

## Description

The invention relates to a process for the catalytic conversion of a liquid and/or a gas comprising the steps of introducing in the upper end of a vessel the liquid to be converted and a gas or the gas to be converted and a liquid, passing said liquid and gas through a bed of catalyst particles within the vessel, and removing the effluent obtained by the catalytic conversion from the lower end of the vessel.

Examples of such a process are hydroprocessing, hydrodesulphurization or hydrocracking. A further example is the catalytic conversion of synthesis gas, comprising hydrogen and carbon monoxide, into hydrocarbons in the boiling range of middle distillates.

These processes are exothermic. To control the temperatures in the catalyst bed it is known to allow the fluids participating in the conversion to flow out of the catalyst bed into a plurality of hollow bars with permeable walls, in which hollow bars the fluids are mixed with cooling fluid, and to allow the cooled fluids to enter the catalyst bed downstream the hollow bars.

A disadvantage of the known process is that the permeable walls can easily be blocked by fragments of catalyst particles or by deposits of coke from the fluid, so that the fluids may have difficulties to reach the mixing zone inside the hollow bars.

It is an object of the present invention to overcome the problem of controlling the temperature of a catalyst bed in which a process is carried out, without encountering the above drawback.

From GB-A 1 500 213 a process and an apparatus are known for catalytically treating hydrocarbons. The process comprises introducing in the upper end of a vessel a liquid and gas, passing said liquid and gas through a bed of catalyst particles within the vessel, allowing the liquid and gas to pass through a plurality of passages defined between the outer surfaces of guide elements, and removing the effluent obtained by the catalytic conversion from the lower end of the vessel. The guide elements defining the passages are triangular rods which are arranged such that they form a surface containing a plurality of passages. The apparatus described above does not contain any means for controlling the temperature in the bed of catalyst particles.

The present invention now relates to a process for the catalytic conversion of liquid and/or gas, which process comprises the steps of introducing in the upper end of a vessel a liquid and gas, passing said liquid and gas through a bed of catalyst particles within the vessel, allowing the liquid and gas to pass through a plurality of passages defined between the outer surfaces of guide elements, and removing the effluent obtained by the catalytic conversion from the lower end of the vessel, characterized in that the liquid and gas comprise a liquid to be converted and a gas or a gas to be converted and a liquid, that the guide elements are arranged in the bed of catalyst particles, and that the passages defined by the guide elements have in the direction of flow a narrowing part, a narrow part and a widening part and an additional fluid is introduced at the

narrowing parts or at or near the narrow parts of the passages.

The specification further relates to an apparatus for carrying out the process of catalytic conversion of a liquid and/or a gas comprising a vessel, inlet means for introducing into the vessel fluids and catalyst particles arranged at the upper end of the vessel, support means for supporting a bed of catalyst particles in the vessel, a grid of guide elements arranged in the vessel, wherein between adjacent elements a passage is defined, and discharge means for discharging from the vessel effluent and catalyst particles at the lower end of the vessel, as is known from GB-A 1 500 213.

Another known apparatus contains a grid of hollow bars having fluid permeable outer walls in which hollow bars there are arranged spray means for introducing, during normal operation, cooling fluid in the hollow bars, which cooling fluid will mix with the fluids that pass from this catalyst bed into the hollow bars.

It is an object of the invention to provide an improved apparatus.

To this end the apparatus for carrying out a process for the catalytic conversion of a liquid and/or a gas according to the invention comprises a vessel, inlet means for introducing into the vessel fluids and catalyst particles arranged at the upper end of the vessel, support means for supporting a bed of catalyst particles in the vessel wherein between adjacent elements a passage is defined, discharge means for discharging from the vessel effluent and catalyst particles arranged at the lower end of the vessel, characterized in that the grid is arranged substantially perpendicular to the direction of fluid flow, wherein between the parts of the outer surfaces of adjacent guide elements facing each other a passage is defined having in the direction of fluid flow a narrowing part, a narrow part and a widening part, and that the guide elements are provided with means for introducing additional fluid into the passage, which means are arranged along the narrowing part or at or near the narrow part of the passage.

