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THE PATENT OFFICE LONDON

(54) IMPROVEMENTS IN AND RELATING TO GAS VALVES

(71) We, UHDE GMBH, formerly known as FRIEDRICH UHDE GMBH., a body corporate organised according to the laws of the Federal Republic of Germany, of Deggingstraße 10-12, 4600 Dortmund, Federal Republic of Germany, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement.-

This invention relates to gas valves which may be used especially, but not exclusively, as parts of reactors for gas-phase reactions.

It has been proposed to use gas valves in which part of the valve body forms a section of tubular reactor for carrying out gas-phase reactions, the valve being used for the admission of quench gas into, or the withdrawal of reaction gas from the tubular reactor. Tubular reactors of this type are usually of considerable length and include a plurality of such valves arranged along their length, and are often constructed to withstand reaction temperatures of over 250°C and pressures of more than 1000 bar.

When the valve is used for the admission of quench gas, it is necessary for quench gas upstream of the valve to remain at a low temperature when the valve is closed, i.e., the quench gas temperature must not be raised by the reaction occurring inside the tubular reactor; at the same time, the dead space between the seal formed by the valve closure member and its seat and the reactor passage must be as small as possible when the valve is closed.

Various designs have been proposed to meet these requirements. For example, the outer walls of the valve body may be provided with cooling ducts which are connected to a coolant cycle. As a result, most of the undesired heat transmitted from the tubular reactor to the valve body via an interposed sealing element is dissipated before it can heat the quench gas above the valve stem.

However, such cooling ducts cannot be arranged too close to the valve passageway for the quench gas, since this would weaken the pressure-bearing walls of the valve; a certain wall thickness must therefore be retained and this causes heat to be transmitted to the quench gas and, consequently, such a design is unsatisfactory.

A further design which allows for the dissipation of undesired heat that has already been transferred to the valve body and to the valve stem is that incorporating thermosiphon cooling of the stem when the latter is arranged vertically. The stem has a bore which is closed at its upper end and which may be of differing diameters, the bore being filled with water or a similar coolant up to two-thirds of its length. Since the stem is heated most at its lower end, the liquid contained in that part will also be heated most. This liquid will rise, cool down, and circulate. Cooling fins on the upper part of the stem increase the temperature gradient and thus the heat that can be dissipated. Thermosiphon cooling can be applied only when the valve stem is vertical, since otherwise a reduced circulation of the coolant will result.

These known measures are intended to dissipate the heat that has already passed into the valve body. However, since a minimum wall thickness must be maintained owing to the high operating pressures involved, there are still some zones of the value body that become unacceptably hot. As a result, the quench gas upstream of the closed valve may heat up and undesired gas reactions inside the quench gas duct may occur.

The present invention seeks to provide a valve in which the dead space of the inlet or outlet duct is as small as possible and in which heating of the quench gas upstream of the valve is largely prevented.

According to the present invention, there is provided a valve including a first body portion having a passageway for gas, a valve closure member for closing said passageway at one end, a second body portion having a passageway for gas in registry with the passageway in the first body portion, and a sealing member against which the valve closure member can seat, the sealing member being located between the first and second body portions and having a thermal conductivity which is at least 50% lower than that of the body portions.

The valve of the present invention is most suitable for use in a tubular reactor of the type described above, and the second body portion of the valve then forms part of the wall of the tubular reactor.

Preferably, the outer surface of the sealing member is provided with cooling fins having a thermal conductivity which is higher than that of the sealing member.

When the reaction taking place inside the tubular reactor is highly exothermic and results in elevated temperatures prevailing inside the tubular reactor and, consequently, inside the second body portion of the valve as well, as a result of which there may be a risk of considerable heat being transferred towards first body portion of the valve, the sealing member suitably comprises at least two superposed annuli which are in mutual contact adjacent their peripheries only, i.e., the sealing member is of sandwich construction.

