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ASPHALT PREPARATION

Alvin Pierce Anderson, Berkeley, Calif., assignor
to Shell Development Company, San Francisco,
Calif., a corporation of Delaware

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This invention relates to improvements in the manufacture of asphalts and especially to a method of synthesizing high-grade asphalts from petroleum hydrocarbons and associated mineral hydrocarbons which have heretofore been regarded as unsuited for producing such high-grade asphalts. The present invention is particularly concerned with the production of asphalts having a high viscosity at elevated temperature and a low viscosity at low temperature; these characteristics generally result in a high fluidity factor and in a good ductility at low temperatures.

The main identifying and classifying properties of asphalt are penetration, melting point, ductility, temperature susceptibility, and fluidity factor.

The expression "temperature susceptibility" is used to describe the variation of penetration or viscosity of the asphalt with changes in temperature, at temperatures below or up to its softening point. It is sometimes expressed by the "susceptibility factor", defined as the ratio of the penetrations at two different temperatures. It may also be conveniently expressed in terms of a "penetration index", as described by Pfeiffer and Van Doormal in National Petroleum News, vol. 39, No. 8, pages R-78 to R-84 (February 23, 1938). The penetration index is based upon the relationship between penetration values (which may be determined at any desired temperature such, as, for example, 59, 77, or 104° F., 77° F. being employed in the present specification), and the softening point by the ring-and-ball method, and relatively higher penetration indices indicate low-temperature susceptibility. On the basis of penetration index, asphalts have been grouped into three classes merging into one another, the boundaries of which have been chosen more or less arbitrarily: (1) The class with an index between -1 and +1, also known as the "N type." This class comprises most steam-refined bitumens (such as the Mexican) generally used for road making; these are sometimes called "normal bitumens": (2) The class with an index below -1, sometimes known as the "Z type." This class is also sometimes indicated by the name "coal tar pitch type." Like the coal tar pitches, the bitumens of this type are characterized by their great temperature susceptibility and, in general, also by their great brittleness: (3) The class with an index above +1, also known as the "R type." Asphalts falling within this class have extremely low temperature susceptibilities, and, in addition, are generally characterized by a slight brittleness. As the majority of the blown bitu-

mens have these characteristics, this type of bitumen is also sometimes known as the "blown type."

The penetration index and susceptibility factor take into account only the behavior at temperatures up to the melting point. The viscosity of the asphalt above its melting point is greatly influenced by its composition, and it is possible for asphalts of different compositions to have identical softening points and susceptibility factors or penetration indices, but different viscosities at elevated temperatures. As a means of defining the asphalt more completely, use is made of a property known as the "fluidity factor" which takes also into account the behavior at elevated temperatures. It is defined by the equation

$$\text{Fluidity factor} = (V - P) \frac{P}{100}$$

where V=viscosity in seconds Saybolt furol at 275° F., and P=penetration at 77° F., 100 grams, 5 seconds. It will be seen that, for asphalts of a given penetration, the fluidity factor increases as the viscosity at 275° F. increases.

Mexican-type asphalts, such as steam-refined Panuco asphalt, generally have high fluidity factors and good ductilities but most steam refined asphalts of lower penetration indices, such as those produced from petroleum oils from United States crudes by steam distillation, as well as asphalts produced by oxidizing such low penetration index steam-refined asphalts, do not possess both of these desirable characteristics. Thus, if these materials are steam-reduced, they will have good ductilities at 77° C. but usually have unsatisfactory ductility at low temperature, such as 32° F., and possess low viscosities at elevated temperatures, and hence, low fluidity factors; on the other hand, if such materials are blown, the fluidity factor is increased, together with the penetration index, but the ductility is unsatisfactory. Many asphalt specifications require a high fluidity factor, such as at least 125 and a good ductility at low temperatures, such as a ductility at 32° F. (¼ cm. per min.) of at least ⅓ of the penetration at 77° F.

