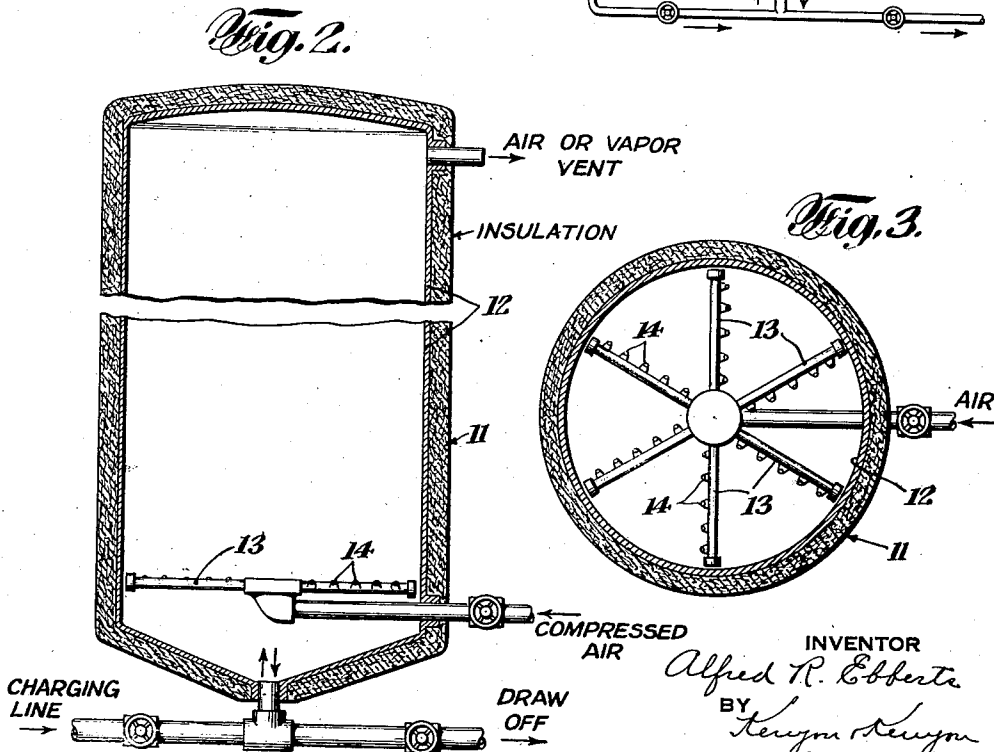
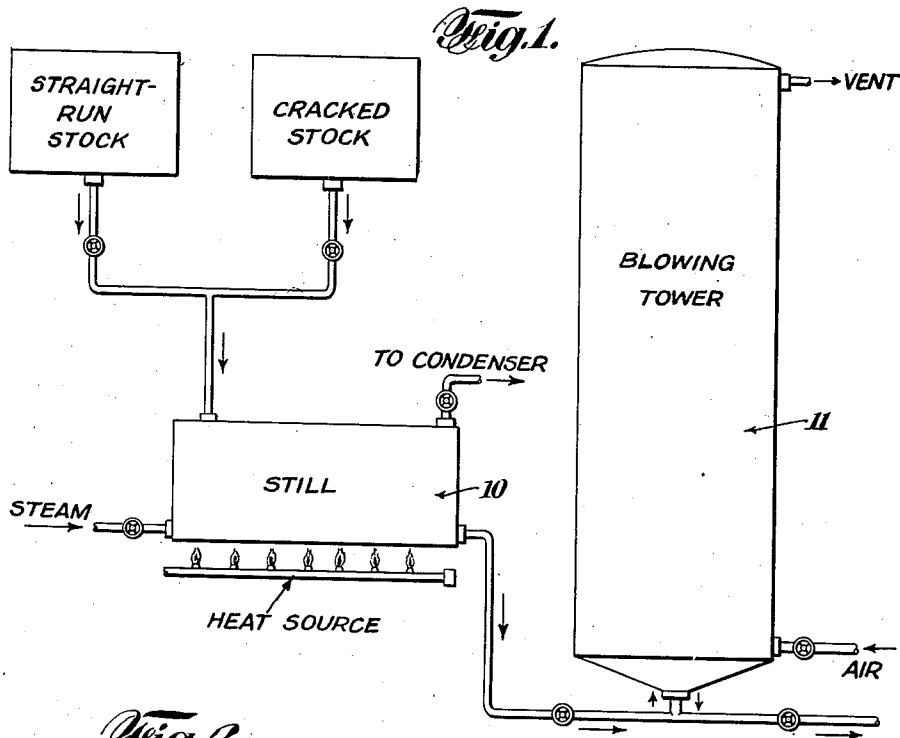
Jan. 12, 1937.

