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- Published:**  
— 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))
- (88) **Date of publication of the international search report:**  
3 March 2011



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(54) **Title:** ABE FERMENTATION, WHEREIN THE FERMENTATION BROTH IS SUBJECTED TO PRESSURE REDUCTION IN A SEPERATE VESSEL

(57) **Abstract:** The present invention relates to a process for production of organic solvents using the anaerobic fermentation by butanol, acetone, and ethanol-producing bacteria. The claimed process comprises the stage in which a portion of the fermentation broth comprising the suspension of cells of the bacteria during the fermentation is withdrawn to a separate vessel, subjected to vacuuming and returned into the fermentor.

**INTERNATIONAL SEARCH REPORT**

International application No  
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**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. C12P7/06 C12P7/16 C12P7/28

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)  
C12P

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)

EPO-Internal, WPI Data, COMPENDEX, FSTA, BIOSIS, EMBASE

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE EPODOC EUROPEAN PATENT OFFICE; 1983, "PRODUCTION OF VOLATILE FERMENTATION PRODUCT" XP002603202 abstract	1,2,4
X	-& JP 58 056688 A (SHINNENRYOYU KAIHATSU GIJUTSU) 4 April 1983 (1983-04-04) figure 2	1,2,4
X	DATABASE EPODOC EUROPEAN PATENT OFFICE; 1983, "MANUFACTURE OF FERMENTATION PRODUCT" XP002603251 abstract	1,2,4
X	-& JP 58 071888 A (TOYO ENGINEERING CORP) 28 April 1983 (1983-04-28) figure 1	1,2,4
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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 document 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 another 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

4 October 2010

Date of mailing of the international search report

03/01/2011

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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/RU2009/000641

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	WO 2009/086391 A2 (GEVO, INC.) 9 July 2009 (2009-07-09) page 10, lines 25-29 page 19, lines 1-29 page 34, line 27 - page 39, line 11 figure 2	1,2,4
E	WO 2010/095975 A2 (LIMITED LIABILITY COMPANY "PROF BUSINESS") 26 August 2010 (2010-08-26) page 2, line 33 - page 3, line 2 page 3, lines 13-26	1

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/RU2009/000641

## 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 additional 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 fees, this Authority did not invite payment of additional fees.
  
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.:

2, 4(completely); 1(partially)

### 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.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

## 1. claims: 2, 4(completely); 1(partially)

process for production of organic solvents comprising:

- pretreating of carbohydrate contained raw material,
- fermenting the pretreated carbohydrate contained raw material with butanol, acetone, ethanol producing bacteria,
- removing organic solvents,
- feeding of carbohydrate and mineral salts solution, wherein a portion of the fermentation broth comprising the suspension of bacterial cells is withdrawn to a separate vessel, subjected to vacuuming and returned into the fermenter

and wherein 8-15% of the fermentation broth is withdrawn from the fermenter

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## 2. claim: 3(completely); 1(partially)

process for production of organic solvents comprising:

- pretreating of carbohydrate contained raw material,
- fermenting the pretreated carbohydrate contained raw material with butanol, acetone, ethanol producing bacteria,
- removing organic solvents,
- feeding of carbohydrate and mineral salts solution, wherein a portion of the fermentation broth comprising the suspension of bacterial cells is withdrawn to a separate vessel, subjected to vacuuming and returned into the fermenter

and wherein the withdrawal of the fermentation broth is set up when butanol concentration in the fermenter is approaching to toxic for the producing culture

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## 3. claim: 5(completely); 1(partially)

process for production of organic solvents comprising:

- pretreating of carbohydrate contained raw material,
- fermenting the pretreated carbohydrate contained raw material with butanol, acetone, ethanol producing bacteria,
- removing organic solvents,
- feeding of carbohydrate and mineral salts solution, wherein a portion of the fermentation broth comprising the suspension of bacterial cells is withdrawn to a separate vessel, subjected to vacuuming and returned into the fermenter

and wherein the removal of the organic solvents and vacuuming are performed simultaneously

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## 4. claim: 6(completely); 1(partially)

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

process for production of organic solvents comprising:  
- pretreating of carbohydrate contained raw material,  
- fermenting the pretreated carbohydrate contained raw material with butanol, acetone, ethanol producing bacteria,  
- removing organic solvents,  
- feeding of carbohydrate and mineral salts solution, wherein a portion of the fermentation broth comprising the suspension of bacterial cells is withdrawn to a separate vessel, subjected to vacuuming and returned into the fermenter  
and wherein the pressure during the removal is  $-0.90 -0.94$  kg/cm<sup>2</sup>

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5. claim: 7(completely); 1(partially)

process for production of organic solvents comprising:  
- pretreating of carbohydrate contained raw material,  
- fermenting the pretreated carbohydrate contained raw material with butanol, acetone, ethanol producing bacteria,  
- removing organic solvents,  
- feeding of carbohydrate and mineral salts solution, wherein a portion of the fermentation broth comprising the suspension of bacterial cells is withdrawn to a separate vessel, subjected to vacuuming and returned into the fermenter  
and wherein said butanol, acetone, ethanol producing bacteria are *Clostridium acetobutylicum*

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/RU2009/000641

Patent document cited in search report	A	Publication date	Patent family member(s)	Publication date
JP 58056688	A	04-04-1983	JP 1491446 C JP 63038191 B	07-04-1989 28-07-1988
JP 58071888	A	28-04-1983	JP 1463817 C JP 63008753 B	28-10-1988 24-02-1988
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