It is an object of the present invention to produce a synthetic asphalt from petroleum hydrocarbons and associated mineral hydrocarbons which has a high viscosity at elevated temperatures, such as about 275° F., or at temperatures above its softening point, and a low viscosity at low temperatures, such as about 32° F. Another object is to manufacture asphalts of improved

fluidity factor and satisfactory ductilities at low temperatures from steam-reduced asphaltic materials initially having lower penetration indices than steam-refined Panuco asphalts of comparable grade (i. e., penetration). It is a further object of the invention to produce a synthetic asphalt which combines the foregoing characteristics of high viscosity at elevated temperature and low viscosity at low temperature with a sufficiently low temperature susceptibility (such as high penetration index) to be suitable for use as paving asphalt. Such asphalts may, for example, have penetrations between 10 and 300 at 77° F. Other objects of the invention will appear from the following specification.

It is generally recognized that asphalts are mixtures of asphaltenes, asphaltic resins, and oil fractions, often together with small quantities of carbenes, carboids, acidic compounds, and in some cases, waxes. The expression "malthenes" is used to designate the portion of the asphalt which is soluble in 86° Bé. petroleum naphtha, and includes the oil fractions together with most of the resins. Asphaltenes are, in the present specification, defined as the constituents which are precipitated when asphalt is dissolved in asphalt by 86° Bé. petroleum naphtha, including, therefore, the carbenes and carboids, when present. The roles of these constituents are discussed in the U. S. Patent 2,073,088 and need not be repeated herein.

From the examination of numerous asphalts it was found that when comparing asphalts of the same penetration and of the same softening point by the ring-and-ball method (and hence, of the same penetration index), a high asphaltene content and a better dispersion (i. e., a more aromatic malthe fraction) go hand in hand. If the malthe fraction is made more paraffinic, the system becomes more poorly dispersed and will have a higher penetration index for a given asphaltene content. Therefore, the addition to asphalt of wax, bright stock or oils which have been freed from the more aromatic constituents by solvent extraction often improves the penetration index. Conversely, it is possible to increase the temperature susceptibility by employing a more aromatic malthe fraction. These methods of regulating the temperature susceptibility of asphalt have been proposed heretofore, being described in the U. S. Patents to Loebel, Nos. 1,881,753 and 1,889,365 and in the U. S. Patent to Bray, No. 1,988,715.

However, in investigations leading up to the present invention, it was found that a poorer dispersion always results in a lower ductility, so that the use of a more paraffinic blending stock is usually not feasible for improving penetration indices when good ductilities must be obtained. To produce high viscosities at elevated temperatures it is necessary to use a highly viscous blending stock, and high molecular paraffinic stocks, including wax were tried. It was found that above the softening point of the asphalt the wax skeleton and the effect of "paraffinity" tends to decrease rapidly as a result of the breakdown of the asphaltene skeleton and the wax approaches a simple liquid blending agent. Such paraffinic materials generally have viscosities of the order of only 100 sec. Saybolt Universal at 275° F., whereas for a satisfactory fluidity factor the viscosity of the asphalt must be of the order of 2,000 to 10,000 sec. Saybolt Universal at 275° F. For these reasons, it is not ordinarily possible to

use paraffinic oil or wax to improve the fluidity factor. While the fluidity factors of certain asphalts, such as the softer grades may be increased by adding wax, the ductility of the resulting asphalt at low temperature is unsatisfactory.

On the other hand, it was found further that too low a penetration index (i. e., too aromatic malthe fraction for a given asphaltene content) will also tend to give at low temperatures, such as 32° F., a high viscosity and hence a low ductility.

In accordance with the present invention, it was, contrary to what would be expected from the prior proposals, found that in the preparation of blended asphalts the viscosity at elevated temperature can be materially increased by adding to the asphaltic bituminous material an extremely viscous hydrocarbon material or blending stock which consists predominantly of non-paraffinic hydrocarbons, and that the resulting blend has a relatively low viscosity, i. e., good ductility, at low temperature. It was found further that the penetration index of the bituminous material is usually not substantially altered by the addition of the viscous hydrocarbon material. Molecular distillation bottoms, produced by distilling heavy aromatic or naphthenic extracts and viscous fractions precipitated by light solvents for low-molecular, paraffinic hydrocarbons are particularly suitable for this purpose. These are described below in greater detail.