The invention will now be described by way of example in more detail with reference to the drawings, wherein

Figure 1 shows schematically a longitudinal section of the apparatus;

Figure 2 shows a cross-section of the apparatus shown in Figure 1 along the line II-II;

Figure 3 shows detail III of the apparatus shown in Figure 1 drawn to a scale larger than the scale of Figure 1; and

Figure 4 shows a cross-section of an alternative design of a guide element.

Reference is now made to Figures 1, 2 and 3. The apparatus according to the invention comprises a vessel 1, a fluid inlet 2 and a catalyst inlet 3 arranged at the upper end of the vessel 1, and a fluid outlet 4 and a catalyst outlet 5 arranged at the lower end of the vessel 1. Furthermore, the vessel 1 comprises a support cone 8 for supporting a bed of catalyst particles (not shown) in the vessel 1, which

support cone 8 has a central opening 9 which is connected by means of tube 10 to the catalyst outlet 5. Furthermore, the catalyst outlet 5 is provided with valve means (not shown) for allowing or stopping discharging of catalyst particles from the vessel 1.

In addition, the vessel 1 is provided with a first grid 12 and a second grid 13, which grids are arranged at different levels in the vessel 1 substantially perpendicular to the direction of fluid flow through the vessel 1. Each grid comprises guide elements 14, which are connected to a ring-shaped support member 18 joined to the inner surface of the side-wall of the vessel 1. The guide elements pertaining to the first grid 12 are preferably staggered with respect to the guide elements pertaining to the second grid 13.

Between the facing parts of outer surfaces of adjacent guide elements 14, and between the facing parts of the outer surfaces of the ring-shaped support member 18 and the adjacent guide elements there are defined passages indicated with reference numeral 20. Each of the passages 20 comprises in the direction of fluid flow a narrowing part 21, a narrow part 22 and a widening part 23. For the sake of clarity, the reference numerals referring to the parts of the passages 20 have only been included in Figure 3.

Each guide element 14 comprises a triangular fluid feed cap 25 (see Figure 3) having side walls 26 and a bottom wall 28, in which fluid feed cap 25 a fluid conduit 29 is arranged. Each ring-shaped support member 18 comprises a fluid feed cap 30 having side wall 26 and bottom wall 28, in which fluid feed cap 30 there is arranged a fluid supply conduit 31 which is in fluid communication with the fluid conduits 29 in the triangular fluid feed caps 25 and with an additional fluid inlet 32 (see Figure 2).

Each of the fluid feed caps 25 and 30 is supported by a support beam 33. The fluid feed cap is so wide that the bottom wall 28 extends beyond the support beam 33, along the length of the support beam 33. In the part of the bottom wall 28 extending beyond the support beam 33 there are arranged means for introducing additional fluid into a passage in the form of a row of outlet openings 35 (see Figure 3), which are in fluid communication with the fluid conduit 29, or, for the outlet openings 35 pertaining to the ring-shaped support member 18, with the fluid supply conduit 31.

It will be appreciated that the above described details of the guide elements and ring-shaped support member pertaining to the second grid 13 are included as well in the guide element and the ring-shaped support member pertaining to the first grid 12.

The process of catalytic conversion of sulphur containing hydrocarbon oil into a substantially sulphur-free hydrocarbon oil with the use of hydrogen will now be described. Catalyst particles are supplied via the catalyst inlet 3 until the space above the support cone 8 and in the tube 10 is filled with a bed of catalyst particles (not shown). Subsequently a mixture of sulphur containing hydrocarbon oil and hydrogen, at a temperature in the range of from 300 °C to 500 °C and at a pressure in the range of from 3 MPa to 25 MPa, is introduced into the vessel 1 via

the fluid inlet 2.

In the reactor an exothermic reaction will occur, wherein hydrogen and the sulphur in the sulphur containing hydrocarbon oil react to give hydrogen sulphide and a substantially desulphurized hydrocarbon oil. The mixture of hydrocarbon oil and hydrogen sulphide is allowed to flow in downward direction and to pass through upward tilting separator slits 40 arranged in the wall of the tube 10 into an effluent collecting space 41 below the support cone 8, from which the mixture is discharged via fluid outlet 4. Upon cooling, the formed hydrogen sulphide is subsequently separated from the desulphurized hydrocarbon oil in a suitable separator (not shown). When the catalyst is deactivated, for example after 6 to 12 months the process is interrupted, all catalyst particles are discharged from the vessel 1, and the vessel 1 is subsequently filled with fresh catalyst particles.