A. R. EBBERTS

2,067,264

PROCESS OF MAKING BITUMINOUS MATERIALS

Original Filed Sept. 19, 1930



UNITED STATES PATENT OFFICE

2,067,264

PROCESS OF MAKING BITUMINOUS MATERIALS

Alfred R. Ebberts, New York, N. Y., assignor to Colprovia Roads, Inc., New York, N. Y., a corporation of New York

Original application September 19, 1930, Serial No. 483,126. Divided and this application April 14, 1932, Serial No. 605,359

11 Claims. (Cl. 196—74)

This invention relates to bituminous binding materials such as are used as binders for stone aggregate in road construction, and is a divisional application with respect to my application, 5 Serial No. 483,126, filed September 19, 1930, now U. S. Patent 1,937,749 for Bituminous materials and process of making same. It not only is applicable to bitumens of relatively high melting point which may, for example, be applied in 10 powdered form, but is also applicable to relatively low melting point bitumens, such as flux oils.

This invention is particularly applicable to a process wherein a bitumen of high melting point gradually amalgamates with a bitumen of relatively 15 lower melting point without the application of heat and at ordinary temperatures to produce a substantially homogeneous binder of desired melting point. Thus this invention is applicable to and improves upon a process of road 20 construction wherein aggregate material is first coated with a substantially non-volatile flux oil which is liquid at temperatures below summer heat and then is coated with powdered bitumen having a melting point higher than is necessary 25 to resist summer heat which adheres to the first coating as an exterior dustlike coating to produce a material the particles of which do not stick together during storing and laying due to the dustlike character of the exterior coating, but which 30 when laid and consolidated in place become securely and permanently bound into a semi-rigid mass by the gradual amalgamation of the liquid and solid binders upon rolling and subsequent traffic to form a substantially homogeneous binder 35 having a melting point sufficiently high to resist summer heat.

Heretofore in the process of road construction referred to, difficulties have been encountered because of failure of the binder parts to properly 40 amalgamate the one with the other and form a proper binder. Difficulties have also been encountered in properly powdering high melting point bitumens. These and other difficulties will be discussed more fully hereinafter.

45 It is a feature of this invention that individual relatively low melting point bitumens such as flux oils and powdered bitumens of relatively high melting point are not only improved in themselves for purposes for which they are intended but also are improved so that they will 50 blend and amalgamate the one with the other in an improved manner producing an amalgamated binder of superior nature.

Further features of this invention are that a 55 process of making a high melting point bitumen

may be controlled so that the resulting product may be made to flux and amalgamate at desired rate with a particular flux oil and that a process of making a flux oil may be controlled so that the 5 resulting product may be made to flux and amalgamate at desired rate with a particular high melting point bitumen. Moreover, it is a feature of this invention that flux oils and high melting point bitumens may be produced which may be 10 made to amalgamate at proper rate with bitumens, either hard or soft, occurring in bituminous rocks.

It is an advantageous feature of this invention in connection with the application of binder parts in the process of road construction above 15 referred to, that a high melting point bitumen may be produced which, when applied as a powder without the application of heat, to aggregate particles coated with a flux oil, will be soluble to the proper extent and at the proper rate 20 in the flux oil, so that during mixing and laying the two parts will not amalgamate too rapidly and prematurely to form unworkable masses which cannot be removed from the mixer or handled or laid cold but will remain substantially 25 unamalgamated, the powdered bitumen acting as a separating substance keeping the individual aggregate particles from adhering to each other and freely movable with respect to each other, and so that after the mix is laid and consolidated 30 with pressure in place the two parts will nevertheless amalgamate and flux together to produce a strong and substantially homogeneous binder. Moreover, it is an advantage of this invention that a high melting point bitumen may be made 35 which, in addition to the properties above mentioned, is sufficiently hard and brittle to permit grinding and reduction to a powder without the formation of lumps or unworkable masses during grinding. According to this invention, high melting point bitumen can be produced which may 40 be readily ground to desired fineness by simple economical means producing a friable powder and which is also of such solubility that it will amalgamate at proper rate with a flux oil used 45 in conjunction therewith.

Hard bitumens have heretofore been made from distillation residues which remain after the lighter fractions have been removed by distillation with little or no cracking (substantially without crack- 50 ing) and which have a consistency ranging from liquids to semi-solids of about 200 penetration (at 77° F. 5 secs.; 100 grams) or melting below 100° F. by blowing such residues, thus raising the melting point of the residues to about 300° F. as 55

determined by the ring and ball method. This product is known as mineral rubber and while useful for certain purposes, its use in road making of the type referred to above is fraught with great difficulties. Mineral rubber is defective first because, due to its rubbery nature, it tends to form into unworkable lumps or masses when attempt is made to reduce it to a powder, and secondly because it is not sufficiently soluble in many flux oils to secure proper amalgamation in the finished road. Lesser blowing, while it reduces the melting point somewhat, thus making the material more soluble, has been found to increase the rubbery consistency of the material, thus making it unfit for grinding. Increased blowing, on the other hand, while it lowers the rubbery consistency of the material, has been found to increase the insolubility of the material in flux oil, thus making it unfit as a binder ingredient.

According to this invention, bituminous material which is to be blown to a high melting point can be treated prior to blowing either to remove certain of the substances which cause the final blown material to be rubbery, or by adding to the material another material which because of its composition contains materials which, when blown, tend to reduce the rubbery consistency of the final product. Preferably a combination of the two methods of reducing the rubbery consistency of the final product is employed. Moreover, I have found that the rubbery consistency of the blown material can thus be reduced not only without increasing the insolubility of the material but also with attendant decrease in insolubility where desired, thus producing a material which can be readily ground to a powder and which also amalgamates with a flux oil used at the desired rate.

