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**Ackerson et al.**

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(54) **TWO PHASE HYDROPROCESSING**  
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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.  
  
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4,333,824 A	*	6/1982	Brown et al.	208/326
4,381,234 A	*	4/1983	Audeh et al.	208/327
4,390,411 A	*	6/1983	Scinta et al.	208/390
4,397,736 A	*	8/1983	Low	208/390
4,399,025 A	*	8/1983	Fletcher et al.	208/180
4,424,110 A	*	1/1984	Bearden, Jr. et al.	208/10
4,428,821 A	*	1/1984	Baset	208/428
4,441,983 A	*	4/1984	Garg	208/210
4,464,245 A	*	8/1984	Hodek	208/10
4,485,004 A	*	11/1984	Fisher et al.	208/112
4,486,293 A	*	12/1984	Garg	208/10
4,491,511 A	*	1/1985	Skinner et al.	208/412
4,514,282 A	*	4/1985	Poynor et al.	208/56
RE32,120 E	*	4/1986	Low	208/390
4,585,546 A	*	4/1986	Bowes et al.	208/253
5,496,464 A	*	3/1996	Piskorz et al.	208/108
5,705,052 A	*	1/1998	Gupta	208/57
5,856,261 A	*	1/1999	Culross et al.	502/325
6,123,835 A	*	9/2000	Ackerson et al.	208/213

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\* cited by examiner

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(57) **ABSTRACT**

A process where the need to circulate hydrogen through the catalyst is eliminated. This is accomplished by mixing and/or flashing the hydrogen and the oil to be treated in the presence of a solvent or diluent in which the hydrogen solubility is "high" relative to the oil feed. The type and amount of diluent added, as well as the reactor conditions, can be set so that all of the hydrogen required in the hydroprocessing reactions is available in solution. The oil/diluent/hydrogen solution can then be fed to a plug flow reactor packed with catalyst where the oil and hydrogen react. No additional hydrogen is required, therefore, hydrogen recirculation is avoided and trickle bed operation of the reactors is avoided. Therefore, the large trickle bed reactors can be replaced by much smaller tubular reactor.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

2,646,387 A	*	7/1953	Francis	156/215
2,698,279 A	*	12/1954	Mondria	208/29
2,902,444 A	*	9/1959	Shmidl	208/323
2,966,456 A	*	12/1960	Honeycutt	208/263
3,152,981 A	*	10/1964	Berlin et al.	208/264
4,209,381 A	*	6/1980	Kelly, Jr.	134/19
4,298,451 A	*	11/1981	Newworth	208/408
4,311,578 A	*	1/1982	Fant et al.	208/416

**31 Claims, 5 Drawing Sheets**