In order to control the temperature in the vessel additional fluid in the form of cooling fluid, comprising, for example, cooled desulphurized hydrocarbon oil or quench gas, is supplied to the additional fluid inlet 32 pertaining to at least one of the grids 12 and 13, which cooling fluid will enter the passages 20 through the outlet openings 35 near the narrow parts 22 of the passages 20 (see Figure 3).

In this manner the reaction products are cooled in the region where the passage is reduced, and consequently where the fluid velocity and turbulence are increased. Thus an improved heat exchange between the hot reaction products and the additional fluid is obtained.

To obtain a sufficient heat exchange and a moderate pressure drop over a grid, the total cross-sectional area of the passages 20 should be in the range of from 30% to 60% of the cross-sectional area of the vessel 1, and preferably in the range of from 45% to 55%.

The bottom walls 28 of the fluid feed caps 25 and 30 extend beyond the support beams 33. When the vessel is filled with catalyst particles (not shown), these particles will be so distributed in the vessel 1 that under the sides of the bottom walls 28 extending beyond the support beams 33 there exist catalyst-free distribution spaces 42 (see Figure 3) extending in longitudinal direction of the support beams 33. Since the fluid outlet openings 35 are arranged in the side of the bottom walls 28 extending beyond the support beam 33, cooling fluid is introduced in the distribution spaces 42 so that, before it enters the bed of catalyst particles, the cooling fluid is uniformly distributed in the distribution spaces 42. This reduces the change of a non-uniform temperature distribution in the catalyst bed in the passages 20.

In order to obtain a uniform distribution of liquid flowing through the widening part 23 of each passage 20, the acute angle 43 between the vertical and the part of the outer surface of a guide element 14 or of the ring-shaped support member 18 defining the widening part 23 should be matched with the liquid spreading angle. For liquids flowing through a bed of conventional catalyst particles the acute angle 43 is in the range of from 3° to 10°.

The uniform distribution of liquid in the widening part 23 of each passage 20 has a beneficial effect on the efficiency of reaction because non-uniform contacting of the liquid with catalyst and consequently non-uniform temperature distribution in the catalyst bed and consequently non-uniform fouling of catalyst particles is avoided.

In the above described process, deactivated catalyst is refreshed only after substantially long periods. In an alternative embodiment of the invention, a volume of catalyst particles is discharged from the vessel and is replaced by a volume of fresh catalyst particles introduced into the vessel via the catalyst inlet 3. Moving the catalyst bed in bunker flow over a small distance so as to allow replacing a volume of deactivated catalyst particles by a volume of fresh catalyst particles may be carried out at short intervals, for example once a day.

To ensure that, when the catalyst particles in the narrowing part 21 of a passage 20 move downwardly in a uniform manner, so that the catalyst particles near the surfaces defining the narrowing part 21 will move at about the same velocity as the catalyst particles in the central part of the narrowing part 21, the acute angle 44 between the vertical and the part of the outer surface of a guide element 14 or of the ring-shaped support member 18 defining the narrowing part 21 should be so selected that mass flow will occur. For conventional catalyst particles the acute angle 44 is in the range of from 10° to 40°.

In an alternative process a gas is converted to a liquid, and, to this end a mixture of gas and liquid is introduced into the vessel through the fluid inlet 2.

An example of such a process is the conversion of synthesis gas, comprising hydrogen and carbon monoxide, into a liquid hydrocarbon in the boiling range of a middle distillate.

In this process a mixture of synthesis gas and recycled liquid hydrocarbon at a temperature in the range of from 200 °C to 250 °C and at a pressure in the range of from 2 MPa to 4 MPa is introduced in the catalyst bed in the reactor. In such a process the purpose of the liquid is to transfer heat so as to obtain a uniform temperature distribution in the catalyst bed in the vessel. During normal operation cooled recycled liquid hydrocarbon product is supplied to the additional fluid inlets 32 and enters the vessel 1 through the outlet openings 35 in order to cool the products.

