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54 **Process for producing premium coke.**

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## Description

The invention relates to premium coke suitable for use in the production of a graphite electrode, and particularly to a process for producing a premium coke from a blend of pyrolysis tar and hydrotreated  
 5 decant oil.

Premium coke is well known in the art and is a commercial grade of coke having acicular, anisotropic microstructure.

The premium cokes are used in the production of electrode grade graphite. This use of premium cokes results in various requirements to be made of the cokes. Some of these requirements are pointed out  
 10 herein.

A graphite electrode which will be used in the arc melting of steel or the like must possess a low value for the coefficient of thermal expansion (CTE) because of the severe thermal shocks which occur in such processes. The premium coke used for producing the graphite electrode must be capable of imparting a low CTE to the electrode.

15 The process for producing a graphite electrode from a premium coke requires that the electrode be heated to a temperature in the range of from about 2000°C to about 3000°C in order to provide energy to convert the carbon in the coke to a graphite crystalline form and to volatilize impurities. When a carbon body made from premium coke is heated to a temperature in the range of from about 1000°C to about 2000°C, various sulfur-containing compounds present in the coke decompose and this could result in a  
 20 rapid, irreversible expansion of the carbon body. This phenomenon is termed "puffing". It is desirable to use a low sulfur containing precursor material for producing the premium coke in order to minimize or preferably eliminate problems due to "puffing".

Typically, commercially produced premium cokes are made from low sulfur containing, aromatic, slowly reacting feedstocks such as decant oils from catalytic cracking and tars obtained from the thermal  
 25 cracking of decant oils and gas oils.

It would be desirable to use pyrolysis tars as feedstocks for producing premium cokes because pyrolysis tars are relatively inexpensive mixtures of aromatic compounds and have low amounts of sulfur. Generally, pyrolysis tars are heavy by-products of the cracking process for producing ethylene.

30 Pyrolysis tars are known to be unsuitable for the commercial production of premium coke because this production is carried out by the delayed coking process and the highly reactive pyrolysis tars convert to coke in the coils of the delayed coker furnace. This results in clogging and short operating periods.

Another drawback of the pyrolysis tars is that the premium cokes produced from them impart an undesirably large CTE to the graphite electrodes.

35 Prior art attempts to produce a premium coke from pyrolysis tars have the drawbacks of poor economy and/or relatively high values of the CTE.

U.S. Patent No. 3,817,853 hydrotreats a pyrolysis tar in the presence of an inert diluent and obtains a feedstock which produces graphite electrodes having a CTE of about  $1.6 \times 10^{-6}$  per °C and higher. While this is an improvement, a CTE of about  $0.5 \times 10^{-6}$  per °C or less is needed for high quality graphite electrodes. In  
 40 addition, the examples in the patent teach the use of from about 12.2 to about 18.7 standard cubic meters of hydrogen per barrel of pyrolysis tar. This is a relatively high cost process.

U.S. Patent No. 4,213,846 hydrotreats pyrolysis tars, petroleum resids, and thermal tars by coking them with a hydrogen donor diluent produced by the catalytic hydrotreatment of a coker gas oil fraction generated from the delayed coking of the blend. The hydrotreated feed is an equal blend with fresh feed.  
 45 This process has several drawbacks. The hydrotreated coker gas oil does not contribute to the yield of the process and the examples teach a maximum of 15% by weight pyrolysis tars.

The instant invention overcomes the drawbacks of the prior art and provides a process for the commercial production of a premium coke suitable for making high quality graphite electrodes.

50 The invention is a process for producing a premium coke for making a graphite electrode having a CTE less than about  $0.5 \times 10^{-6}$  per °C, comprising the steps of forming a blend of a pyrolysis tar and a hydrotreated decant oil which includes from 50% to 75% by weight of the pyrolysis tar and from 50% to 25% by weight of the hydrotreated decant oil; and coking the blend by delayed coking, whereby the premium coke is formed.

In a preferred embodiment, the hydrotreated decant oil is produced by hydrotreating a decant oil until  
 55 there is added from about 2 to about 4 hydrogen atoms per average molecule of the decant oil, more preferably from about 2 to about 3 hydrogen atoms.

Another preferred embodiment of the invention is a graphite electrode made from the premium coke of the invention.

60 Further embodiments and advantages of the invention will be set forth in the following specification and will be obvious therefrom.

