



US009410093B2

(12) **United States Patent**
Cash et al.

(10) **Patent No.:** **US 9,410,093 B2**
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **HEAVY OIL HYDROCRACKING PROCESS**

(71) Applicants: **Dennis R. Cash**, Novato, CA (US);
Graham J. Forder, San Rafael, CA (US); **David S. Mitchell**, San Rafael, CA (US); **Joel W. Rosenthal**, Lafayette, CA (US)

(72) Inventors: **Dennis R. Cash**, Novato, CA (US);
Graham J. Forder, San Rafael, CA (US); **David S. Mitchell**, San Rafael, CA (US); **Joel W. Rosenthal**, Lafayette, CA (US)

(73) Assignee: **Chevron U.S.A. Inc.**, San Ramon, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 177 days.

(21) Appl. No.: **14/216,947**

(22) Filed: **Mar. 17, 2014**

(65) **Prior Publication Data**
US 2014/0262943 A1 Sep. 18, 2014

Related U.S. Application Data
(60) Provisional application No. 61/851,903, filed on Mar. 15, 2013, provisional application No. 61/852,652, filed on Mar. 19, 2013.

(51) **Int. Cl.**
C10G 65/12 (2006.01)
C10G 69/04 (2006.01)
C10G 69/06 (2006.01)
C10G 65/00 (2006.01)
C10G 65/02 (2006.01)

(52) **U.S. Cl.**
CPC **C10G 69/04** (2013.01); **C10G 69/06** (2013.01)

(58) **Field of Classification Search**
CPC C10G 65/00; C10G 65/02; C10G 65/12
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---------------|---------|------------------|----------------------|
| 4,330,393 A | 5/1982 | Rosenthal et al. | |
| 4,354,920 A | 10/1982 | Rosenthal et al. | |
| 4,391,699 A | 7/1983 | Rosenthal | |
| 4,422,922 A | 12/1983 | Rosenthal et al. | |
| 4,564,439 A | 1/1986 | Kuehler et al. | |
| 4,761,220 A | 8/1988 | Beret et al. | |
| 4,842,719 A | 6/1989 | Macarthur et al. | |
| 5,071,540 A * | 12/1991 | Culross | C10G 1/00 208/413 |
| 5,246,570 A | 9/1993 | Cronauer et al. | |
| 5,871,638 A | 2/1999 | Pradhan et al. | |

FOREIGN PATENT DOCUMENTS

WO 2012170082 12/2012

OTHER PUBLICATIONS

International Search Report from corresponding Application No. PCT/US2014/030737 mailed Aug. 21, 2014.

* cited by examiner

Primary Examiner — Brian McCaig

(74) *Attorney, Agent, or Firm* — Melissa M. Hayworth; E. Joseph Gess; Susan M. Abernathy

(57) **ABSTRACT**

A process for the production of high yields of high quality products from heavy hydrocarbonaceous feedstock comprising a two-stage, close-coupled process. The first stage comprises a thermo-catalytic zone into which is introduced a mixture comprising the feedstock, coal, a liquid catalyst precursor, and hydrogen. The second, close-coupled stage comprises a catalytic-hydrotreating zone into which substantially all the effluent from the first stage is directly passed and processed under hydrotreating conditions.

23 Claims, 1 Drawing Sheet