The apparatus described with reference to Figure 1 is provided with two grids of guide elements; a very small apparatus can be provided with only one grid of guide elements, and, on the other hand, a larger apparatus can be provided with more than one grid, for example 3 to 10 arranged at different levels in the vessel.

In the guide elements described with reference to Figure 3, the means for introducing additional fluid into a passage are arranged in the sides of the bottom wall extending beyond the support beam, so that during normal operation additional fluid is introduced near the narrow part of the passage.

Reference is now made to Figure 4 showing a guide element 45 that can replace part of, or all guide elements 14 in the grids 12 and 13 as described

with reference to Figures 1, 2 and 3. The guide element 45 comprises a triangular fluid feed cap 46 supported by a support beam 47. Each side wall of the triangular fluid feed cap 46 comprises a lower strip 48 and an upper strip 49 extending along the length of the guide element 45, and so arranged one above the other that the lower part of the upper strip 49 overlaps the upper part of the lower strip 48. Means for introducing additional fluid into a passage in the form of a row of outlet openings 50 are arranged along the narrowing part of a passage in the area where the upper strip 49 overlaps the lower strip 48, which area extends along the guide element 45.

In addition, bottom wall 53 of the fluid feed cap 46 is so wide that it extends beyond the support beam 47, and means for introducing additional fluid in the form of a row of outlet openings 54 are arranged in the part of the bottom wall 53 extending beyond the support beam 47.

The outlet openings 50 and 54 are in fluid communication with a fluid conduit 55 arranged within the triangular fluid feed cap 46, which fluid conduit 55 is in fluid communication with the fluid supply conduit 31 pertaining to the ring-shaped support member 18 (see Figure 3).

During normal operation, the vessel is filled with a bed of catalyst particles (not shown) so distributed in the vessel that there exist catalyst-free distributor spaces 56 and 57 below the area where the strips 49 overlap the strips 48 and below the sides of the bottom wall 53 extending beyond the support beam 47. Additional fluid, supplied to the fluid conduits 55 pertaining to the guide element 45 of each grid, will be introduced via the openings 50 and 54 into the narrowing parts and near the narrow part of each passage.

The fluid feed cap pertaining to a ring-shaped support member can as well be provided with a side wall comprising two strips extending along the support member and so arranged that the lower part of the upper strip overlaps the upper part of the lower strip, wherein means for introducing additional fluid into the passage are arranged in the area where the upper strip overlaps the lower strip.

The acute angle between the outer surfaces of the strips and the vertical should be in the range of from 10° to 40°.

The sides of the triangular fluid feed cap may comprise more than two strips, for example 3 to 5, extending along the guide element and so arranged one above the other that the lower part of the upper strip overlaps the upper part of the lower strip, wherein means for introducing additional fluid are arranged in the area where the upper strip overlaps the lower strip so as to allow introduction of additional fluid into the narrowing part or at the narrow part of a passage.

Each row of outlet openings 35 (see Figure 3), 50 and 54 (see Figure 4) extend along the corresponding guide elements, such a row of outlet openings can at least partly be replaced by a slit extending along at least part of the guide element.

During normal operation, additional fluid in the form of a fluid required for the catalytic conversion

can be supplied. An example of such an additional fluid is hydrogen gas supplied to maintain a required ratio between the volumes of sulphur containing hydrocarbon oil and hydrogen in the above described process of catalytic conversion of a sulphur containing hydrocarbon oil.

Where the process of catalytic conversion of a liquid and/or a gas is endothermic, the additional fluid comprises a heating fluid, for example steam, or heated fluid required for the catalytic conversion.

In an alternative embodiment, fluids can be sucked into the upper part of the fluid feed cap 46 (see Figure 4) through openings 50, mixed with additional fluid and introduced into the passages through openings 54.

In the apparatus described with reference to Figure 1 the support means for supporting a bed of catalyst particles in the vessel 1 comprises a support cone 8. In an alternative embodiment of the invention the catalyst bed may be supported by a perforated plate or a wire mesh which have the additional advantage of enhancing the catalyst/fluid separation. The catalyst bed may also be supported by the bottom wall of the vessel 1. In addition, gas and liquid can be supplied to the vessel via separated inlet means.