Instead of directly blowing substantially uncracked straight run residues ordinarily encountered having, for example, melting points below 100° F., to high melting points such as 300° F. as heretofore practised, I have found that certain constituents which cause the blown product to be rubbery can be removed as by straight distillation as with steam up to a point where the residue will have a comparatively high melting point such as 170° F. If this material is then blown to a melting point of about 240°-270° F., a satisfactory final product will be obtained which can be readily reduced to a powder and which will amalgamate properly with the flux oil. Moreover, I have found that certain materials contain substances which, when blown, increase the brittleness and grinding quality of blown materials with which they are mixed while at the same time tending to increase their solubility. An example of such a material is cracking still residue, which material is advantageous for use according to this invention because it is efficient and readily available and cheap. While certain advantages can be obtained according to this invention merely by mixing cracking still residue with straight run residue and then blowing the mixture to a high melting point, it is preferable first to make the mixture and then treat the mixture as by straight running with steam prior to blowing as a superior product can be obtained in this way. Where the mixture is used, however, the straight running with steam does not have to be taken to so high a melting point as where cracking still residues are not used in order to produce an entirely satisfactory product. By such procedure, a product which is hard and brittle and therefore readily powderable will be produced and at the same time the

solubility of the bitumen may be modified so as to make it soluble at a desired rate in a flux oil to be used in conjunction therewith.

In the accompanying drawing, Fig. 1 is a flow sheet indicating diagrammatically apparatus which may be employed in practicing this invention;

Fig. 2 is a side view in section of a blowing tower which may be used in the practice of this invention; and

Fig. 3 is a sectional view of the tower shown in Fig. 2 looking down on the air inlet nozzle arrangement.

By way of illustration, where substantially uncracked straight reduction residues of approximately 800 sec. Furol (at 122° F.) viscosity are available, this material when directly blown results in a binder which is too rubbery for grinding or too insoluble for use or both, depending upon the amount of blowing to which it has been subjected. These difficulties can be overcome according to this invention by straight running such residues with steam so that a residue having a melting point of about 170° F. is produced. Straight running may be carried out in any type of still commonly used for the purpose and such still is indicated diagrammatically by the reference character 10 in the accompanying drawing. Straight running is to be understood to mean distillation at pressures below the generally accepted cracking pressure zone without the use of air blowing but with or without the aid of steam. Straight running does not result in substantial cracking and is to be distinguished from cracking distillation which requires the processing of the hydrocarbons under substantial pressures such as, in usual practice, about 250 lbs. per square inch or greater. Straight running is also to be distinguished from "blowing", which is primarily an oxidation treatment rather than a distillation. When this product is blown to a melting point of from 240-275° F., I have found that a product of the desired hardness and solubility is obtained. When reference is made herein to "blowing" a residue it is to be understood that the residue is blown with air or is blown with some other gas which contains oxygen and which is adapted to oxidize the residue. Any type of blowing still indicated broadly by reference character 11 commonly used such as a tank or tower still may be used for carrying out the blowing operation. A type of blowing still which has proved to be satisfactory is a vertical cylindrical insulated tower 12 with radial air inlets 13 having orifices 14 on the sides thereof to produce swirling. According to common practice, the air may be controlled to maintain a temperature around 450-600° F. and when the operation is complete the material is allowed to stand hot for five hours or more to permit escape of air and water vapor.

Since the straight distillation is relatively expensive compared with blowing, I have found it desirable to mix with the initial distillation residues a certain amount of cracking still residues. Where, for example, 35 parts of the straight reduction residues of about 800 sec. Furol (at 122° F.) viscosity are mixed with 65 parts of cracking still residues of about 400 sec. Furol (at 122° F.), this mixture, due to the presence of the cracking still residues, need only be straight run to a melting point of about 140° F. prior to blowing, and when blown to a melting point of 240-275° F. produces a completely satisfactory hard bitumen.

The following table will indicate variations in treatment of different mixes according to this invention.

Straight reduction residues	Cracking still residues	Straight reduction melting point (M. P.)	Blowing melting point (M. P.)
100% (any viscosity).	0%-----	170° F. M. P.	240-275° F. M. P.
65% (800 sec. Furol).	35% (400 sec. F.)----	160° F. M. P.	240-275° F. M. P.
35% (800 sec. Furol).	65% (400 sec. F.)----	140° F. M. P.	240-275° F. M. P.
20% (41-50 penetration).	80% (400 sec. F.)----	120° F. M. P.	240-275° F. M. P.
0%-----	100% (any viscosity).	300° F. Flash point.	200-275° F. M. P.