The sealing member is suitably compressed between the first and second body portions of the valve. When the second body portion forms part of the wall of a tubular reactor, this compressive force acting on the second body portion enables the thickness of the wall of the tubular reactor in the vicinity of the valve to be reduced by at least 35% relative to the thickness of other parts of the wall. This enables the sealing member which serves also as the valve seat, to be correspondingly closer to the reaction chamber and this, in turn, results in the dead space between the reaction chamber and the valve closure member being correspondingly smaller.

The smaller dead space and the reduction in heat transfer to the first body portion of the valve by virtue of the sealing member having a reduced thermal conductivity mean that the local cooling effect obtained by cooling ducts in the valve body and by thermosiphon cooling of the valve stem are sufficient to prevent unwanted heating of the quench gas.

If the sealing member is additionally provided with cooling fins or is of sandwich construction as described above, a further reduction of heat transfer can be obtained. If the annular cavity between the two annular parts of the sealing member has a thickness of 1mm and an area of about 50% of the total surface area of the sealing member, for example, the calculated further reduction in the heat transfer is 50%.

With the valve according to the present invention, the temperature gradient that can be attained in the first body portion of the valve is such that, even with reactors working at reaction temperatures of over 300°C, the temperature will not reach 150°C at any point of the first body portion. It is therefore possible to avoid undesired reaction of the quench gas inside the closed valve.

The present invention will now be described in greater detail by way of example only with reference to the accompanying drawings, in which:

Figure 1 shows a cross-sectional view of a valve in accordance with the invention;

Figure 2 shows a side view of the valve shown in Figure 1;

Figure 3 shows a cross-sectional view of a first 'sandwich' sealing member; and

Figure 4 shows a cross-sectional view of a second 'sandwich' sealing member.

Referring to the drawings, the valve shown in Figure 1 includes a lower body portion 1 in the form of a section of a tubular reactor having a reaction space 2, and an upper body portion 4. The latter has a passageway 12 for quench gas, which communicates with the reaction space 2 via a duct 3. The upper and lower body portion are connected by bolts 6 which serve also to compress between the body portions a sealing member 8 of a material having a thermal conductivity which is at least 50% lower than that of the material of the body portions, and which is provided on its outer surface with cooling fins 9 of a material having a thermal conductivity which is higher than that of the material of the sealing member. Immediately below the sealing member, the thickness of the wall 7 of the tubular reactor is at least 35% less than the thickness of the other parts of the wall (see also figure 2 of the drawings).

The upper body portion 4 is also provided with a bore through which passes a valve stem 5 which seats at its lower end on the sealing member 8. The valve stem 5 has a bore 11 for thermosiphon cooling, and the upper body portion 4 is also cooled by water passing through the cooling ducts 10.

The sealing member 8 shown in Figure 1 is of unitary construction. As shown in Figures 3 and 4, it may alternatively be of sandwich construction consisting of two annuli which are in mutual contact adjacent their peripheries 13 only leaving a cavity 14 between their inner zones 15 (Figure 3) or consisting of three superposed annuli which form two cavities between their inner zones.

The valve according to the present invention can also be used as a safety valve by providing an appropriate mechanism to enable the valve stem 5 to move away from the sealing member 8 when excess pressure builds up in the reaction space 2. The reaction gas can then be vented from the reaction space 2 to a discharge line via the duct 3 and passageway 1.

WHAT WE CLAIM IS:-

1. A valve including a first body portion having a passageway for gas, a valve closure member for closing said passageway at one end, a second body portion having a passageway for gas in registry with the passageway in the first body portion, and a sealing member against which the valve closure member can seat, the sealing member being located between the first and second body portions and having a thermal conductivity which is at least 50% lower than that of the body portions.

2. A valve according to claim 1, wherein the sealing member is compressed between the first and second body portions.

3. A valve according to claim 1 or claim 2, wherein the sealing member is provided with cooling fins the thermal conductivity of which is higher than that of the sealing member.

4. A valve according to any one of claims 1 to 3, wherein the sealing member comprises at least two superposed annuli which are in mutual contact adjacent their peripheries only.

5. A valve according to any one of claims 1 to 4, wherein the second body portion forms part of the wall of a reaction vessel.