It will be appreciated that the apparatus may comprise more than one bed of catalyst particles arranged axially spaced apart in the vessel, wherein at least one of the beds is provided with the guide elements as described hereinabove.

## Claims

1. Process for the catalytic conversion of a liquid and/or a gas, comprising the steps of introducing in the upper end of a vessel a liquid and gas, passing said liquid and gas through a bed of catalyst particles within the vessel, allowing the liquid and gas to pass through a plurality of passages defined between the outer surfaces of guide elements, and removing the effluent obtained by the catalytic conversion from the lower end of the vessel, characterized in that the liquid and gas comprise a liquid to be converted and a gas or a gas to be converted and a liquid, that the guide elements are arranged in the bed of catalyst particles, and that the passages defined by the guide elements have in the direction of flow a narrowing part, a narrow part and a widening part and an additional fluid is introduced at the narrowing parts or at or near the narrow parts of the passages.

2. Process as claimed in claim 1, characterized in that the additional fluid comprises a cooling fluid.

3. Process as claimed in claims 1 or 2, characterized in that the additional fluid comprises a fluid required for the catalytic conversion.

4. Process as claimed in any one of the claims 1-3, characterized in that the process further comprises discharging at the lower end of the vessel a volume of catalyst particles and introducing in the upper end of the vessel a volume of catalyst particles to replace the discharged volume of catalyst particles.

5. Apparatus for carrying out the process of catalytic conversion of a liquid and/or a gas comprising a vessel, inlet means for introducing into the vessel fluids and catalyst particles arranged at the upper end of the vessel, support means for supporting a bed of catalyst particles in the vessel, a grid of guide elements arranged in the vessel wherein between adjacent elements a passage is defined, discharge means for discharging from the vessel effluent and catalyst particles arranged at the lower end of the vessel, characterized in that the grid is arranged substantially perpendicular to the direction of fluid flow, wherein between the parts of the outer surfaces of adjacent guide elements facing each other a passage is defined having in the direction of fluid flow a narrowing part, a narrow part and a widening part, and that the guide elements are provided with means for introducing additional fluid into the passage, which means are arranged along the narrowing part or at or near the narrow part of the passage.

6. Apparatus as claimed in claim 5, characterized in that a guide element comprises a triangular fluid feed cap having two side walls and a bottom wall, which fluid feed cap is supported by a support beam of which the outer surface has an inverse triangular cross-section.

7. Apparatus as claimed in claim 6, characterized in that a side wall of the fluid feed cap is formed by at least two strips extending along the guide element and so arranged one above the other that the lower part of the upper strip overlaps the upper part of the lower strip, and wherein fluid passages are arranged in the area where the upper strip overlaps the lower strip.

8. Apparatus as claimed in claim 6 or 7, characterized in that the bottom wall of the fluid feed cap is so wide that the bottom wall extends beyond the support beam, and wherein the means for introducing additional fluid comprise openings arranged in the part of the bottom wall extending beyond the support beam.

9. Apparatus as claimed in any one of the claims 5-8, characterized in that the total cross-sectional area of the passages is in the range of from 30% to 60% of the cross-sectional area of the vessel.

10. Apparatus as claimed in any one of the claims 5-9, characterized in that the acute angle between the part of the outer surface of a guide element defining the narrowing part of the passage and the vertical is in the range of from 10° to 40°.

11. Apparatus as claimed in any one of the claims 5-10, characterized in that the acute angle between the part of the outer surface of a guide element defining the widening part of the passage and the vertical is in the range of from 3° to 10°.

12. Apparatus as claimed in any one of the claims 5-11, characterized in that the catalytic converter comprises two or more grids of guide elements arranged at different levels in the vessel.

13. Apparatus as claimed in claim 12, characterized in that the guide elements of a grid are staggered with respect to the guide elements of an adjacent grid.

can be supplied. An example of such an additional fluid is hydrogen gas supplied to maintain a required ratio between the volumes of sulphur containing hydrocarbon oil and hydrogen in the above described process of catalytic conversion of a sulphur containing hydrocarbon oil.

Where the process of catalytic conversion of a liquid and/or a gas is endothermic, the additional fluid comprises a heating fluid, for example steam, or heated fluid required for the catalytic conversion.