While cracking still residues as shown in the above table can be straight run to a flash point of about 300° F. to prepare them for the blowing, and then blown, and a brittle product obtained, according to this invention it is preferable to mix with the cracking still residues a certain amount of straight run residues, as the final product of such a mixture possesses superior lasting properties in the finished road. Straight running of cracking still residues to about 85° F. M. P. should ordinarily give a safe flash point prior to blowing and give a satisfactory powderable bitumen where cracking still residues are used. Where cracking still residue is used alone, it is not necessary to carry the blowing to as high a melting point as where substantial amounts of straight run residues are mixed therewith in order to produce a hard powderable product. When substantially uncracked straight run residue is mixed with cracking still residue, the brittleness of the blown product resulting from the mixture decreases rapidly upon adding a substantial proportion of the substantially uncracked straight run residue to the cracking still residue, thus requiring more straight running and requiring blowing to a higher melting point in the case of such mixtures than when cracking still residue by itself is used.

While mention has been made of mixing straight run residue with cracking still residue, for example, and blowing the mixture, it is apparent that this has been done merely by way of illustration, and that such procedure may be considerably varied in the practice of this invention. Thus, for example, straight run residue can be reduced to a relatively high melting point before cracking still residue is added thereto. Moreover, cracking still residue may be straight run prior to adding it to straight run residue. Moreover, a resulting blend in the blown product can be made either prior to or during blowing according to this invention. Any such variations in the practice of this invention are to be considered as coming within the scope thereof.

With regard to the above examples, it is apparent that they are illustrative merely, for it must be borne in mind that there is practically no uniformity of materials which are ordinarily available for the manufacture of bituminous binders. Not only do the crude oils in different localities differ markedly in their composition and properties, but also refining practices in the removal of the lighter fractions of gasoline, naphtha, kerosene, oils, etc., differ to great extent, so that the residues available for conversion into bituminous binders differ widely in composition. It is a feature of this invention that it is adapted to meet substantially all of these varying

conditions in a simple commercial way to produce uniformly satisfactory binders.

The straight reduction residues and cracking still residues which are normally available are often of varying viscosities. In such case, this invention can be appropriately modified in each particular case guided by the following general rules. If the substantially uncracked straight run component used in a mixture is of low viscosity, then straight running after mixing to a lesser melting point is required, as the light hydrocarbons that cause the low viscosity are driven off by the straight running, thus increasing the percentage of cracked residues in the remaining material and thus augmenting their effect in making a brittle product. Conversely, if the cracking still residues are of low viscosity, then straight running the mixture to a higher temperature is required as the light cracked hydrocarbons are driven off, leaving a lesser concentration of the cracked residues in the remaining material. If desired either or both of the components may be straight run separately as above set forth to materially increase the viscosity of one or the other or both before they are blended with each other and in either case the blending may be at any desired time such as prior to, at, or during the blowing step. By any such treatment the ingredients which are rubbery or which may produce a rubbery consistency when blown are removed from the substantially uncracked straight run residue and the benefit of the cracked hydrocarbons in the cracking still residue is achieved and it is usually desirable to carry at least the straight run component to a melting point of about 120° F. or over as indicated in the preceding table.

In the making of hard bitumen, residues of certain crude oils such as Pennsylvania crudes are unsuitable due to their high paraffin content. Such oils cannot be converted either by blowing or straight distillation to form hard bitumen suitable as a binding material for roads. Those crude oils are preferable which possess a high asphaltic base. Asphaltic or mixed base crudes lend themselves admirably to the practice of this invention. Thus, by mixing straight run residue from asphaltic or mixed base crudes with cracking still residue, for example, to produce a mixture of the two prior or during blowing, as above described, a blown product can be made according to this invention which is of increased friability but which is not excessively insoluble in flux oils while relatively cold. Moreover, those oils which possess naturally a high naphthene content have been found to give very satisfactory results according to this invention, since they are of such a character that they require less straight running prior to blowing. Thus a satisfactory hard bitumen can be made according to this invention by straight running a high naphthene base crude to a melting point of about 85° F. as a safe flash point is thus obtained and then blowing it to 240-275° F. Moreover, high naphthene base crudes may be mixed with crude residues (e. g. residues from ordinary Mexican, Venezuelan, South American and other similar crudes) which give a blown product which is too rubbery or too insoluble or both, prior to blowing to increase the powderable quality of the blown product and/or increase its solubility according to this invention.

While this invention has been described as being particularly useful in the production of blown high melting point bitumens which are of

increased hardness without sacrificing the solubility of the blown product, it is apparent that this invention can be applied conversely in the production of blown bitumens of increased rubbery quality and/or increased insolubility. Thus by avoiding high naphthene base crudes and cracking still residues and by reducing straight reduction to a minimum prior to blowing, a very rubbery and relatively insoluble product can be obtained if such a product is desired. Where straight run residue is used the blown product is less susceptible to temperature change than blown cracking still residue.

In methods heretofore practiced, difficulties have not only been encountered in securing a satisfactory high melting point bitumen, but also difficulties have been encountered in making and securing relatively low melting point bitumens. Thus in the process of road construction above referred to, the flux oil used should meet the following requirements: The flux oil to be satisfactory should preferably have sufficient viscosity or body properly to coat the aggregate particles at ordinary temperatures, i. e., approximately between 40° F. and 100° F. If the flux is too thin, it will drain off the aggregate particles and coat them insufficiently. A flux which is too thick, on the other hand, does not spread well on the aggregate particles so as to coat them thoroughly and tends to make the mass unworkable unless heating is resorted to with attendant expense and delay. It is preferable to use a flux oil having a viscosity between 600 to 800 sec. Furol (at 122° F.), though flux oils which range about 200 sec. Furol (at 122° F.) above and below the limits above-mentioned may be used, though less advantageously.