A pyrolysis tar as used herein and according to the prior art is generally the heaviest by-product of olefins production by vapor-phase cracking of liquid hydrocarbons in the presence of steam at temperatures of from about 760°C to about 930°C at pressures from about 100 pa to about 200 pa. It is the fraction which boils above about 200°C.

65 A decant oil as used herein and according to the prior art is generally the highest boiling by-product of

gasoline production by catalytic cracking after the removal of catalyst particles by settling. It generally boils at a temperature above about 300°C.

Preferably, the pyrolysis tar used in the invention should have a sulfur content of less than about 1% by weight and the decant oil used in the invention should have a sulfur content of less than about 2% by weight. The hydrotreatment of the decant oil provides the additional incidental advantage of hydrodesulfurizing the decant oil so that the potential problem of puffing is reduced or eliminated even though the hydrotreatment is not carried out for that purpose.

Generally the hydrotreatment of the decant oil can be carried out in accordance with the prior art by contacting the decant oil with hydrogen at an elevated temperature and high pressure in the presence of a suitable catalyst.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawings, in which:

Fig. 1 is a simplified block system of a bench-scale delayed coking unit used in a laboratory; and

Fig. 2 is a simplified block system of a pilot plant delayed coker.

Illustrative, non-limiting examples of the practice of the invention are set out below. Numerous other examples can readily be evolved in the light of the guiding principles and teachings contained herein. The examples given herein are intended to illustrate the invention and not in any sense to limit the manner in which the invention can be practiced. The parts and percentages recited therein and all through this specification, unless provided otherwise, refer to parts by weight and percentages by weight.

#### Example 1

A gas oil-based pyrolysis tar A having the properties shown in Table 1 was blended with a hydrotreated decant oil A, having the properties shown in Table 2. Three blends were prepared with the amounts of pyrolysis tar A being 25%, 50%, and 75% by weight.

TABLE 1  
Pyrolysis Tar A

	Specific Gravity (15.6°C)	1.1238
30	Distillation	
	1BP	230°C
	5%	280°C
35	10%	290°C
	20%	320°C
	30%	336°C
40	40%	364°C
	50%	390°C
45	60%	450°C
	70%	
	80%	
50	90%	
	95%	
55	EP	
	% Recovery	67.5
	Molecular weight	319
60	Carbon, wt. %	91.7
	Hydrogen, wt. %	6.78
65	Nitrogen, wt. %	0.21

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TABLE 1 (contd.)  
Pyrolysis Tar A

5	Ash, wt. %	0.0018
	Metals, ppm	
	Sulfur, wt. %	1.20
10	Modified Conradson Carbon, wt. %	23.1
	Aromaticity, wt. %	
	Proton NMR	40.09
15	<sup>13</sup> C NMR	80.6
	Pour Point	19°C
20	Flash Point	127°C
	Bromine No.	15.44
	Viscosity, centistokes	
25	38°C	4079
	99°C	206
	TGA Pitch Fraction (550°C±)	29.6 wt. %
30	Toluene Insoluble, wt. %	4.6
	Heptane Insoluble, wt. %	21.1

TABLE 2  
Hydrotreated decant oil A

35	Specific Gravity (15.6°C)	1.0187
40	Distillation	
	IBP	229°C
	5%	290
45	10%	318
	20%	346
50	30%	363
	40%	377
	50%	389
55	60%	404
	70%	424
60	80%	449
	90%	502
	95%	—
65	EP	

TABLE 2 (contd.)  
Hydrotreated decant oil A

	Recovery %	90%
5	Molecular Weight	
	Carbon, wt. %	90.59
10	Hydrogen, wt. %	9.29
	Nitrogen, wt. %	0.13
	Sulfur, wt. %	0.37
15	Modified Conradson Carbon, wt. %	2.63
	Aromaticity, Proton NMR	20.5
20	<sup>13</sup> C NMR	57.6
	Pour Point	-13°C
	Flash Point (Open Cup)	138°C
25	Bromine No.	6.47
	Viscosity, centistokes 38°C (100°F)	69.42
30	99°C (210°F)	5.65
	TGA Pitch Fraction (550°C+)	48.7
35	Toluene Insoluble, wt. %	0.20
	Heptane Insoluble, wt. %	0.01
40	Hydrogen atoms per average molecule	3

A bench scale delayed coking unit as shown in Fig. 1 was used to coke each of the blends as well as separate portions of the pyrolysis tar A and the hydrotreated decant oil A.