The best systems, from the viewpoint of ductility at low temperature and viscosity at high temperature, are believed to be asphalts with relatively high asphaltene contents wherein the asphaltenes are well dispersed, such as Mexican asphalts, or well dispersed asphalts containing hydrocarbons so high in molecular weight and so aromatic in nature that, although still soluble in 86° Bé. naphtha, they belong in a structural sense already to the dispersed phase; these may replace some of the asphaltenes. In this the present preparation of asphalt differs basically from the prior proposals, as outlined heretofore. The invention is not, however, dependent upon any theory advanced herein as to the reason for the improvement, which is demonstrated in the examples given, and achieved by the method described and claimed herein.

According to one embodiment of the invention, suitable for improving the properties of most asphaltic bituminous materials, including those which are not high in asphaltenes, the hydrocarbon blending stock preferably should have a viscosity of not less than about 600 sec. Say. furol at 275° F., viscosities as high as 700 to 850 sec. and higher being particularly suitable, although molecular distillation bottoms and similar precipitated fractions of somewhat lower viscosities may also be used. The degree of aromaticity or non-paraffinity may be defined by stating that the hydrocarbon material should preferably have a viscosity gravity constant of 0.870 or higher, materials with constants above 0.900 being preferred. The viscosity gravity constant is defined by Hill and Coats in the Journal of Industrial and Engineering Chemistry, vol. 20, page 641 et seq., (June 1928). This material is, in the preferred form of the invention, comparatively free from asphaltenes, i. e., over about 95% is soluble in 86° Bé. petroleum naphtha. The presence of larger amounts of asphaltenes therein is not, however, excluded from the scope of this invention, it being permissible to increase

the asphaltene content of the asphalt by adding certain quantities of asphaltenes to the blending stock. The quantity of asphaltenes which may be added in this manner is governed largely by the nature of the initial asphaltic bituminous material, which must contain sufficient resinous materials to produce a good dispersion of asphaltenes.

Such a viscous hydrocarbon blending stock may be produced by extracting a heavy residual or distillate petroleum or other mineral hydrocarbon fraction with a selective solvent for non-paraffinic hydrocarbons, such as liquid SO₂, nitrobenzene, methyl acetate, methyl cellosolve, phenyl acetate, cellosolve acetate, furfural, acetone, aniline, phenol, and cresylic acid. Petroleum fractions derived from asphaltic or mixed base crudes are particularly suitable for this purpose, and fractions extracted from Pennsylvania type crudes may also be employed, such crudes, however, containing relatively smaller amounts of these viscous, non-paraffinic fractions. The initial heavy petroleum fraction may or may not have been previously extracted with the same or similar selective solvent. In other words, the extracted oil may represent either all of the material of highest viscosity gravity constant contained in the fraction produced from a petroleum crude, or it may represent an extract derived from a first raffinate after such a fraction has been subjected to a preliminary extraction. The petroleum fraction, which is subjected to the above described extraction, if it contains asphaltic bodies, may be first de-asphalted by treatment with sulfuric acid or with liquid propane, butane, petroleum naphtha, or the like.

Following the treatment with the selective solvent, the extracted material is freed from the selective solvent for non-paraffinic hydrocarbons and subjected to fractionation to concentrate the viscous hydrocarbon materials; this may be in the form of distillation or treatment with solvents which effect separation primarily on the basis of molecular size, like liquid carbon dioxide. The distillation is preferably conducted under vacuum, and when applied to extracts from mixed base crudes may, for example, be carried out so as to separate substantially all constituents boiling below about 500° F. at a pressure of 10⁻⁴ mm. A prolonged steam and vacuum distillation may be used, particularly with asphaltic base oils.

Materially larger percentages of the extracted hydrocarbons can be distilled over, and more viscous residues can be produced by distilling under "high vacuum", i. e., under an absolute pressure of 0.01 mm. of mercury or lower, preferably 10⁻⁴ mm., at suitable temperatures, such as above about 350° F. and below incipient cracking, i. e., below about 625° F. Such a distillation is sometimes known as "molecular distillation". The distance between the heating and the cooling surfaces of the molecular distillation apparatus may range conveniently from about 0.5 to 10 cm.