In an alternative embodiment, fluids can be sucked into the upper part of the fluid feed cap 46 (see Figure 4) through openings 50, mixed with additional fluid and introduced into the passages through openings 54.

In the apparatus described with reference to Figure 1 the support means for supporting a bed of catalyst particles in the vessel 1 comprises a support cone 8. In an alternative embodiment of the invention the catalyst bed may be supported by a perforated plate or a wire mesh which have the additional advantage of enhancing the catalyst/fluid separation. The catalyst bed may also be supported by the bottom wall of the vessel 1. In addition, gas and liquid can be supplied to the vessel via separated inlet means.

It will be appreciated that the apparatus may comprise more than one bed of catalyst particles arranged axially spaced apart in the vessel, wherein at least one of the beds is provided with the guide elements as described hereinabove.

## Claims

1. Process for the catalytic conversion of a liquid and/or a gas, comprising the steps of introducing in the upper end of a vessel a liquid and gas, passing said liquid and gas through a bed of catalyst particles within the vessel, allowing the liquid and gas to pass through a plurality of passages defined between the outer surfaces of guide elements, and removing the effluent obtained by the catalytic conversion from the lower end of the vessel, characterized in that the liquid and gas comprise a liquid to be converted and a gas or a gas to be converted and a liquid, that the guide elements are arranged in the bed of catalyst particles, and that the passages defined by the guide elements have in the direction of flow a narrowing part, a narrow part and a widening part and an additional fluid is introduced at the narrowing parts or at or near the narrow parts of the passages.

2. Process as claimed in claim 1, characterized in that the additional fluid comprises a cooling fluid.

3. Process as claimed in claims 1 or 2, characterized in that the additional fluid comprises a fluid required for the catalytic conversion.

4. Process as claimed in any one of the claims 1-3, characterized in that the process further comprises discharging at the lower end of the vessel a volume of catalyst particles and introducing in the upper end of the vessel a volume of catalyst particles to replace the discharged volume of catalyst particles.

5. Apparatus for carrying out the process of catalytic conversion of a liquid and/or a gas comprising a vessel, inlet means for introducing into the vessel fluids and catalyst particles arranged at the upper end of the vessel, support means for supporting a bed of catalyst particles in the vessel, a grid of guide elements arranged in the vessel wherein between adjacent elements a passage is defined, discharge means for discharging from the vessel effluent and catalyst particles arranged at the lower end of the vessel, characterized in that the grid is arranged substantially perpendicular to the direction of fluid flow, wherein between the parts of the outer surfaces of adjacent guide elements facing each other a passage is defined having in the direction of fluid flow a narrowing part, a narrow part and a widening part, and that the guide elements are provided with means for introducing additional fluid into the passage, which means are arranged along the narrowing part or at or near the narrow part of the passage.

6. Apparatus as claimed in claim 5, characterized in that a guide element comprises a triangular fluid feed cap having two side walls and a bottom wall, which fluid feed cap is supported by a support beam of which the outer surface has an inverse triangular cross-section.

7. Apparatus as claimed in claim 6, characterized in that a side wall of the fluid feed cap is formed by at least two strips extending along the guide element and so arranged one above the other that the lower part of the upper strip overlaps the upper part of the lower strip, and wherein fluid passages are arranged in the area where the upper strip overlaps the lower strip.

8. Apparatus as claimed in claim 6 or 7, characterized in that the bottom wall of the fluid feed cap is so wide that the bottom wall extends beyond the support beam, and wherein the means for introducing additional fluid comprise openings arranged in the part of the bottom wall extending beyond the support beam.

9. Apparatus as claimed in any one of the claims 5-8, characterized in that the total cross-sectional area of the passages is in the range of from 30% to 60% of the cross-sectional area of the vessel.

10. Apparatus as claimed in any one of the claims 5-9, characterized in that the acute angle between the part of the outer surface of a guide element defining the narrowing part of the passage and the vertical is in the range of from 10° to 40°.

11. Apparatus as claimed in any one of the claims 5-10, characterized in that the acute angle between the part of the outer surface of a guide element defining the widening part of the passage and the vertical is in the range of from 3° to 10°.

12. Apparatus as claimed in any one of the claims 5-11, characterized in that the catalytic converter comprises two or more grids of guide elements arranged at different levels in the vessel.