6. A valve according to claim 5, wherein the thickness of the wall which constitutes the second body portion is at least 35% less than that of the remaining parts of the wall.

7. A valve according to any of claims 1 to 6, wherein the first body portion is provided with ducts for the passage of cooling water.

8. A valve according to claim 1 substantially as hereinbefore described with reference to and as shown in Figures 1 and 2 or Figure 3 or Figure 4 of the accompanying drawings.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

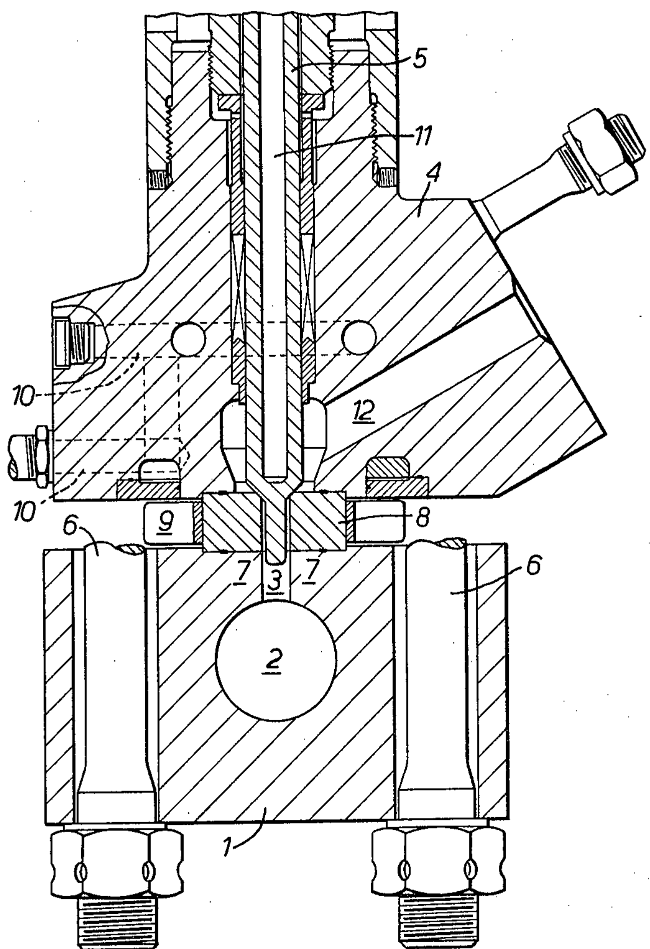

FIG. 1.

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Sheet 2

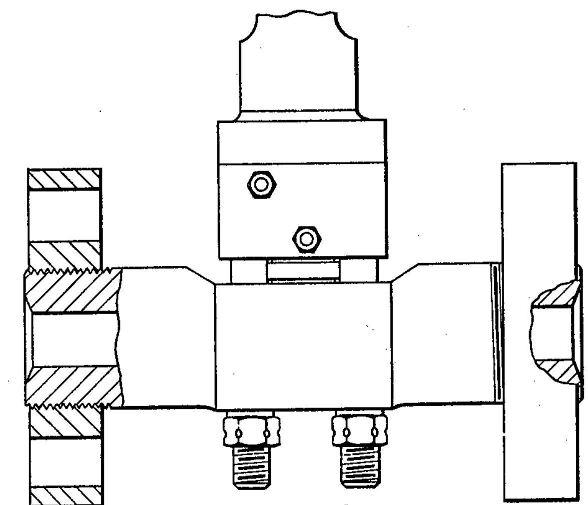

FIG. 2.

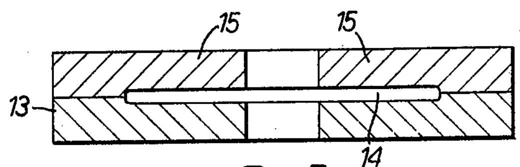

FIG. 3.

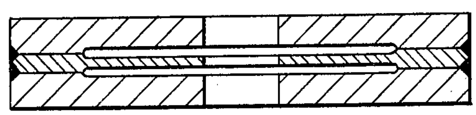

FIG. 4.