In addition to proper viscosity, the flux oil should be of such nature that it will amalgamate at a proper rate with the hard bitumen with which it is used. As herein already stated, the amalgamation should be sufficiently slow to permit the powdered bitumen to remain as a dust adhering to the first coating of the flux oil and keep the aggregate particles from sticking together during handling, shipping, laying, etc., of the mix. The rate of amalgamation should be sufficiently rapid, however, to permit eventually a perfect consolidation and blending by solution of the one binder with the other in the finished road upon rolling and subsequent traffic to produce a composite substantially homogeneous binder of the required specification and melting point.

Heretofore difficulty has been encountered with the use of straight run residues such as fuel oil due to the fact that they lack sufficient solvent power to amalgamate with many hard powdered bitumens without the application of heat.

According to this invention, a flux oil such as fuel oil, which ordinarily is of too low solvent power, can be treated by adding materials thereto which have a relatively high solvent power for hard bitumen to produce a mixture which is satisfactory both in viscosity and solvent power. For example, the solvent property of fuel oil may be increased by adding to it a certain amount of cracking still residues, a material which I have found increases the solvent power of fuel oil when added thereto.

While this invention is not regarded as dependent upon the correctness of any theory which I may advance, I believe that the addition of a substance such as cracking still residues to increase the solvent power of flux oil for high melt-

ing point bitumen and therefore the rate at which the two will blend and amalgamate together is due to the fact that cyclic hydrocarbons have high solvent power for hard bitumens and that cracking still residues contain such a large proportion of these cyclic hydrocarbons that the addition of the cracking still residues to the fuel oil causes an increase in the cyclic hydrocarbon content of the resultant mix and a corresponding increase in its solvent power. It is apparent, however, that any other source of cyclic hydrocarbons such as residues from crudes containing naturally a high naphthene content may also be used according to this invention to increase the solvent power of a flux oil which is deficient in this regard. Moreover, residues from high naphthene base crudes may be used alone as a gradual solvent for high melting point bitumen according to this invention. Conversely, where a flux oil possesses too great solvent power and therefore amalgamates too rapidly with a high melting point bitumen, its solvent power may be decreased according to this invention by adding to the material a substance which is deficient in cyclic hydrocarbons, such as straight run fuel oil from asphaltic or mixed base crudes, so that the resultant mixture will blend and amalgamate with the hard bitumen at the proper rate. Heretofore differences in cyclic hydrocarbon content and solvent power of residues of different crudes and different refinery processes have not been known or utilized, as herein described and set forth.

Inasmuch as the materials which are available for flux oils differ not only in solvent power but also in viscosity, depending upon the crude oils from which they have been derived and the manner in which the crudes have been treated in making the flux oils, it is apparent the procedure to be followed must be adapted to the materials which are available. The principles which are to be followed according to this invention in selecting a flux oil of proper solvent power have already been set forth above. In order to procure a flux oil which will also have a proper viscosity, a blending of flux oils of different viscosities is frequently required. The production of a flux oil having both a proper solvent power and a proper viscosity is preferably accomplished in a single operation. For example, a flux oil of insufficient solvent power and of too high viscosity may be blended with another oil such as cracking still residues which is of too low viscosity and of too great solvent power, to produce a flux oil which is satisfactory in all respects.

While it is possible to determine the solvent power of a flux oil by actually trying the material out in the manufacture of roads and noting its behavior during mixing and laying and also in the finished road, I have found that a relatively accurate test of the rate of amalgamation of a particular hard bitumen with a particular flux oil may be made in the following way: The hard asphalt is first powdered and that portion which passes a 30 mesh sieve and is retained in a 100 mesh sieve (both U. S. standard sieve series) is combined with the flux oil at room temperature in such proportion as would give an asphalt cement of 70 penetration at 77° F., 5 secs., 100 grams, if the two were melted together. The materials are then thoroughly mixed and allowed to stand at room temperatures for twenty-four hours, at which time the penetration is taken in the usual manner. The mixture is permitted to stand for an additional six days (one week from the time

of mixing) and the penetration again taken. The penetration at the end of a week must be between fifty and eighty per cent. of that at the end of twenty-four hours, for the amalgamation rate to be proper.

From the foregoing, it is apparent that means have been set forth not only for modifying the properties of hard bitumens on the one hand and of flux oils on the other, so that they can be made to correspond to certain specifications and requirements when considered separately, but also for selecting pairs of these materials which blend and amalgamate with each other while cold to produce firm durable binders. This modification and adaptation of the separate flux and hard bitumen parts so that the two parts may form a pair which co-operate and supplement each other in the most advantageous manner is an important feature of this invention. It is thus possible according to this invention to modify a flux oil so that it may be more advantageously used with a particular hard bitumen and a hard bitumen may also be modified to adapt it for use in conjunction with a particular flux oil. Usually, it is preferable to first modify the properties of the hard bitumen as by increasing both its brittleness and solubility in flux oil and then modify the flux oil so that it will amalgamate perfectly with the bitumen.