The coking unit of Fig. 1 operates as follows:

45 A feed liquid 1 in tank 2 is pumped through line 3 by pump 4 at a rate of from about 17 to about 24 g. per minute. The feed liquid 1 in line 3 is conveyed to heated, pressurized coil 6 which maintains a high pressure due to pressure unit 7. The material in coil 6 communicates through line 8 to top of heated, pressurized tank 9. The temperature and pressure of coil 6 and tank 9 were about 475°C and about 689 kPa. The feed period was from about 140 to about 170 minutes. After the feeding was completed, the coke was further devolatilized by heating at about 50°C per hour to about 500°C and holding this temperature for 50 from about 75 to about 90 minutes. A pressure control valve 11 is provided for the removal of distillates and cracking gases.

For each blend, additional heating at about 1000°C was carried out and the yields for these examples is shown in Table 3. The values shown in the Table 3 are based on measurements and deviate slightly from the sum of the components, being equal to 100%.

TABLE 3  
Coking yields

5	Wt. % Pyrolysis tar A in blend	Feed rate g/min	Yields wt. %			
			500°C Coke	1000°C Coke	Distillate	Cracking gas
	0	24	27	25.5	64.5	8.5
10	25	17	31.5	29.5	60	8.5
	50	21	34	32	59	7
15	75	17	40	37.5	53	7
	100	20	39	36	56	5

20 The Table 3 shows that the distillates and cracking gas yields reduced as the amount of pyrolysis tar increased.

The coke from each of the tests was used to produce graphite electrodes in accordance with conventional testing procedures. The procedure used is generally as follows:

The coke which had been calcined at 1000°C was crushed and milled to  $55\% \pm 10\%$  through 200 mesh to obtain a flour. The flour was made into a rod about 130 mm long with a 19 mm diameter.

25 The rod was then converted into a graphite electrode. Typically, the last graphitizing temperature is in the range of from about 2800°C to about 3000°C.

The value of the longitudinal CTE of each rod was measured in the temperature range of from 30°C to 100°C. Only longitudinal CTE is of interest herein.

30 Table 4 shows the values of CTE for rods made from different blends.

TABLE 4  
Longitudinal CTE

35	Wt % Pyrolysis tar A in blend	CTE Graphite electrode per °C
	0	$0.44 \times 10^{-6}$
40	25	$0.47 \times 10^{-6}$
	50	$0.49 \times 10^{-6}$
	75	$0.79 \times 10^{-6}$
45	100	$0.94 \times 10^{-6}$

50 It is surprising that as much as about 50% pyrolysis tar A in the blend will still provide a graphite electrode having an excellent CTE. If one were to compute the expected value for the CTE on the basis of the rule of mixtures, a much higher value greater than about  $0.5 \times 10^{-6}$  per °C would be calculated.

The hydrotreated decant oil modifies the pyrolysis tar to allow good continuous delayed coking and to provide excellent values of the CTE for high proportions of pyrolysis tar.

55 The amount of hydrotreatment given to the decant oil will have an effect on the process. If the decant oil is saturated, then it will not act as a donor. The lower limit for hydrotreating the decant oil for various blends can be determined experimentally.

The Example 1 shows that high coke yields are obtained for relatively low amounts of hydrogen. It is also advantageous economically to hydrotreat the decant oil rather than the pyrolysis tar.

#### Example 2

60 The tests carried out in the Example 1 were carried out with the hydrotreated decant oil A of Example 1, and a predominantly kerosene-based pyrolysis tar B, having properties as shown in Table 5.

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TABLE 5 Pyrolysis Tar B

	Specific Gravity (15.6°C)	1.0835
5	ASTM Distillation IBP	171°C
	5%	238
	10%	249
10	20%	268
	30%	288
15	40%	321
	50%	371
	60%	410
20	70%	441
	80%	—
25	90%	—
	95%	0
	% Recovery	70
30	Molecular Weight	398
	Carbon, wt. %	90.97
35	Hydrogen, wt. %	7.62
	Nitrogen, wt. %	0.66
	Ash, wt. %	0.01
40	Metals, ppm	0.1
	Sulfur, wt. %	0.50
45	Modified Conradson Carbon, wt. %	16
	Aromaticity, Proton NMR	42.9
	<sup>13</sup> C NMR	—
50	Pour Point	3°C
	Flash Point (Open Cup)	77°C
55	Bromine No.	17.98
	Viscosity, centistokes 38°C (100°F)	1154
60	99°C (210°F)	27
	TGA Pitch Fraction (550°C+)	30.1
	Toluene Insoluble, wt. %	0.1
65	Heptane Insoluble, wt. %	19.2

