reactor with catalyst and a separate hydrogenating reactor with catalyst. Kubo '168 also relies on the breakdown of the donor diluent for supply hydrogen in the reaction process.

U.S. Patent Number 5,164,074, issued to Houghton on November 17, 1992, shows a HYDRODESULFURIZATION PRESSURE CONTROL apparatus for controlling pressure in a combination hydrodesulfurization and reforming process wherein the pressure of a hydrogen-rich gas source from the reforming process is adjusted by coordinately manipulating a vent control valve for the reforming process in a manner that insures maximum utilization of available hydrogen for desulfurization before any of the hydrogen from the reforming process is vented through its own vent valve.

U.S. Patent Number 4,761,513, issued to Steacy on August 2, 1988, shows a TEMPERATURE CONTROL FOR AROMATIC ALKYLATION PROCESS. The temperature control is a quench system that uses a methylating agent as a quench medium that is introduced between sequential reaction zones in a reactor. The proportion of vapor phase and liquid phase methanol is adjusted to control the enthalpy of the methylating agent and provide temperature reduction by the vaporization of the liquid component of the methylating agent.

BRIEF SUMMARY ~~OF THE INVENTION~~

In accordance with the present disclosure~~invention~~, a process has been developed wherein the need to circulate hydrogen gas 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, in a constant pressure environment, so that the hydrogen is in solution.

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 reactor, such as a plug flow or tubular reactor, packed with catalyst where the oil and hydrogen react. No additional hydrogen is required, therefore, the hydrogen recirculation is avoided and the trickle bed operation of the reactor is avoided. Therefore, the large trickle bed reactors can be replaced by much smaller reactors (see FIGS. 1, 2 and 3). The continuous liquid phase reactors provide more control over the reactor temperature, virtually eliminate catalyst coking, reduce light end hydrocarbon production and can make the system safer.

The present disclosure~~invention~~ is also directed to hydrocracking, hydroisomerization, hydrodemetalization, and the like. As described above, hydrogen gas is mixed and/or flashed

together with the feedstock and a diluent, such as recycled hydrocracked product, isomerized product, or recycled demetaled product, so as to place hydrogen in solution, and then the mixture is passed over a catalyst.

A principle object of the present disclosure~~invention~~ is the provision of an improved continuous liquid phase hydroprocessing system, process, method, and/or apparatus.

Another object of the present disclosure~~invention~~ is the provision of an improved hydrocracking, hydroisomerization, Fischer-Tropsch and/or hydrodemetalization process.

Another object of the present disclosure~~invention~~ is the provision of a control method for a reactor in a continuous liquid phase hydroprocessing system, process, method or apparatus.

Another object of the present disclosure~~invention~~ is the provision of an improved apparatus for controlling a continuous liquid phase hydroprocessing system, process, method and/or apparatus.

Another object of the present disclosure~~invention~~ is the provision of a liquid level control method for a reactor in a continuous liquid phase hydroprocessing system, process, method or apparatus.

Another object of the present disclosure~~invention~~ is the provision of a pressure control method for the vapor phase inside a reactor for a continuous liquid phase hydroprocessing system, process, method or apparatus.

Another object of the present disclosure~~invention~~ is the provision of an improved continuous liquid phase hydroprocessing system, process, method, and/or apparatus wherein the liquid may flow into the reactor from either the top of the reactor or the bottom of the reactor.

Another object of the present disclosure~~invention~~ is the provision of an improved continuous liquid phase hydroprocessing system, process, method, and/or apparatus wherein the design of the system may feature a single reactor, multiple reactors, and/or multiple bed reactors.

Another object of the present disclosure~~invention~~ is the provision of reducing light end hydrocarbons in a continuous liquid phase hydroprocessing system by venting excess gas at a constant rate directly from the top of the reactor.

Accordingly, in one aspect, there is provided a reactor for a continuous liquid phase hydroprocessing system, wherein liquids react with hydrogen dissolved in the liquids at a catalyst surface to form reacted liquids, excess hydrogen gas, and light end hydrocarbon gases and said liquids additionally serve to minimize fluctuations in the temperature of the reactor, comprising: (a) a vessel having a top and a bottom; (b) a catalyst bed containing catalyst particles which fill a majority of said vessel; (c) inlet to allow a mixture of liquids with hydrogen dissolved therein to enter said vessel wherein the inlet to the vessel is at the top of the vessel; (d) an upper zone of said vessel adapted to temporarily house gases inside said vessel; (e) a substantially isothermal lower zone of said vessel adapted to temporarily house liquids, surrounding said catalyst bed inside said vessel; (f) an outlet to allow said reacted liquid to exit said vessel; (g) a control system to adjust the quantity of the liquids in the vessel or to adjust pressure of the hydrogen gas by increasing or decreasing the amount of hydrogen added to said liquids; (h) a vent to allow said excess hydrogen gas and said light end hydrocarbon gases to leave said vessel through said top of said vessel; and (i) a valve to adjust the amount of gas leaving said vessel through said vent.