APPARATUS FOR INSTALLING A THERMOCOUPLE INSIDE A REACTOR TUBE FILLED WITH CATALYST

Cross Reference to Related Applications

This application claims priority to U.S. Patent Application No. 16/665,394, filed October 28, 2019, which claims the benefit of priority under 35 U.S.C. § 119 (a), the entire contents of which are incorporated herein by reference.

Background

A steam methane reformer (SMR) is an industrial apparatus that utilizes heat, pressure, and a catalyst to convert methane (CH_4) and steam (H_2O) into hydrogen ($3H_2$) and carbon monoxide (CO). The CH_4 and H_2O react with each other in catalyst-filled tubes that are enclosed within a furnace which provides heat to the endothermic reaction that forms H_2 and CO. In order for this endothermic reaction to proceed, a very high furnace temperature is required. Typically, the temperature will be within 700-1,000ºC (1,292-1,832ºF), while the pressure may typically range from 3 to 25 bar.

Some companies manufacture thermocouples that can be inserted into SMR tubes, by which the temperature can be measured along the length of the tube. Knowing this inside-of-SMR-tube temperature is valuable, so that the SMR reaction can be monitored, the process can be optimized, and the tube failure can be predicted.

Installing these inside-of-SMR-tube thermocouples can be challenging because they need to be installed before catalyst is installed around them.

This invention outlines an apparatus by which the inside-of-reactor tube thermocouple is installed and centered, and then catalyst is loaded into the tube afterwards.

Summary

A device for centering a temperature measurement device inside a tube reactor that will be filled with catalyst, including a single inflatable bladder mechanically and fluidically attached to a centering ring.

In one aspect, there is provided a device for centering a temperature measurement device inside a tube reactor that will be filled with catalyst, comprising a centering ring with an interior and an exterior, configured to accommodate a

temperature measurement device and a pressurized gas conduit in the interior, a single inflatable bladder mechanically and fluidically attached to the exterior of the centering ring, the pressurized gas conduit fluidically attached to the centering ring such that a flow of pressurized gas exiting the pressurized gas conduit passes through a gas passage into the single inflatable bladder.

What is claimed is:

~~1. A device for centering a temperature measurement device inside a tube reactor that will be filled with catalyst, comprising a single inflatable bladder mechanically and fluidically attached to a centering ring.~~

~~2. The device of claim 1, wherein a pressurized gas conduit is located inside the centering ring and is fluidically attached to a compressed gas source.~~

~~3. The device of claim 1, wherein the single inflatable bladder is configured to center the centering ring within a reactor tube when inflated.~~

~~4~~1. A device for centering a temperature measurement device inside a tube reactor that will be filled with catalyst, comprising:

- a centering ring with an interior and an exterior, configured to accommodate a temperature measurement device and a pressurized gas conduit in the interior,
- a single inflatable bladder mechanically and fluidically attached to the exterior of the centering ring,
- the pressurized gas conduit fluidically attached to the centering ring such that a flow of pressurized gas exiting the pressurized gas conduit passes through a gas passage into the single inflatable bladder.

~~5~~2. The device of claim ~~4~~1, wherein the pressurized gas conduit is fluidically attached to a compressed nitrogen source.

~~6~~3. The device of claim ~~4~~1, wherein the pressurized gas conduit is fluidically attached to a compressed air source.

~~7~~4. The device of claim ~~4~~1, wherein the single inflatable bladder is configured to center the centering ring within a reactor tube when inflated.

~~8~~5. The device of claim ~~4~~1, wherein the temperature measurement device comprises a distal end, and the distal end is attached to a distal end mesh disk.