Table 6 shows the yields for the different blends and Table 7 shows the values of longitudinal CTE measured for graphite electrodes made from the blends. The measured CTE's of the graphite electrodes made from blends having 50% and 75% pyrolysis tar were lower than one would calculate based on the mixture of the two components, and one would not expect to obtain good quality graphite electrodes based on such calculations.

TABLE 6

	Wt. % pyrolysis tar in blend	Feed rate g/min	Yields wt. %			
			500°C Coke	1000°C Coke	Distillate	Cracking gas
10	0	24	27			
15	25	21	27.5	26	64.5	8
	50	20	27.5	26	66	6.5
	75	22	29	27	65	6
20	100	23	29	27	63	8

TABLE 7  
Longitudinal CTE

	Wt. % Pyrolysis tar in blend	CTE Graphite electrode per °C
25	0	$0.44 \times 10^{-6}$
30	25	$0.55 \times 10^{-6}$
	50	$0.50 \times 10^{-6}$
35	75	$0.60 \times 10^{-6}$
	100	$0.82 \times 10^{-6}$

## Example 3

The hydrotreated decant oil A of the Example 1 and the pyrolysis tar B of the Example 2 were blended to run tests with the pyrolysis tar content 0%, 50%, 75%, and 100%.

The pilot plant delayed coker shown in Fig. 2 was used. The operation of the pilot plant delayed coker is as follows:

Feed tank 12 supplies the blend to be coked. Pump 13 moves the blend from the feed tank 12 through line 14 to preheater 16 and then to the delayed coker 17. Distillates and cracking gases from the coker 17 moves through line 18 to fractionator 19. Heavy products suitable for recycling are pumped from the fractionator 19 through line 21 by pump 22 through line 26 to the preheater 16. Light products from the fractionator 19 move through line 23 to quencher 24 where they are cooled. The light products in the quencher 24 which are suitable for recycling are pumped by the pump 22 through line 26 to the preheater 16. The light products in the quencher 24 not suitable for recycling are removed through line 27. Gases in the fractionator 19 are removed through line 28.

Table 8 shows some of the operating parameters of the pilot plant delayed coker. A pressure of about 275 K Pa was maintained, the throughput ratio was held as close to 2.0 as possible, and the furnace temperature was in the range of from about 470°C to about 500°C. The higher temperature was used for less reactive feedstocks whereas the lower temperature was used for more reactive feedstocks.

TABLE 8

5	Wt. % Pyrolysis tar in blend	Feed rate /min.	Throughput ratio	Yields, wt. %			
				Coke as made	1000°C Coke	Distillate	Cracking gas
	0	83	2.1	24	22.5	72	4
	50	144	1.9	21	19.5	75	4
10	75	106	2.0	28.5	26.5	68.5	4
	100	98	3.1	38	35	58	4

15 The coke yields increased and the distillate yields decreased for higher proportions of the pyrolysis tar B in the blends. The yield of coke for 100% pyrolysis tar B was higher than one would anticipate from the other results because for this test the throughput was much higher than the throughput used for the other tests.

20 Graphite electrodes were made from the cokes calcined at 1000°C and the value of the CTE of each was measured, as in the Example 1. The measured values are shown in Table 9.

TABLE 9  
Longitudinal CTE

25	Wt. % Pyrolysis tar in blend	CTE Graphite electrode per °C
	0	$0.21 \times 10^{-6}$
30	50	$0.37 \times 10^{-6}$
	75	$0.44 \times 10^{-6}$
	100	$1.0 \times 10^{-6}$

#### 35 Example 4

Blends were prepared of a hydrotreated decant oil B having the properties shown in Table 10 and a naphtha-based pyrolysis tar C having the properties shown in Table 11.

40 The coking was carried out as described in the Example 1 and test graphite electrodes were prepared. Table 12 shows the measured values of the CTE for each of the graphite electrodes. The values of the CTE for the blends were considerably less than one would expect based on the rule of mixtures.