The following is a specific illustration of this invention where straight run residues are available which are of about 800 sec. Furol viscosity. As set forth above, where cracking still residues are also available which are of about 400 sec. Furol viscosity, these two materials can be mixed in the proportion of 35 parts of the straight run residues with 65 parts of the cracking still residues, the mixture straight run to a melting point of about 140° F., and then blown to a melting point of 240° F. to 275° F. to produce a hard bitumen which can be readily reduced to a powder and is of increased solubility in flux oil. A flux oil of proper viscosity which will amalgamate with the hard asphalt thus produced may be determined as follows. As it may be assumed for reasons herein stated that straight run residues used alone probably will not dissolve the hard bitumen sufficiently rapidly, a known quantity of the straight run residues may be mixed with a known quantity of cracking still residues to increase its solvent power having in mind also the production of a flux oil of proper viscosity. A test of the rate of fluxing and amalgamation is then made after the manner above described. If the rate of amalgamation is either too rapid or too slow, the original proportions can be changed and the test repeated until flux oil of satisfactory solvent power and viscosity is determined upon. By experiments as above conducted and also by actual use in roads, I have found that a flux oil which will give satisfactory results in connection with the hard bitumen above mentioned will usually have approximately the following composition:

30 parts of straight run residues 800 sec. Furol (at 122° F.).

70 parts of cracking still residues 400 sec. Furol (at 122° F.).

It is a further feature of this invention that it is applicable not only to the making of relatively low melting point bitumen such as flux oils and the making of relatively high melting point bitumens which are of proper consistency both in themselves and as paired with one another to effect proper amalgamation but that it is also ap-

plicable to the making of bituminous materials which will blend and amalgamate as desired with bitumen occurring in bituminous rocks. A bituminous rock, for example, having not only a deficiency of bitumen but also a bitumen of improper consistency for use in road construction may be used in connection with an added bitumen according to this invention so that the rock and added bitumen may merely be mixed together while cold and then laid cold upon the road. Upon subsequent rolling and traffic, a composite consolidated binder can be produced of desired amount and consistency wherein the bitumen occurring naturally in the rock (unsatisfactory in itself) is advantageously utilized by simple means.

Bituminous rock in connection with which this invention is applicable may be any naturally occurring combination of bitumen and mineral such as the bituminous limestones of Alabama and Texas, the bituminous sandstones of Kentucky, the bituminous sands of Alberta and the like. In the usual case, bituminous rocks as mined are unsuitable for paving use due to a deficiency of bitumen and/or due to improper consistency of the bituminous material present.

Where, for example, a bituminous rock is encountered having a deficiency of bitumen and having a bitumen of too low melting point for use alone in road construction such as Kentucky bituminous sand stone, the bituminous rock may be reduced to desired fineness and powdered bitumen of high melting point coated thereon as an adhering dust which keeps the particles of asphaltic rock separate during mixing but which gradually amalgamates with the bitumen occurring in the rock without the application of heat after laying and upon subsequent rolling and traffic to form a binder proper both in amount and consistency to meet desired specifications. While a hard powderable bitumen of desired solubility in the bitumen occurring in the bituminous rock can be determined by experiment in samples of road, a way of assisting in determining the required hardness, solubility and amount of powdered bitumen to be used in connection with the bitumen in the bituminous rock, is to take a sample of the bituminous rock aggregate used and treat it with a volatile solvent such as benzol to extract the bitumen therefrom. By evaporating the added solvent, a sample of the bitumen occurring in the bituminous rock can be obtained and a determination can be made of the amount thereof which is available for amalgamation with a bituminous coating added thereto. Having obtained a sample of the bitumen occurring in the natural rock, a high melting point bitumen which will have hardness and dissolving power to amalgamate therewith at a desired rate, may be made according to this invention by procedure herein already described in connection with the preparation of hard powderable bitumen which will amalgamate at desired rate with a given flux oil. An amount of powdered bitumen selected in the manner above described is then coated on the aggregate particles, so as to form a composite binder comprising an amalgamation product of the bitumen occurring in the natural rock with the powdered bitumen added thereto which will have a desired melting point for the finished road. If it is desired to build up the total amount of binder in the finished road, a flux oil can be coated upon the bituminous rock aggregate prior to applying the powdered bitumen and then sufficient powdered bitumen added to amalgamate with both the flux oil and with the bitumen occurring

in the natural rock. To this end, a flux oil having the proper solvent power for the powdered bitumen may be selected according to methods herein already described. The flux oil used should preferably correspond in solvent power to that of the low melting point bitumen occurring in the natural rock.

