Abstract: A hybrid continuous fermentation system and related process for fermenting sugars to produce alcohol containing liquors. The system includes a fermentor arranged with a packed bed region and a fluidized bed region. A yeast bed is retained in the packed bed region using a retention matrix and flocculation. A sugar supply is directed through the yeast bed with sufficient dwell time for satisfactory sugar conversion. The fluidized bed region is arranged to allow fermented product to pass through the fermentor while allowing yeast cell growth and retention. A nutrient may be added to the fermentor to aid in yeast flocculation. The fermentor is sized and shaped to allow sufficient dwell time of the sugar supply in the packed bed region and in the fluidized bed region to maximize sugar conversion to ethanol by fermentation.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C12C 11/00 (2011.01)
USPC - 426/11

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 -- 426/11

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC -- 426/14, 426/49, 426/330.3, 426/330.4, 426/493, 426/597 (see search terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST -- PGPB, USPTO, USOC, EPAB, JPAB, Dialog Classic Files -- 654, 652, 349, 348, 35, 65, 155; USPTO Web Page; Google Scholar; Search terms -- fermentation reactor, packed bed, fluidized bed, immobilized yeast, alcohol production, conduit, inlet, outlet, collector, sugar source, yeast retention matrix, cylindrical tank, flow rate control, conical, g

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 2005/0214408 A1 (PILKINGTON et al.) 29 September 2005 (29.12.2005) para [0003], [0013]-[0016], [0025]-[0028], [0169], [0194]-[0195], [0198], [0200], [0228], [0233], [0250]-[0252], [0256], [0260], [0271], [0293], [0397], [0399]-[0390], [0411], [0460], [0489]-[0490], [0522], Figs 2-6, 148; abstract</td>
<td>1-20</td>
</tr>
<tr>
<td>Y</td>
<td>US 5,563,069 A (YANG) 08 October 1996 (08.10.1996) col 2, In 24-66; col 6, In 32-44; col 7, In 10-19; col 8, In 9-23; col 9, In 38-45; col 14, In 13-26; col 21, In 14-35; Fig 1, 17</td>
<td>1-20</td>
</tr>
<tr>
<td>Y</td>
<td>US 4,599,312 A (MUGNIER et al.) 08 July 1986 (08.07.1986) col 2, In 64-col 3, In 20; col 4, In 12-16; In 58-64</td>
<td>4</td>
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</tbody>
</table>

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

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   "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
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   "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
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   "&" document member of the same patent family

Date of the actual completion of the international search
04 August 2011 (04.08.2011)

Date of mailing of the international search report
17 AUG 2011

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