TABLE 10  
Hydrotreated decant oil B

45	Specific gravity (15.6°C)	1.04
	Molecular weight	309
50	Carbon, wt. %	89.0
	Hydrogen, wt. %	8.7
	Sulfur, wt. %	0.79
55	Modified Conradson Carbon, wt. %	1.8
	Aromaticity, Proton NMR %	25
60	Oxygen, wt. %	0.5
	Added hydrogen per average molecule	2.5

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TABLE 11  
Pyrolysis tar C

5	Specific gravity (15.6°C)	1.08
	Carbon, wt. %	91.0
	Hydrogen, wt. %	7.5
10	Ash, wt. %	0.002
	Sulfur, wt. %	0.1
	Modified Conradson carbon, wt. %	12
15	Aromaticity, Proton NMR %	52.4
	Toluene insoluble %	0.1
20	Heptane insoluble %	0.1

TABLE 12  
Longitudinal CTE

25	Wt. % Pyrolysis tar in blend	CTE Graphite electrode per °C
	0	$0.54 \times 10^{-6}$
30	25	$0.47 \times 10^{-6}$
	50	$0.49 \times 10^{-6}$
	75	$0.74 \times 10^{-6}$
35	100	$1.78 \times 10^{-6}$

## Example 5

40 A pyrolysis tar D having the properties shown in Table 13 and hydrotreated decant oil A were blended together for coking in the pilot plant delayed coker. Blends having 0%, 50%, 75%, and 100% pyrolysis tar were used.

45

50

55

60

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**0 083 143**TABLE 13  
Pyrolysis Tar D

	Specific Gravity (15.6°C)	1.1313
5	Distillation	
	IBP	—
	5%	160°C
10	20%	172
	30%	191
	40%	207
15	50%	232
	60%	268
20	70%	—
	80%	—
	90%	—
25	95%	—
	EP	—
30	Recovery, %	55.0
	Carbon, wt. %	93.1
	Hydrogen, wt. %	6.8
35	Nitrogen, wt. %	0.0
	Ash, wt. %	0.02
40	Metals, ppm	0.1
	Sulfur, wt. %	0.22
	Modified Conradson Carbon, wt. %	25.1
45	Aromaticity, Proton NMR	48.3
	<sup>13</sup> C NMR	84.3
50	Pour Point	14°C
	Flash Point (Open Cup)	146°C
	Bromine No.	12.88
55	Viscosity, centistokes	
	38°C	14,456
	99°C	80
60	TGA Pitch Fraction (550°C+)	40.6
	Toluene Insoluble, wt. %	4.1
65	Heptane Insoluble, wt. %	22.8

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Some of the operating parameters of the pilot plant delayed coker are shown in Table 14. The coking yields increased for larger proportions of pyrolysis tar.

TABLE 14

	Wt. % Pyrolysis tar in blend	Feed rate g/min.	Throughput ratio	Yields, wt. %			
				Coke as made	1000°C Coke	Distillate	Cracking gas
5							
10	0	83	2.1	24	22.5	72	4
	50	113	2.0	34	31	54	7
	75	91	2.0	36.5	33	57	5
15	100	60	2.0	46	42.5	48	6

Test graphite electrodes were made and the measured values of the CTE are given in Table 15.

TABLE 15  
Longitudinal CTE

	Wt. % Pyrolysis tar in blend	CTE Graphite electrode per °C
20		
25	0	$0.20 \times 10^{-6}$
	50	$0.30 \times 10^{-6}$
30	75	$0.47 \times 10^{-6}$
	100	$0.65 \times 10^{-6}$

### Example 6

Blends were made with pyrolysis tar D and decant oil C, having the properties shown in Table 15 to show the results of blends which are not in accordance with the invention.

The bench scale delayed coker of the Example 1 was used for blends of 0%, 50%, 75%, and 100% pyrolysis tar. Table 17 shows some of the operating parameters. The relatively high level of sulfur for the graphite electrode made from an equal blend would be expected to present puffing problems and would be regarded as unacceptable. This high amount of sulfur is due to the omission of the hydrotreatment which would reduce the sulfur content of the decant oil.

