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PCT/US2011/041350(74) Agents: BALDAUF, Kent, E., Jr. et al.; The Webb Law
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LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
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GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: NOVEL HYDROGENATED SOLVENTS FOR COAL LIQUEFACTION

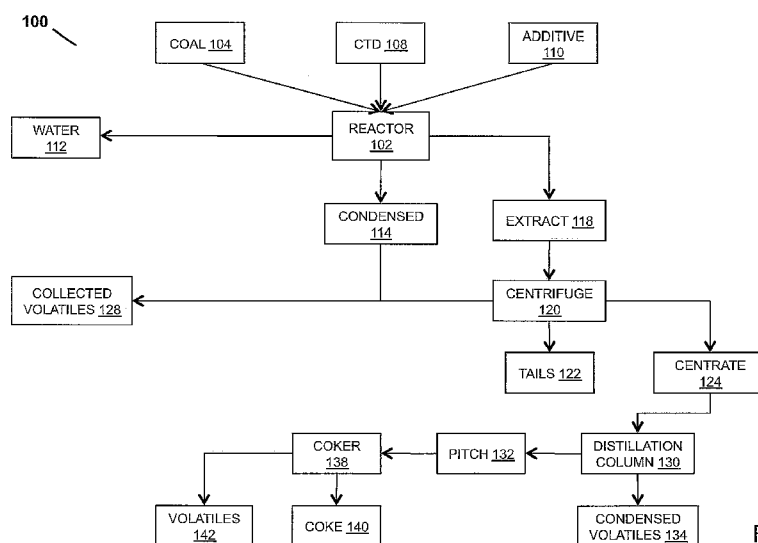


Fig. 1

(57) Abstract: The present disclosure provides method and systems for liquefying coal utilizing a hydrogenated solvent, including hydrogenated vegetable oil, a rubber material, a sewage material, and pipeline crude oil. The method includes exposing a coal to one of the hydrogenated solvents in the presence of a coal-derived solvent to form a slurry, elevating the temperature of the slurry to facilitate liquefying the coal and liberating a volatile matter, and separating the insoluble components from the slurry to obtain a de-ashed coal extract, wherein the coal extract is suitable for downstream processing.

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- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

A. CLASSIFICATION OF SUBJECT MATTER***C10G 1/06(2006.01)i***

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C10G 1/00-1/10, C10L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: coal, (liquef*, destructive hydrogenation), (coal derived oil, anthracene oil, coal tar), vegetable oil, petroleum crude, (rubber, tire, industrial waste), (lignin, sludge, sewage)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 04081361 A (HILDEBRAND et al.) 28 March 1978 See column 2, line 46 to column 3, line 56; column 5, line 33 to column 7, line 56; figure 1	1-11, 17-21, 22-29
Y	US 04671801 A (BURGESS et al.) 09 June 1987 See claims 1-6; column 11, line 9-25	1-11, 17-21, 22-29
X	US 04610776 A (URBAN et al.) 09 September 1986 See claims 5 and 13	12-14
X	US 04303496 A (RUDNICK) 01 December 1981 See claims 1-8; figure 1; column 1, line 58 to column 2, line 39	16, 15
Y	JP 05-230469 A (NIPPON STEEL CORP) 07 September 1993 See [0007]; figure 1	1-11, 17-21, 22-29
Y	JP 56-072079 A (CHIYODA CHEM ENG & CONSTR CO LTD) 16 June 1981 See claim 5	1-11, 17-21, 22-29
E	US 2011-0230688 A1 (CHARON NADEGE et al.) 22 September 2011 See [0024]-[0046]	1-29



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2011/041350

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009-0250381 A1 (FAN et al.) 08 October 2009 See [0163]; claims 30 and 45	1-11, 17-21, 22-29
A	US 2008-0072476 A1 (KENNEL et al.) 27 March 2008 See [0023], [0024]	1-11, 17-21, 22-29
A	US 04394248 A (GATSIS) 19 July 1983 See column 2, line 46-63; claims 1-4	1-11, 17-21, 22-29

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2011/041350**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Continuation of Box No. III

Group 1: Claims 1-11 and 17-21 relate to a method of obtaining a de-ashed coal extract, comprising the step of exposing a coal to hydrogenated vegetable oil in the presence of a coal-derived solvent.

Claims 22-28 and 29 relate a coal liquefaction system comprising said step.

Group 2: Claims 12-14 relate to a method of obtaining a de-ashed coal extract, comprising the step of exposing a coal to a petroleum crude.

Group 3: Claim 15 relates to a method of obtaining a de-ashed coal extract, comprising the step of exposing a coal to a rubber material in the presence of a coal-derived solvent.

Group 4: Claim 16 relates to a method of obtaining a de-ashed coal extract, comprising the step of exposing a coal to a rubber material in the presence of a coal-derived solvent.

The inventions listed as groups 1-4, do not relate to a single general inventive concept under PCT Rule 13.1, because, under PCT Rule 13.2 they do not share the same or corresponding technical features.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2011/041350

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 04081361 A	28.03.1978	JP 53-014705 A	09.02.1978
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US 2008-0072476 A1	27.03.2008	None	
US 04394248 A	19.07.1983	None	