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[Continued on next page]

(54) Title: PROCESS FOR CONVERSION OF BIOMASS TO FUEL

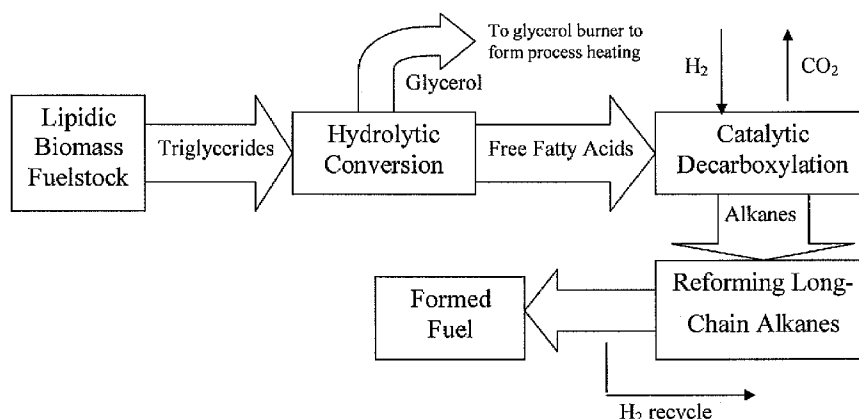


FIG. 2

(57) Abstract: The present invention is directed to processes for the direct conversion of lipidic biomass fuelstock to combustible fuels. In particular, the invention provides a process for the direct conversion of animal fats to transportation fuels suitable as replacement for petroleum-derived transportation fuels. In one embodiment, the method comprises the steps of hydrolyzing a lipidic biomass to form free fatty acids, catalytically deoxygenating the free fatty acids to form *n*-alkanes, and reforming at least a portion of the *n*-alkanes into a mixture of compounds in the correct chain length, conformations, and ratio to be useful transportation fuels. Particularly, the product prepared according to the invention comprises mixtures of hydrocarbon compounds selected from the group consisting of *n*-alkanes, isoalkanes, aromatics, cycloalkanes, and combinations thereof.



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B. FIELDS SEARCHED

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

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2004/230085 A1 (JAKKULA JUHA [FI] ET AL) 18 November 2004 (2004-11-18)	1-4, 6-32, 36
X	claim 1 page 2, paragraphs 17,20,21 page 3, paragraph 31-33	35
Y	US 2004/192981 A1 (APPEL BRIAN S [US] ET AL) 30 September 2004 (2004-09-30)	1-4, 6-32, 36
	page 5, paragraphs 52-54,56-58 page 6, paragraphs 61,63 page 7, paragraphs 78,79 page 8, paragraphs 81,82 figures 1,3	
X	US 2004/074760 A1 (PORTNOFF MARC A [US] ET AL) 22 April 2004 (2004-04-22)	33-35
	claims 1,8 page 2, paragraph 32	
	-/-	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 594 141 A (EMERY INDUSTRIES INC) 4 November 1947 (1947-11-04) claims; figures 1,2 page 1, lines 11-51 -----	1,6
P,X	EP 1 741 767 A (NESTE OIL OYJ [FI]) 10 January 2007 (2007-01-10) claims 1,9,10,12-16 page 3, paragraph 11 page 4, paragraph 35 page 5, paragraph 39 -----	1-36
P,X	WO 2007/068795 A (NESTE OIL OYJ [FI]; MYLLYOJA JUKKA [FI]; JAKKULA JUHA [FI]; AALTO PEKK) 21 June 2007 (2007-06-21) claims 8,10,14-17; figure 1 page 8, lines 6-17 page 19, lines 10-31 -----	1-36

INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/US2007/086023

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2004230085	A1	18-11-2004	NONE	
US 2004192981	A1	30-09-2004	NONE	
US 2004074760	A1	22-04-2004	AU 2003301310 A1 CA 2542309 A1 WO 2004035714 A1	04-05-2004 29-04-2004 29-04-2004
GB 594141	A	04-11-1947	NONE	
EP 1741767	A	10-01-2007	CN 101233212 A	30-07-2008
WO 2007068795	A	21-06-2007	AU 2006325183 A1 CA 2639827 A1 EP 1963461 A1 KR 20080081033 A	21-06-2007 21-06-2007 03-09-2008 05-09-2008