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TABLE 16 Decant Oil C

	Specific Gravity (15.6°C)	1.0029
5	Distillation IBP	230°C
	5%	310
10	10%	354
	20%	372
	30%	380
15	40%	390
	50%	395
20	60%	410
	70%	420
	80%	447
25	90%	465
	95%	493
30	% Recovery	95%
	Molecular Weight	275
	Carbon, wt. %	89.6
35	Hydrogen, wt. %	9.48
	Nitrogen, wt. %	0.30
40	Ash, wt. %	0.003
	Metals, ppm	N/A
	Sulfur, wt. %	1.46
45	Modified Conradson Carbon, wt. %	2.0
	Aromaticity, Proton NMR	17.4
50	<sup>13</sup> C NMR	57.0
	Pour Point	18°C
	Flash Point (Open Cup)	149°C
55	Bromine No.	15.4
	Viscosity, centistokes 38°C	51
60	99°C	5
	TGA Pitch Fraction (550°C+)	4.8
	Toluene Insoluble, wt. %	0.0
65	Heptane Insoluble, wt. %	0.4

TABLE 17

	Wt. % Pyrolysis tar in blend	Feed rate g/min	Yields, wt. %				
			500°C Coke	1000°C Coke	Distillate	Cracking gas	% Sulfur in coke
5	0	20	26	23.5	62	12	1.3
10	25	18	29	26.5	61	10	0.9
	50	19	32	30	60	8	0.65
	75	19	39	36	54	7	0.35
15	100	23	46	42.5	48	6	0.2

Graphite electrodes were made from the blends except of the blend containing 25% pyrolysis tar. Table 18 shows the measured values of CTE.

TABLE 18

Graphite electrodes not according to the invention

	Wt. % of Pyrolysis tar in blend	Graphite electrode CTE per °C
25	0	$0.49 \times 10^{-6}$
	50	$0.57 \times 10^{-6}$
30	75	$0.81 \times 10^{-6}$
	100	$0.83 \times 10^{-6}$

#### Example 7

The tests carried out in the Example 6 were repeated in a pilot plant delayed coker for blends containing 0%, 50%, and 100% pyrolysis tar D. In addition, the decant oil C was hydrotreated until there was added about 2.5 hydrogen atoms per average molecule of decant oil. A blend of 50% of this hydrotreated decant oil with 50% pyrolysis tar D was also coked in the pilot plant coker. Table 19 shows operating parameters and coke yields. Results for the blend containing 50% hydrotreated decant oil are shown by 50.

TABLE 19

	Wt. % Pyrolysis tar in blend	Feed rate g/min	Throughput ratio	Yields, wt. %			
				Coke as made	1000°C Coke	Distillate	Cracking gas
45	0	113	2.5	31	29	59	9
50	50	106	2.0	35	32	60	5
	75	83	2.0	37.5	34	54	6
	100	60	2.0	46	42.5	48	6
55	50*	106	1.8	27.5	26	62	7

TABLE 20  
Longitudinal CTE

	Wt % Pyrolysis tar in blend	Graphite electrode CTE per °C
5	0	$0.20 \times 10^{-6}$
	50	$0.50 \times 10^{-6}$
10	75	$0.65 \times 10^{-6}$
	100	$0.75 \times 10^{-6}$
15	50*	$0.35 \times 10^{-6}$

Table 20 shows that cokes made from the blends containing untreated decant oil have CTE's in accordance with those calculated by the rule of mixtures, whereas coke from the blend containing 50% hydrotreated decant oil has a CTE substantially lower than that calculated from the rule of mixtures.

20 We wish it to be understood that we do not desire to be limited to the exact details shown and described herein, or other modifications that occur to a person skilled in the arts.

Having thus described the invention, what we claim as new and desired to be secured by Letters Patent, is as follows:

#### 25 Claims

1. A process for producing a premium coke for making a graphite electrode having a CTE less than about  $0.5 \times 10^{-6}$  per °C, comprising the steps of: forming a blend of pyrolysis tar and a hydrotreated decant oil which blend includes from 50% to 75% by weight of the pyrolysis tar and from 50% to 25% by weight of the hydrotreated decant oil; and coking the blend by delayed coking, whereby the premium coke is formed.

2. The process of claim 1, wherein the hydrotreated decant oil is produced by hydrotreating a decant oil until there is added from about 2 to about 4 hydrogen atoms per average molecule of the decant oil.