It is also possible to produce the viscous blending stock without extraction with selective extraction solvents for non-paraffinic hydrocarbons. Thus, the heavy petroleum fraction, or fraction containing viscous hydrocarbons, may be treated with solvents which preferentially dissolve the more paraffinic and less viscous oils and precipitate the less paraffinic and more viscous constituents in a heavier liquid phase. According to one form of such a treatment, the initial oil frac-

tion is dissolved in a light liquid solvent such as propane, butane, pentane, naphtha, and the like, to form a solution of oil. When the initial fraction contains asphaltic bodies these will be precipitated upon dilution. A gaseous treating agent such as methane, ethane, propane, carbon dioxide, etc., preferably at a paracritical temperature, i. e., above, at, or not more than about 30° C. below its critical temperature, is then dissolved in the resulting oil solution under pressure, the amount dissolved being regulated by controlling the pressure. At first only a small amount of the most viscous and most aromatic oil is precipitated as a heavier liquid phase, and as the quantity of the dissolved gas in the solution is increased, progressively larger quantities of successively lighter materials are precipitated. The quantity of the gaseous treating agent is regulated to produce a precipitated fraction of the desired characteristics, following which the lighter liquid phase is separated from the precipitated phase and the latter is freed from entrained diluent and gas. It may be used without further distillation as the blending stock. It is, of course, also possible to distill this precipitated fraction to effect a further increase in viscosity. In the procedure described above, the solution of the gaseous treating agent in the liquid solvent resulting from the addition of the gas acts as the solvent which preferentially dissolves the paraffinic, less viscous hydrocarbons. Single solvents, such as liquid ethane, at temperatures near to critical, may also be employed for such a treatment, as is known in the art. When it is not desired to include asphaltenes in the blending stock, or when the quantity of asphaltic bodies precipitated is too great, all or part of the latter may be separated from the oil solution before introducing the gas; or, when a single solvent is used, the extraction may be effected in several stages so as to produce a precipitated blending stock having the desired solubility in 86° Bé. naphtha.

The viscous blending stock may or may not be substantially completely soluble in acetone, depending upon whether it was obtained from a first extraction or from an extract derived from a petroleum raffinate after a preliminary extraction, as explained above, and depending upon the nature of the initial oil, i. e., whether derived from an asphaltic or mixed base crude. When derived from material substantially or completely free from asphaltenes, it will be soluble in 86° Bé. petroleum naphtha. The viscous blending stock will usually have a penetration at 77° F. of less than 3 and a softening point of at least about 140° F., the properties of the molecular still bottoms given in the second line of Table I being typical for blending stocks derived from mixed base crude.

This viscous material may be employed to raise the viscosity at elevated temperature, and hence the fluidity factor, of any asphaltic material having a low fluidity factor, including steam reduced asphaltic materials having lower penetration indices than steam reduced Panuco of the same grade, and particularly asphalts produced by oxidizing such materials. It is often preferable to subject such steam reduced asphaltic materials to blowing to improve the penetration index prior to blending. This blowing need not be longer than that required to lower the ductility of the asphalt at 32° F. (¼ cm. per second) to about 0.05 of the penetration at 77° F., although the material may be subjected to even more severe ox-

dations (such as described below). From 2 to 40% of the viscous aromatic material, based upon the final blend, are usually satisfactory, although the present invention is not restricted to these quantities.

EXAMPLE I

An asphaltic residual oil derived from a Hendricks crude, having a softening point of 95° F., was oxidized by blowing to produce an asphalt having the properties given in the first line of Table I. Extract oil obtained from the double countercurrent extraction of a Mid-Continent residual oil with cresylic acid and propane was subjected to molecular distillation at a pressure of 10^{-4} mm. of mercury and a temperature of 630° F., yielding a bottom product having the properties given in the second line of the table. The properties of blends containing different proportions of the oxidized asphalt and the molecular still bottoms are shown in the third and fourth lines of the table. For purposes of comparison, the properties of the steam-refined Panuco asphalt are given in the last line.

