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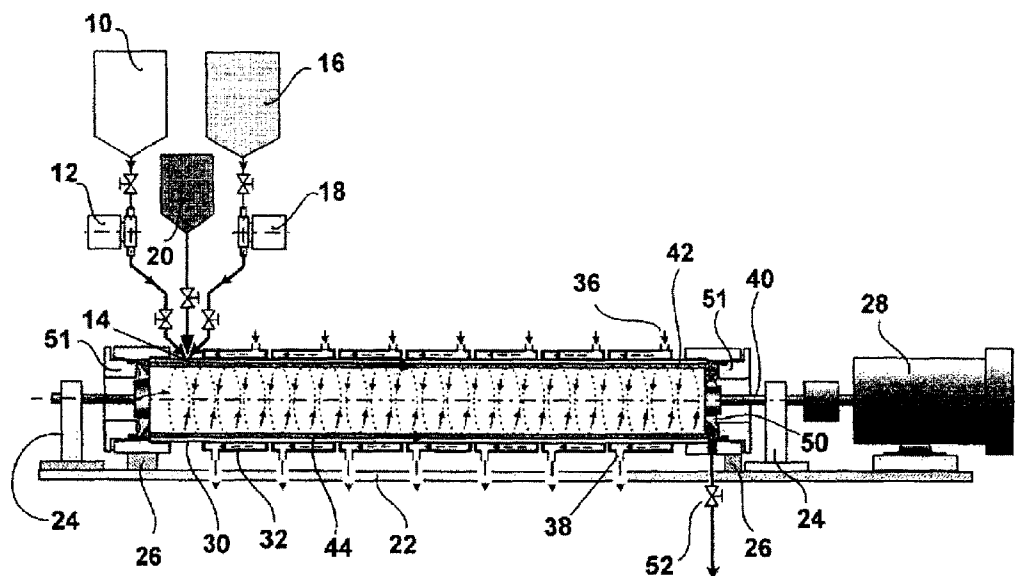
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(54) **Title:** ESTERIFICATION AND TRNSESTERIFICATION SYSTEMS, METHODS AND APPARATUS



(57) **Abstract:** Esterification and transesterification methods, systems and apparatus are disclosed which increase the efficiency of esterification reactions. The methods comprises utilizing an annular gap reactor comprises a rotor rotating within a stator to provide an annular flow passage comprising a flow path containing a high-shear treatment zone in which the passage spacing is smaller than in the remainder of the zone to provide a subsidiary higher-shear treatment zone. In exemplary embodiments, the reactor is modified to include an evaporator portion including an opening in the stator near the end of the reactor and a series of fins placed in the opening, increase in the rates due to the annular gap reactor allow for the use of less catalyst, poorer catalysts, lower temperature and reduction in unwanted side reactions at more economically favorable conditions.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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USPC - 435/289.1

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)

USPC: 435/289.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 560/129, 231(see search terms below)

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

PubWEST(USPT,PGPB,EPAB,JPAB); DialogPRO

Search Terms: gap reactor, esterification, transesterification, biodiesel, sodium hydroxide

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 6,471,392 B1 (HOLL et al.) 29 October 2002 (29.10.2002) entire document, especially Abstract; col 1, ln 5-20; col 4, ln 35-37; col 9, ln 20-25	1-3, 7 and 9 ----- 4-6, 8 and 10-15
Y	US 6,712,867 B1 (BOOCOCH) 30 March 2004 (30.03.2004) entire document, especially Title and Abstract	4-6, 8 and 10-15
A	US 5,279,463 A (HOLL) 18 June 1994 (18.06.1994), entire document, especially Abstract	1-15

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


* 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

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"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

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"&" document member of the same patent family

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