13. Apparatus as claimed in claim 12, characterized in that the guide elements of a grid are staggered with respect to the guide elements of an adjacent grid.



## Patentansprüche

1. Verfahren zur katalytischen Umwandlung einer Flüssigkeit und/oder eines Gases, bei welchem eine Flüssigkeit und Gas in das obere Ende eines Gefäßes eingeführt wird, die Flüssigkeit und Gas durch ein Bett von Katalysatorteilchen in dem Gefäß hindurchtreten gelassen werden, der Flüssigkeit und Gas ein Durchgang durch eine Mehrzahl von Durchgängen ermöglicht wird, die zwischen den Außenflächen von Führungselementen gebildet sind, und der durch die katalytische Umwandlung erhaltene Ausfluß am unteren Ende des Gefäßes entfernt wird, dadurch gekennzeichnet, daß die Flüssigkeit und Gas eine umzuwandelnde Flüssigkeit und ein Gas oder ein umzuwandelndes Gas und eine Flüssigkeit aufweisen, daß die Führungselemente in dem Bett aus Katalysatorteilchen angeordnet sind und daß die durch die Führungselemente gebildeten Durchgänge in der Fließrichtung einen sich verengenden Teil, einen engen Teil und einen sich erweiternden Teil aufweisen und ein zusätzliches Fluid an den sich verengenden Teilen oder an oder nahe den engen Teilen der Durchgänge eingeführt wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das zusätzliche Fluid ein Kühlfluid aufweist.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das zusätzliche Fluid ein für die katalytische Umwandlung erforderliches Fluid aufweist.

4. Verfahren nach irgendeinem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß bei dem Verfahren weiterhin am unteren Ende des Gefäßes ein Volumen bzw. eine Menge von Katalysatorteilchen abgegeben wird und am oberen Ende des Gefäßes ein Volumen oder eine Menge von Katalysatorteilchen eingeführt wird, um das abgegebene Volumen bzw. die abgegebene Menge von Katalysatorteilchen zu ersetzen.

5. Vorrichtung zum Durchführen des Verfahrens der katalytischen Umwandlung einer Flüssigkeit und/oder eines Gases, umfassend ein Gefäß, eine Einlaßeinrichtung zum Einführen von Fluiden und Katalysatorteilchen in das Gefäß, wobei die Einlaßeinrichtung am oberen Ende des Gefäßes angeordnet ist, eine Trageinrichtung zum Abstützen eines Bettes von Katalysatorteilchen in dem Gefäß, ein Gitter aus Führungselementen, die in dem Gefäß angeordnet sind, wobei zwischen benachbarten Elementen ein Durchgang gebildet ist, eine Abgabereinrichtung am unteren Ende des Gefäßes zum Abgeben des Ausflusses und Katalysatorteilchen aus dem Gefäß, dadurch gekennzeichnet, daß das Gitter im wesentlichen rechtwinklig zur Fließrichtung des Fluids angeordnet ist, zwischen den Teilen der Außenflächen benachbarter Führungselemente, die einander zugewandt sind, ein Durchgang gebildet ist, der in Richtung des Fluidflusses einen sich verengenden Teil, einen engen Teil und einen sich erweiternden Teil aufweist, und daß die Führungselemente mit Mitteln versehen sind zum Einführen von zusätzlichem Fluid in den Durchgang, wobei diese Mittel entlang des sich verengenden Teiles oder an

oder nahe dem engen Teil des Durchganges angeordnet sind.

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß ein Führungselement eine dreieckförmige Fluidzuführkappe aufweist, die zwei Seitenwände und eine Bodenwand hat und die durch einen Tragbalken abgestützt ist, dessen Außenfläche einen umgekehrten dreieckförmigen Querschnitt hat.

7. Vorrichtung nach Anspruch 6, dadurch gekennzeichnet, daß eine Seitenwand der Fluidzuführkappe durch wenigstens zwei Streifen gebildet ist, die sich entlang des Führungselementes erstrecken und derart übereinander angeordnet sind, daß der untere Teil des oberen Streifens den oberen Teil des unteren Streifens überlappt, und wobei Fluiddurchgänge in dem Bereich oder in der Fläche angeordnet sind, in welchem bzw. in welcher der obere Streifen den unteren Streifen überlappt.