Table I

Asphalt	Properties					
	Pen. at 77° F.	Soft. pt., °F.	Pen. index	Say. furol visc. at 275° F.	Fluidity factor	Duct. at 32° F. $\frac{1}{4}$ cm./sec.
Original oxidized Hendricks asphalt produced by blowing 95° S. P. flux	49	134	0.4	310	120	4.4
Original molecular still bottoms	1	175	-1.8	786	-----	0
Properties of blends:						
5% molecular still bottoms+95% Hendricks	49	129	-0.2	334	141	4.9
10% molecular still bottoms+90% Hendricks	50	131	0.0	325	137	5.7
Panuco, steam-refined	55	130	-0.1	413	197	7

It will be noted that the addition of the molecular still bottoms had very little effect on the penetration although its penetration was only 1.0; that it lowered the softening point although its softening point was much higher; that it had only a slight effect on the penetration index; and that it increased the ductility markedly although its ductility was zero. All of these effects are believed to result from an increased dispersion. The blends tabulated in the third and fourth lines each have ductilities not less than $\frac{1}{10}$ of the penetration at 77° F. and have fluidity factors above 125.

The extremely viscous high viscosity-gravity constant hydrocarbon material having viscosities over 600 sec. Saybolt furol are not readily available in many refineries because molecular distillation and treatments with preferential solvents for light, paraffinic hydrocarbons, the most suitable means for preparing the same, are not generally in use, and it is therefore sometimes desirable to employ less viscous materials. Although these less viscous materials improve the ductility of most asphalts, they are not generally suitable for improving the fluidity factor unless the asphaltic bituminous material has a relatively high asphaltene content such as over about 15%. Materials which are particularly suitable for this purpose are products obtained by blowing steam-reduced asphalts to increase the asphaltene content, although the invention is not restricted to any particular method for producing the asphaltic bituminous material. By employing asphaltic materials of such high asphaltene content the present invention affords the possibility of employing viscous hydrocarbon materials which are somewhat less viscous than 600

sec. Saybolt furol at 275° F. for producing blended asphalt of good ductility at high fluidity factor.

While the fluidity factor can be increased by merely increasing the content of asphaltenes, as by blowing, this step alone does not result in good asphalts because when asphalt is blown to the extent required to produce a satisfactory fluidity factor, the ductility is unsatisfactory. When such blown asphalt is blended with aromatic extracts of viscosities proposed for this purpose according to the prior art, such as those described in the U. S. Patent No. 2,073,088, i. e., with extracts having viscosities of about 500 seconds Saybolt furol at 210° F., and slightly greater (corresponding to a viscosity of the order of about 70 to 100 sec. Saybolt furol at 275° F.) in sufficient quantity to improve the ductility, the viscosity of the asphalt at 275° F. is lowered so much that an unsatisfactory fluidity factor results. The extent of blowing is, therefore, limited by the fact that the further the asphalt is oxidized, the greater is the quantity of extract that must be

added to improve the ductility, which in turn results in a greater decrease in viscosity at 275° F., and it is not possible to produce an asphalt of the desired high fluidity factor and good ductility by such methods.

According to the present invention, it was discovered that asphalts of high viscosities at elevated temperatures and low viscosities at low temperatures can be prepared provided the aromatic blending stock has a viscosity of at least about 200 seconds Saybolt furol at 275° F. The preferred procedure involves the following steps: An asphaltic bituminous material, such as a steam reduced or slightly oxidized petroleum residue, is blended with a suitable quantity, such as 15 to 40% of a distillate oil, preferably having a viscosity of between 50 and 100 seconds Saybolt Univ. at 210° F., although viscosities falling outside of these limits may also be used. Either unrefined petroleum fraction or fractions which have been treated with selective solvents may be employed. Thus, distillates having viscosity indices between about -50 and +80 and even those falling outside of this range may be employed, those with viscosity indices below about 0 being preferred. The resulting blend is then blown to produce a blown product of higher softening point and asphaltene content, and a ductility at 32° F. less than 0.1 of the penetration at 77° F. In the preferred embodiment, the blended blowing stock is blown until the asphaltene content is above about 15%, usually not over 30%, and has a ductility at 32° F. not over 0.08 of the penetration at 77° F.

