

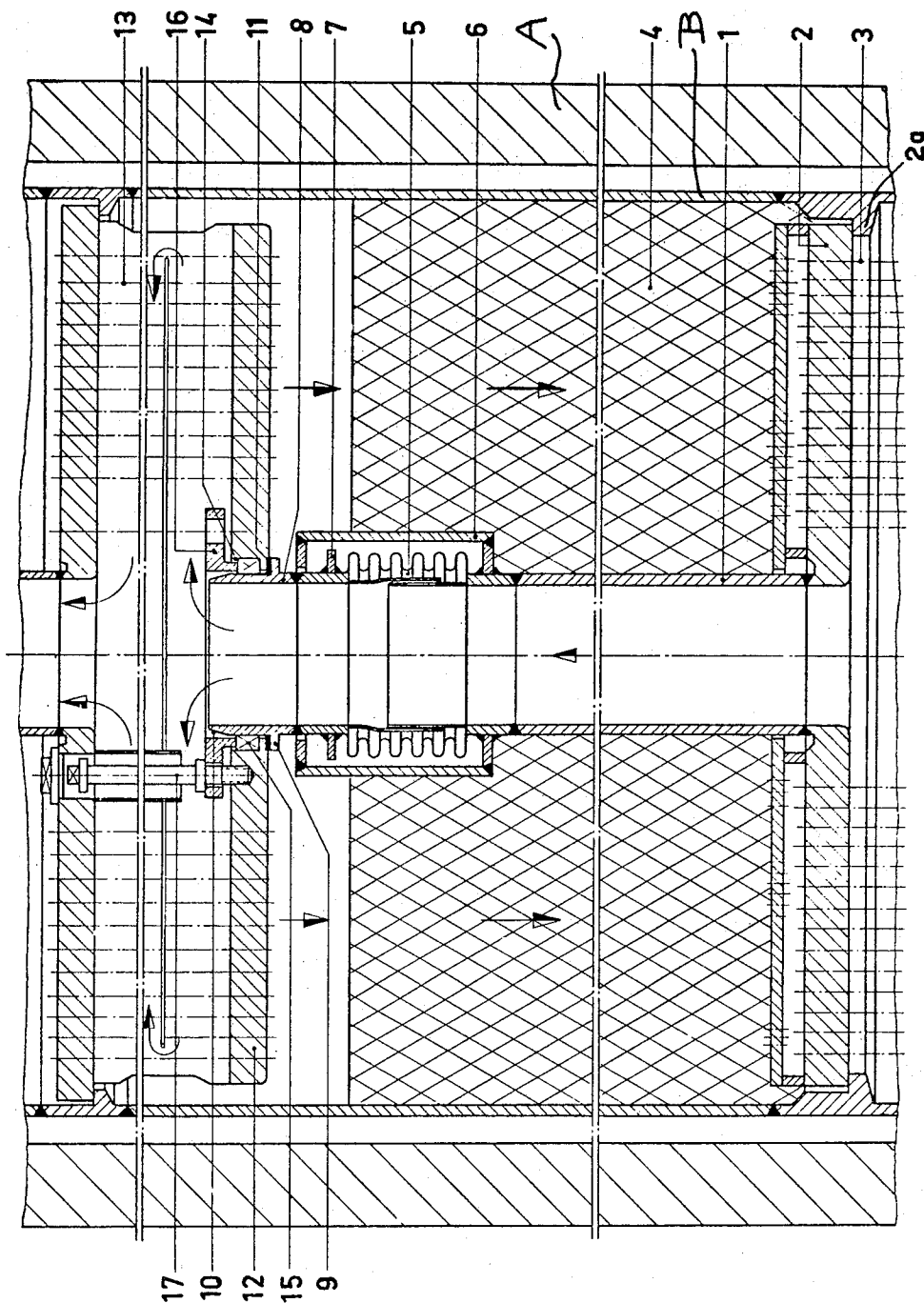
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PIPE CONNECTOR FOR THE INTERIOR OF REACTION VESSELS

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PIPE CONNECTOR FOR THE INTERIOR OF REACTION VESSELS

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4 Claims

ABSTRACT OF THE DISCLOSURE

In a reaction vessel, for example an ammonia synthesis converter, a detachable pipe connector for the reaction sections that are filled with catalyst, and a number of intermediate heat exchangers, and which ensures at all times, despite thermal expansion, the necessary gas-tightness, but at the same time affords accessibility to the catalyst beds.

BACKGROUND OF THE INVENTION

The present invention relates to a detachable pipe connector for the interior of reaction vessels having several reaction sections that are filled with catalyst, and a number of internal members, for example intermediate heat exchangers.

Reaction vessels, for example ammonia synthesis converters, comprise a final heat exchanger, several catalyst beds, and intermediate heat exchangers. The process gas first passes upward on the shell side of the final heat exchanger, then alternately through a central tube arranged in each catalyst bed, and through the shell side of the intermediate heat exchangers. After reversal of the direction of flow, the gas leaves the reaction vessel after having passed through the catalyst beds, the tube side of the intermediate heat exchangers, and the final heat exchanger.

The intermediate heat exchangers are equipped with reversing baffles of the disk and annular disk type. The gas stream to be heated is routed from heat exchanger to heat exchanger through the central tubes arranged in the catalyst beds. The intermediate heat exchangers have the same diameter as the catalyst beds. That means they occupy the entire cross-sectional area of the reaction vessel insert.

Referring to the known reaction vessels, all sections are welded gas-tight and are surrounded by the insert shell to which the tube sheets are attached by gas-tight welds to prevent the formation of gas short circuits.