Where a bituminous rock is available such as Alabama rock asphalt or bituminous limestone having a bitumen content which is deficient and of too high a melting point, an analogous procedure may be employed. In such case the bituminous rock may be reduced to desired fineness and coated with a flux oil in which the hard bitumen in the rock will dissolve and gradually amalgamate without the application of heat. Then a coating of powdered artificial bitumen may be added to keep the bituminous rock aggregate particles separate during mixing and laying and which will gradually amalgamate while cold with the flux oil upon rolling and subsequent traffic. Preferably the exterior coating of powdered artificial bitumen should correspond closely as to solubility with the high melting point bitumen occurring in the bituminous rock. In this case also, the selection of a flux oil which will properly amalgamate with the bitumen occurring in the bituminous rock and of a powderable bitumen which will also amalgamate at proper rate with the flux oil used, may be assisted by extracting with a volatile solvent the bitumen from a sample of the bituminous rock aggregate used, and evaporating the volatile solvent therefrom in order to obtain a sample of the bitumen occurring in the natural rock and determine the amount of bitumen in the aggregate which is available for amalgamating with a coating of flux oil. Having obtained a sample of the bitumen occurring in the rock, a flux oil which will have the proper solvent power and viscosity to pair correctly with the bitumen of the rock can be selected by methods which have already been described in connection with the preparation of a flux oil which will amalgamate at desired rate with a given high melting point bitumen. A powdered asphalt is then selected following procedure already herein disclosed for producing a powdered asphalt which will pair properly with the flux oil. The amount of flux oil and powdered bitumen used may be adjusted in accord with the quantity and melting point of the bitumen naturally occurring in the rock asphalt so that the total corresponds in melting point and quantity to that desired for the pavement for which the mixture is to be used. As the quantity and physical properties of bitumen occurring naturally in bituminous rocks is widely variant, it is apparent that the foregoing example of procedure in connection with bituminous rocks having too soft bitumen content on the one hand and having too hard bitumen content on the other, are illustrative merely. Thus, for example, a bituminous rock containing bitumen which is satisfactory as to consistency but deficient in amount, etc., may be treated by coating the bituminous rock aggregate particles with a flux oil adapted to blend and amalgamate with the bitumen occurring in the rock and then applying a powdered high melting point bitumen which is adapted according to this invention of amalgamating gradually with the flux oil coating. Where two coatings, one of flux oil and one of powdered bitumen adhering thereto, are added to bituminous rock, more of the fluid portion is used generally speaking in those cases where the naturally occurring bitu-

men is too hard and more of the solid portion in those cases where the naturally occurring bitumen is too soft. Moreover, other methods of combining, modifying and/or augmenting bitumens occurring in natural rocks with bitumens added thereto, so that the combination will neither amalgamate so fast as to interfere with mixing, shipping or storage of the material and easy handling or laying, nor amalgamate so slowly as to prevent its proper compaction and consolidation into a dense and durable pavement upon rolling and subsequent traffic may be employed according to this invention. Moreover, the employment of natural bituminous rock in an all-cold process wherein bitumen occurring in the rock amalgamates without the application of heat and/or without resort to the use of a volatile solvent, with bitumen added thereto to produce a substantially homogeneous binder for inorganic aggregate material which is of proper melting point and consistency, is regarded as within the scope of this invention.

In the specification and claims, such terms as "high melting point bitumen", "bituminous flux" and the like are to be regarded as embracing both bitumens occurring separately and bitumens occurring in bituminous rocks.

In describing the process of road constructing above referred to wherein a high melting point bitumen, e. g. in powdered form, amalgamates with a bituminous flux without the application of heat, it is understood that the bitumen parts are not heated so as to materially increase the speed at which the two bitumens amalgamate and flux together, as, for example, in hot mix method of road construction wherein bitumen is melted. Where a flux oil chilled as by winter temperatures is warmed slightly merely to decrease its viscosity so that it will flow more readily in pipes leading to a mixer for example and more readily form a coating on the aggregate, the process is to be regarded as being carried out without the application of heat. Where a bituminous flux amalgamates with a high melting point bitumen below about 120° F., the amalgamation is understood to be without the application of heat.

While specific materials and specific figures and proportions have been used in describing this invention, it is to be understood that these have been given for purposes of illustration merely, and that the principles of this invention may be adapted to various other materials and conditions and other figures and proportions without departing from the true scope of this invention. Thus considerable variation in the blending and modifying of constituents, in the extent of straight running, in the extent of blowing and the like may be practiced within the scope of this invention. The figures which have been given are, however, regarded as preferable, both from the practical and economical standpoint and from the standpoint of physical desirability, and furnish an accurate description of and guide to the practice of this invention.

I claim:

1. In a process of making a high melting point bitumen wherein an asphaltic or mixed base petroleum is straight run leaving a residue and the residue is thereafter blown to a high melting point, the steps comprising continuing the straight running operation until the residue has a melting point above about 170° F. prior to blowing the residue to a high melting point and

thereafter blowing the residue to a melting point of about 240° F. to 270° F.

2. In a process of making high melting point bitumen wherein asphaltic or mixed base petroleum is straight run leaving a residue and the residue is thereafter blown to a high melting point, the steps comprising mixing straight run residue with cracking still residue in proportions ranging from about 65% straight run residue and 35% cracking still residue to about 20% straight run residue and 80% cracking still residue, forming a mixture of said residues prior to blowing having a melting point of about 160° F. to 120° F. and blowing the mixture to a melting point of about 240° to 275° F.