The blown product (or any other asphaltic bituminous material of similar characteristics) is then blended with a viscous hydrocarbon mate-

rial or blending stock consisting predominantly of non-paraffinic hydrocarbons, having the general characteristics of the viscous material as described above, save that the viscosity may be as low as about 200 seconds Saybolt furol at 275° F., materials with viscosities of from 400 to 550 seconds Saybolt furol at 275° F. and higher being preferred. These viscous materials may be prepared according to any of the methods described above for the more viscous blending stocks. These materials usually have penetrations at 77° F. of less than about 7 and softening points of not less than about 120° F. The material described in the third line of Table II is typical for blending stock derived from mixed base crudes. More viscous materials, such as those having viscosities above 600 seconds Saybolt furol at 275° F. may also be employed in this embodiment of the invention, but are not essential.

By employing the relatively low viscosity oil for blending prior to blowing, it is possible to oxidize the asphalt to a greater extent, and hence to effect a greater increase in the asphaltene content for a given penetration of the blown product than if a heavier blending oil were used. The blowing is carried sufficiently far to produce a final product (after the blending with the viscous hydrocarbon material) of the desired fluidity factor. This usually necessitates that the blowing be carried far enough to produce a blown product of low ductility. Since, however, by subsequently blending it with the viscous hydrocarbon material defined above it is possible to improve the ductility without lowering the viscosity to the same extent as in the prior art, this practice is entirely practical.

EXAMPLE II

A residual steam reduced asphaltic flux from a Hendricks crude having the properties shown in the first line of Table II, was blended with a Coalinga distillate having a viscosity index of -40 and a viscosity at 210° F. of 70 seconds Say. Univ., to produce a blowing stock consisting of 75% asphaltic flux and 25% distillate. The stock was blown at a temperature of 450° F. for 13 hours. The properties of the blown material are shown in the second line. The blown product was blended with 20% (based on the blend) of a vacuum and steam distillation bottom product produced by distilling an extract obtained by extracting a Mid-Continent residual oil in double countercurrent with cresylic acid and propane. The properties of the distillation product and of the blend, and the properties of a Panuco steam reduced asphalt are given in the table:

Table II

Asphalt	Properties						
	Pen. at 77° F.	Soft. pt., °F.	Pen. index	Say. furol visc. at 275° F.	Fluidity factor	Duct. at 32° F. 1/4 cm./min.	Percent 60/80 asphaltenes
Orig. Hendricks asphalt flux	-----	86	-----	70	-----	-----	10
Product from blowing blend of 75% Hendricks flux+25% Coalinga distillate	51	139	+1.0	355	155	3.7	20
Vacuum and steam distillation bottoms from Mid-Continent extract	2	157.5	-2.3	480	-----	0	-----
Blend of 80% above blown product+20% vac. and steam dist. bottoms	66	127	+0.2	292	150	7.6	16
Panuco steam reduced asphalt	66	128	+0.2	350	187	9.0	21

tility at 32° F., and of relatively high viscosity at 275° F. and high fluidity factor.

I claim as my invention:

1. A process for preparing improved asphalt of high viscosity at elevated temperatures and good ductility at low temperatures, comprising the steps of blending asphaltic bituminous material with a hydrocarbon material having a viscosity not less than about 600 seconds Saybolt furol at 275° F., and a viscosity-gravity constant above 0.870, said hydrocarbon material being at least about 95% soluble in 86° Bé. naphtha.

2. The process according to claim 1 in which the hydrocarbon material is the less paraffinic and more viscous fraction of a hydrocarbon oil, separated therefrom in a heavier liquid phase by treating the oil with a solvent which preferentially dissolves the more paraffinic and less viscous oils, under conditions causing the formation of two liquid phases and separating said liquid phases.

3. A process for preparing improved asphalt of high viscosity at elevated temperature and good ductility at low temperature, comprising the steps of extracting a hydrocarbon oil containing non-paraffinic hydrocarbons having viscosities of over 600 seconds Saybolt furol at 275° F. with a selective solvent for non-paraffinic hydrocarbons, subjecting the extracted material to a molecular distillation under an absolute pressure below 0.01 mm. of mercury at a temperature between about 350° F. and 625° F., to produce a distillation residue, and blending said distillation residue with asphaltic bituminous material.