A reaction vessel insert is a complex assembly and is subject in operation to heavy and varying thermal stresses. In addition, the catalyst must be filled into and withdrawn from the individual sections. For this purpose, the intermediate heat exchangers must be provided with traversing filling openings parallel to the tubes. This means a waste of expensive high-pressure space. For reaction vessels that have a diameter of 2 m. and more, the charging and withdrawal of catalyst through two or three filling openings is cumbersome, and a uniform bed thickness cannot be achieved because of the poor accessibility to the top of the catalyst bed towards the end of the filling procedure.

SUMMARY OF THE INVENTION

The object of the invention is to produce for the insert sections a detachable pipe connector that will ensure at any time, despite thermal expansion, the necessary gas-tightness and at the same time perfect accessibility to the catalyst beds.

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According to the invention, the problem is solved in that the pipe connector for the central tube consists of an expandable corrugated pipe section, an expansion limiting means, a packing section, and a sealing collar. One end of the connector is rigidly attached to the central tube while the other end is connected through a detachable joint to the tube sheet of the adjacent intermediate heat exchanger.

The invention incorporates the particular advantages that the ammonia synthesis converter insert which consists of several sections can be assembled in the field, each section comprising the heat exchanger with the superimposed central tube. The catalyst beds can be filled into the insert before the adjacent section is added. The upper tube sheets of the intermediate heat exchangers are suspended from the insert shell, and the heat exchangers are free to expand in a downward direction to compensate thermal expansion. Referring to the given industrial dimensions, the tolerances relating to the diameter are insignificant as regards any axial displacement because the pipe connector is capable of compensating such axial displacement. The thermal expansion to which the central tube and the corrugated pipe section are subject because of the operating temperature of 400 to 550° C. prevailing at the pipe connector is bound to increase the sealing force on the lower tube sheet.

Another advantage of the invention is that the gas pressure inside the corrugated pipe section is higher than the external pressure so that a force component as the product of the differential pressure and the surface of the last half corrugation becomes effective in an axial direction towards the sealing collar. Consequently, the differential pressure produces an additional load upon the sealing collar.

Dismantling the individual sections is performed in the same simple way that is applied for assembly.

BRIEF DESCRIPTION OF THE DRAWING

The figure is a fragmentary vertical sectional diagrammatic view of a reaction vessel showing a central tube for a catalyst bed having an expandable section rigid at one end with the tube but detachable at the other with the intermediate heat exchanger end.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The reaction vessel has an outer wall A providing a housing within which are disposed heat exchangers and catalyst beds all arranged within a casing B. A central tube 1 is fixedly connected to the upper tube sheet 2 of a heat exchanger 3, the tube sheet 2 being supported on a shelf 2a on casing B. A corrugated pipe section 5 is welded in place within the upper zone of a future catalyst bed 4. This corrugated pipe section is surrounded by an expansion limiting shell 6 which also prevents any contact between the corrugated pipe section and the catalyst. A stop ring 7 above the corrugated pipe section 5 limits the axial travel of the corrugated pipe section. A packing box tube section 8 is provided with a collar 9 and a beveled upper end 10. A gasket 11 is placed upon the collar 9 while the lower tube sheet 12 of an adjacent intermediate heat exchanger 13 rests on said gasket.

The lower tube sheet 12 of the intermediate heat exchanger 12 is provided with a recess 14. This recess accommodates a packing 15, which is inserted between the lower tube sheet 12 and the packing box section 8 of the pipe connector. The packing 15 is firmly pressed into the recess 14 of the lower tube sheet by means of a packing box ring 16 and bolts 17 secured in the tube sheets.

The overall length of the corrugated pipe section 5 is selected to achieve a certain pre-stress, i.e. a reduction in length in the corrugated pipe section in assembled condition and at normal ambient temperature, and a tight seal

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at the lower tube sheet of the adjacent intermediate heat exchanger through the pre-stress force acting on the flat face gasket 11. Sealing by the flat face gasket is supplemented by the packing 15.

Under operating conditions, the sealing force acting upon the flat face gasket 11 rises because, owing to the thermal expansion of the tubes of intermediate heat exchanger 13, the lower tube sheet 12 moves towards the packing box, and the differential pressure in the corrugated pipe section becomes effective in an upward direction through the last half corrugation.

What we claim is:

1. A reaction vessel comprising a casing, reaction sections within said casing in the form of catalyst beds and heat exchangers provided with upper and lower tube sheets, said reaction sections and heat exchangers being arranged alternately, each catalyst bed resting on the upper tube sheet of a heat exchanger, a shelf fixed to the inner wall of said casing on which said upper tube sheet rests, a central pipe in each catalyst bed, a fixed connection between the lower part of each central pipe and the upper sheet of the heat exchanger immediately below the catalyst bed, there being a central hole in the lower tube sheet of the heat exchanger immediately above said catalyst bed through which the upper part of said central pipe extends freely, an expandable corrugated pipe section having one end rigidly secured to the upper end of each central pipe, means for limiting the expansion of said corrugated pipe section, a packing box on said upper pipe end for effecting a gas-tight seal with said tube sheet, and means bearing against said packing for establishing such gas-tight seal.

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2. In a reaction vessel as claimed in claim 1, in which said expansion limiting means comprises a shell between said central pipe and said catalyst bed.

3. In a reaction vessel as claimed in claim 2, comprising a rigid connection between said shell and pipe, and a stop ring within said shell and movable with said corrugated pipe section and engageable with one end of said shell for limiting the axial travel thereof.

4. In a reaction vessel as claimed in claim 1, in which said gas-tight connection means comprises a collar on said tube section, a gasket on said collar against which said intermediate tube sheet rests, means providing a recess between said tube section and tube sheet and spaced beyond said gasket, a packing in said recess, a packing ring bearing against said packing in a direction toward said corrugated pipe section, and adjustable screw means for retaining said ring in position.

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