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. 16/665,377, 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 reactor 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 reactor tube that will be filled with catalyst, including multiple inflatable bladders mechanically and fluidically attached to a centering ring.

In one aspect, there is provided a device for centering a temperature measurement device inside a reactor tube that will be filled with catalyst, comprising multiple inflatable bladders mechanically and fluidically attached to a centering ring,

wherein when inflated, the multiple inflatable bladders are configured to comprise multiple open regions though which catalyst passes through.

In another aspect, there is provided a device for centering a temperature measurement device inside a reactor tube 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,
- multiple inflatable bladders 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 multiple inflatable bladders.

wherein when inflated, the multiple inflatable bladders are configured to comprise multiple open regions though which catalyst passes through.

What is claimed is:

1. A device for centering a temperature measurement device inside a reactor tube that will be filled with catalyst, comprising multiple inflatable bladders mechanically and fluidically attached to a centering ring, wherein when inflated, the multiple inflatable bladders are configured to comprise multiple open regions though which catalyst passes through.

2. The device of claim 1, wherein the multiple inflatable bladders comprise three inflatable bladders.

3. The device of claim 1, wherein a pressurized gas conduit is fluidically attached to a compressed gas source.

4. The device of claim 1, wherein the multiple inflatable bladders are configured to center the centering ring within reactor tube when inflated.

5. A device for centering a temperature measurement device inside a reactor tube 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,
- multiple inflatable bladders 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 multiple inflatable bladders.

wherein when inflated, the multiple inflatable bladders are configured to comprise multiple open regions though which catalyst passes through.

6. The device of claim 5, wherein the multiple inflatable bladders comprise three inflatable bladders.

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

8. The device of claim 5, wherein the pressurized gas conduit is fluidically attached to a compressed air source.

9. The device of claim 5, wherein the multiple inflatable bladders are configured to center the centering ring within a reactor tube when inflated.

10. The device of claim 5, further comprising a temperature measurement device, wherein the temperature measurement device comprises a distal end, and the distal end is attached to a distal end mesh disk.