3. In a process of making a high melting point bitumen wherein asphaltic or mixed base petroleum residuum of heat treatment is blown to a high melting point, the step comprising forming a blown mixture having a melting point of about 240° F. to 270° F. containing a first portion which prior to blowing was characterized by having been straight run to yield a residue having a melting point above about 120° F., and a second portion characterized by having been, prior to blowing, a pressure cracking still residue.

4. In a process of making a bituminous binder for aggregate wherein a high melting point bitumen is prepared in powdered form and is amalgamated with a flux oil by contacting said powdered bitumen with said flux oil, the steps comprising straight running residue from asphaltic or mixed base crude petroleum to a melting point not lower than 120° F. to eliminate ingredients which when blown are rubbery and are difficultly soluble in said flux oil, blowing the bituminous material thus prepared to a melting point sufficiently high to permit the powdering of the blown material, and powdering the blown material, thereby producing a powdered blown bituminous material adapted to be contacted with a bituminous flux oil to form an amalgamated binder having a melting point between the melting points of said powdered bitumen and said flux oil.

5. In a process of making a bituminous binder for aggregate wherein a high melting point bitumen is prepared in powdered form and is amalgamated with flux oil by contacting said powdered bitumen with said flux oil, the steps comprising straight running an asphaltic or mixed base crude petroleum until the residue has a melting point above about 170° F. prior to blowing, blowing said residue to a melting point sufficiently high to permit powdering of the blown product, and powdering the blown product, thereby producing a powdered blown bituminous product adapted to be contacted with a flux oil to form an amalgamated binder having a melting point between the melting points of said powdered bitumen and said flux oil.

6. In a process of making a bituminous binder for aggregate wherein a high melting point bitumen is prepared in powdered form and is amalgamated with flux oil by contacting said powdered bitumen with said flux oil, the steps comprising straight running an asphaltic or mixed base crude petroleum until the residue has a melting point above about 170° F. prior to blowing, blowing said residue to a melting point of about 240° F. to about 270° F., and powdering the blown product, thereby producing a powdered blown bituminous product adapted to be contacted with a flux oil to form an amalga-

mated binder having a melting point between the melting points of said powdered bitumen and said flux oil.

7. In a process of making a bituminous binder for aggregate wherein a high melting point bitumen is prepared in powdered form from asphaltic or mixed base crudes and is amalgamated with a flux oil by contacting said powdered bitumen with said flux oil, the steps comprising mixing substantially uncracked straight run residue with cracking still residue in proportions ranging from about 65% straight run residue and 35% cracking still residue to about 20% straight run residue and 80% cracking still residue, the mixture of said residues prior to blowing having a melting point of about 160° F. to about 120° F., blowing the mixture to a melting point of about 240° F. to about 275° F., and powdering the blown product, thereby producing a powdered blown bituminous product adapted to be contacted with a flux oil to form an amalgamated binder having a melting point between the melting point of said high melting point bitumen and said flux oil.

8. In a process of making a bituminous binder for aggregate wherein a high melting point bitumen is prepared in powdered form and is amalgamated with a flux oil by contacting said powdered bitumen with said flux oil, the steps comprising mixing with substantially uncracked straight run residue from a mixed base crude a substantial proportion of a hydrocarbon selected from the group consisting of cracking still residue and naphthene base crude residue, forming a distillation residue of the mixture of straight run residue and added hydrocarbon having a melting point above about 120° F., blowing the mixture to a melting point of from about 240° F. to about 270° F., and powdering the blown product, thereby producing a powdered blown bituminous product adapted to be contacted with a flux oil to form an amalgamated binder having a melting point between the melting points of said high melting point bitumen and said flux oil.

9. In a process of making a bituminous binder for aggregate by preparing a high melting point bitumen in powdered form and amalgamating the high melting point bitumen with a flux oil by contacting the powdered bitumen with said flux oil, the steps comprising forming a blown bituminous mixture having a melting point of about 240° F. to about 275° F. containing a first portion characterized by having been straight run without substantial cracking to yield a residue having a melting point above about 120° F. and a second portion characterized by having been prior to blowing a pressure cracking still residue, and powdering said blown product, thereby producing a powdered blown bituminous product adapted to be contacted with a flux oil to form an amalgamated binder having a melting point between the melting points of said powdered bitumen and said flux oil.

10. In a process of making a high melting point bitumen wherein an asphaltic or mixed base petroleum is straight run leaving a residue and the residue is thereafter blown to a high melting point, the steps comprising straight running a first portion without substantial cracking prior to blowing to yield a first residue having a melting point above about 120° F., separately distilling a pressure cracking still residue to yield a second residue having a melting point above about 120° F. prior to blowing, blowing said first and second

residues, and making a blown mixture from said first and second residues having a melting point of about 240° F. to about 275° F.

11. In a process of making a high melting point bitumen wherein a crude petroleum is distilled leaving a residue and the residue is thereafter blown to a high melting point, the steps comprising distilling a mixed base crude to a melting
- 5

point above about 120° F. prior to blowing, separately distilling a naphthene base crude to a melting point above about 120° F. prior to blowing, making a blown mixture from said residues having a melting point of about 240° F. to about 275° F. said residues being subjected to blowing.

5

ALFRED R. EBBERTS.