3. The process of claim 1, wherein the hydrotreated decant oil is produced by hydrotreating a decant oil until there is added from about 2 to about 3 hydrogen atoms per average molecule of the decant oil.

35 4. A graphite electrode made from the premium coke produced by claim 1.

#### Patentansprüche

1. Verfahren zur Herstellung von Koks hoher Qualität zur Herstellung von Graphitelektroden mit einem thermischen Ausdehnungskoeffizient von weniger als  $0,5 \times 10^{-6}$  je °C, das folgende Schritte umfasst:

— Herstellung einer Mischung von Pyrolyseteer und einem wasserstoffbehandelten Absetzöl, wobei die Mischung zwischen 50 und 75 Gew.% Pyrolyseteer und zwischen 50 und 75 Gew.% wasserstoffbehandeltes Absetzöl enthält;

45 — Verkoken der Mischung nach dem "Delayed Coking"-Prozess, wobei der Koks hoher Qualität gebildet wird.

2. Verfahren nach Anspruch 1, bei dem das wasserstoffbehandelte Absetzöl durch Wasserstoffbehandlung eines Absetzöls hergestellt wird, bis zwischen etwa 2 und etwa 4 Wasserstoffatome je Durchschnittsmolekül des Absetzöls zugegeben sind.

3. Verfahren nach Anspruch 1, bei dem das wasserstoffbehandelte Absetzöl durch Wasserstoffbehandlung eines Absetzöls hergestellt wird, bis zwischen etwa 2 und etwa 3 Wasserstoffatome je Durchschnittsmolekül des Absetzöls zugegeben sind.

55 4. Graphitelektrode, hergestellt aus dem nach dem Verfahren des Anspruchs 1 gewonnenen Koks hoher Qualität.

#### Revendications

60 1. Procédé de production d'un coke de qualité supérieure pour la fabrication d'une électrode en graphite ayant un coefficient de dilatation thermique inférieur à environ  $0,5 \times 10^{-6}$  par °C, comprenant les étapes qui consistent: à former un mélange de goudron de pyrolyse et d'une huile clarifiée hydrotraitée, ce mélange renfermant 50 à 75% en poids du goudron de pyrolyse et 50 à 25% en poids de l'huile clarifiée hydrotraitée; et à cokéfier le mélange par cokéfaction retardée de manière à former le coke de qualité supérieure.

65 2. Procédé suivant la revendication 1, dans lequel l'huile clarifiée hydrotraitée est produite par

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hydrotraitement d'une huile clarifiée jusqu'à ce qu'environ 2 à environ 4 atomes d'hydrogène aient été ajoutés par molécule moyenne de l'huile clarifiée.

3. Procédé suivant la revendication 1, dans lequel l'huile clarifiée hydrotraitée est produite par hydrotraitement d'une huile clarifiée jusqu'à ce qu'environ 2 à environ 3 atomes d'hydrogène aient été ajoutés par molécule moyenne de l'huile clarifiée.

4. Electrode en graphite fabriquée avec le coke de qualité supérieure produit selon la revendication 1.

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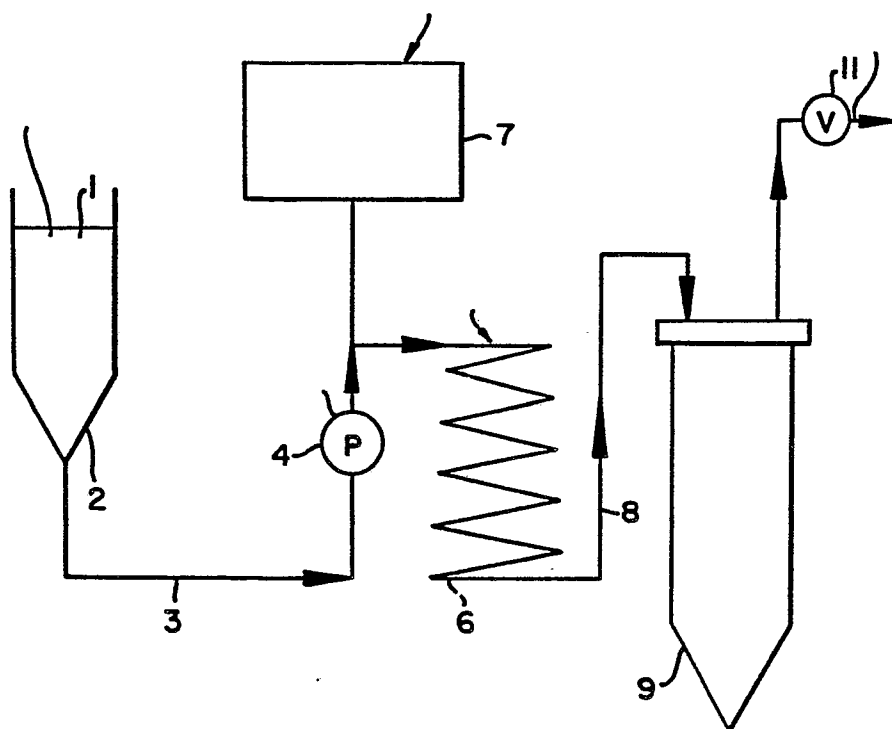