4. A process for preparing improved asphalt of high viscosity at elevated temperature and good ductility at low temperature, comprising the steps of extracting a hydrocarbon oil containing non-paraffinic hydrocarbons having viscosities of over 600 seconds Saybolt furol at 275° F. with a selective solvent for non-paraffinic hydrocarbons, subjecting the extracted material to a molecular distillation under an absolute pressure below 0.01 mm. of mercury to produce a distillation residue substantially free from constituents boiling below 500° F. at a pressure of 10⁻⁴ mm. of mercury, and blending said distillation residue with asphaltic bituminous material.

5. A process for preparing improved asphalt of high viscosity at elevated temperature and good ductility at low temperature, comprising the steps of extracting a viscous hydrocarbon oil which is substantially soluble in 86° Bé. naphtha with a selective solvent for non-paraffinic hydrocarbons, subjecting the extracted ma-

It will be seen that by this method it is possible to produce a synthetic asphalt of good ductility

material to a molecular distillation under an absolute pressure below 0.01 mm. of mercury at a

temperature between about 350° F. and 625° F. to produce a distillation residue and blending said distillation residue with asphaltic bituminous material.

5 6. A process for preparing improved asphalt of high viscosity at elevated temperature and good ductility at low temperature, comprising the steps of oxidizing an asphaltic petroleum residue to raise its softening point, and blending
10 the resulting oxidized asphaltic bituminous material with a hydrocarbon material having a viscosity not less than about 600 seconds Saybolt furol at 275° F., and a viscosity-gravity constant about 0.870, said hydrocarbon material
15 being at least about 95% soluble in 86° Bé. naphtha.

7. A process for preparing improved asphalt of high viscosity at elevated temperature and good ductility at low temperature, comprising
20 the steps of blending an asphaltic petroleum residue with a low viscosity distillate oil, oxidizing the resulting blend to raise its softening point and increase its asphaltene content, and blending the resulting oxidized asphaltic bituminous material with a hydrocarbon material having
25 a viscosity not less than about 200 seconds Saybolt furol at 275° F., and a viscosity gravity constant above 0.870.

8. The process according to claim 7 in which
30 the hydrocarbon material has a viscosity of not less than about 400 seconds Saybolt furol at 275° F.

9. A process for preparing improved asphalt of high viscosity at elevated temperatures and
35 good ductility at low temperatures, comprising the steps of blending asphaltic bituminous material with a distillation residue produced by subjecting an extract, obtained by extracting hydrocarbon oil with a selective solvent for non-paraffinic hydrocarbons, to a molecular distillation
40 under an absolute pressure below 0.01 mm.

of mercury at a temperature between 350 and 625° F. said distillation residue having a viscosity not less than about 600 seconds Saybolt furol at 275° F., and a viscosity gravity constant above 0.870.

5 10. A process for preparing improved asphalt of high viscosity at elevated temperature and good ductility at low temperature, comprising the steps of blending an asphaltic petroleum residue with a low viscosity distillate oil, oxidizing
10 the resulting blend to raise its softening point and increase its asphaltene content to produce a blown product having a ductility at 32° F. less than 0.1 of the penetration at 77° F., and blending the resulting bituminous material with
15 a hydrocarbon material having a viscosity not less than about 200 seconds Saybolt furol at 275° F. and a viscosity gravity constant above about 0.870, said hydrocarbon material being the less paraffinic and more viscous fraction of a
20 hydrocarbon oil separated therefrom in a heavier liquid phase by treating the oil with a solvent which preferentially dissolves the more paraffinic and less viscous oils, under conditions causing the formation of two liquid phases and separating
25 said liquid phases.

11. A process for preparing improved asphalt of high viscosity at elevated temperature and good ductility at low temperature, comprising the steps of blending an asphaltic petroleum
30 residue with a low viscosity distillate oil having a viscosity between 50 and 100 seconds Saybolt Universal at 210, oxidizing the resulting blend to raise its softening point and increase its asphaltene content, and blending the resulting
35 oxidized asphaltic bituminous material with a hydrocarbon material having a viscosity not less than about 200 seconds Saybolt furol at 275° F., and a viscosity gravity constant above 0.870.

ALVIN PIERCE ANDERSON.