FIG. 1

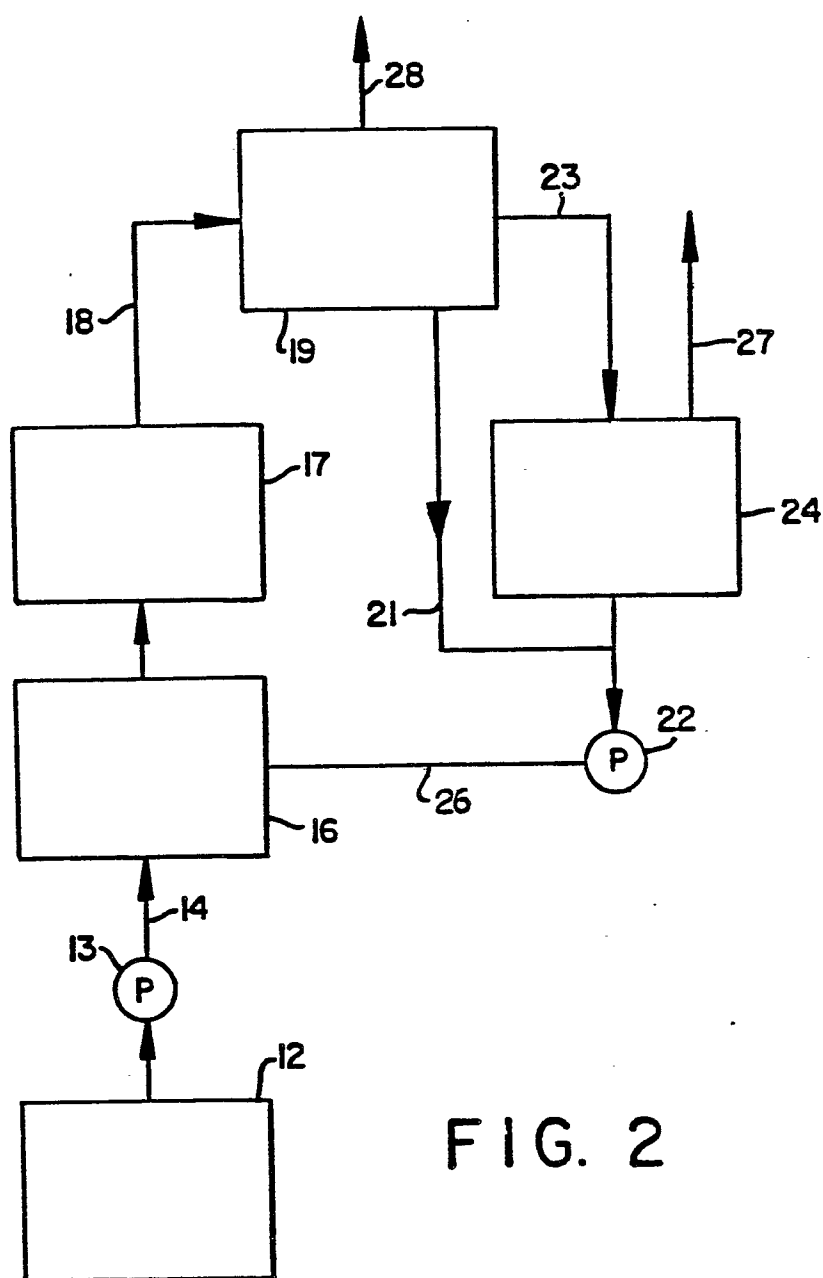


FIG. 2