8. Vorrichtung nach Anspruch 6 oder 7, dadurch gekennzeichnet, daß die Bodenwand der Fluidzuführkappe so weit ist, daß die Bodenwand sich über den Tragbalken hinaus erstreckt, und wobei die Mittel zum Einführen zusätzlichen Fluids Öffnungen aufweisen, die in dem Teil der Bodenwand angeordnet sind, der sich über den Tragbalken hinaus erstreckt.

9. Vorrichtung nach irgendeinem der Ansprüche 5 bis 8, dadurch gekennzeichnet, daß die Gesamtquerschnittsfläche der Durchgänge im Bereich von 30% bis 60% der Querschnittsfläche des Gefäßes liegt.

10. Vorrichtung nach irgendeinem der Ansprüche 5 bis 9, dadurch gekennzeichnet, daß der spitze Winkel zwischen dem Teil der Außenfläche eines Führungselementes, der den sich verengenden Teil des Durchganges bildet, und der Vertikalen im Bereich von 10° bis 40° liegt.

11. Vorrichtung nach irgendeinem der Ansprüche 5 bis 10, dadurch gekennzeichnet, daß der spitze Winkel zwischen dem Teil der Außenfläche eines Führungselementes, der den sich erweiternden Teil des Durchganges bildet, und der Vertikalen im Bereich von 3° bis 10° liegt.

12. Vorrichtung nach irgendeinem der Ansprüche 5 bis 11, dadurch gekennzeichnet, daß der katalytische Umwandler zwei oder mehr Gitter aus Führungselementen aufweist, die in dem Gefäß an unterschiedlichen Höhen angeordnet sind.

13. Vorrichtung nach Anspruch 12, dadurch gekennzeichnet, daß die Führungselemente eines Gitters mit Bezug auf die Führungselemente eines benachbarten Gitters versetzt bzw. gestaffelt angeordnet sind.

## Revendications

1. Procédé de conversion catalytique d'un liquide et/ou d'un gaz, ce procédé comprenant les étapes qui consistent à introduire, dans l'extrémité supérieure d'un récipient, un liquide et un gaz, à faire passer le liquide et le gaz à travers un lit de particules de catalyseur contenues dans le récipient, à laisser le liquide et le gaz traverser une pluralité de passages définis entre les surfaces extérieures



d'éléments guides, et à éliminer l'effluent obtenu par la conversion catalytique depuis l'extrémité inférieure du récipient, caractérisé en ce que le liquide et le gaz comprennent un liquide à transformer et un gaz, ou un gaz à transformer et un liquide, en ce que les éléments guides sont disposés dans le lit de particules de catalyseur et en ce que les passages définis par les éléments guides possèdent, dans le sens de l'écoulement, une partie qui se rétrécit, une partie étroite et une partie qui s'élargit et un fluide additionnel est introduit au niveau des parties qui se rétrécissent ou au niveau ou à proximité des parties étroites des passages.

2. Procédé selon la revendication 1, caractérisé en ce que le fluide additionnel comprend un fluide refroidissant.

3. Procédé selon les revendications 1 ou 2, caractérisé en ce que le fluide additionnel comprend un fluide nécessaire à la conversion catalytique.

4. Procédé selon l'une quelconque des revendications 1-3, caractérisé en ce que le procédé comprend en outre la décharge, à l'extrémité inférieure du récipient, d'un volume de particules de catalyseur et l'introduction, dans l'extrémité supérieure du récipient, d'un volume de particules de catalyseur pour remplacer le volume déchargé de particules de catalyseur.

5. Dispositif pour mettre en œuvre un procédé de conversion catalytique d'un liquide et/ou d'un gaz selon l'invention comprenant un récipient, un dispositif d'entrée pour introduire, dans le récipient, des fluides et des particules de catalyseur disposées à l'extrémité supérieure du récipient, un dispositif de support pour supporter un lit de particules de catalyseur dans le récipient, un réseau d'éléments guides disposé dans le récipient, un passage étant défini entre des éléments adjacents, et un dispositif de décharge pour décharger du récipient l'effluent et les particules de catalyseur disposées à l'extrémité inférieure du récipient, caractérisé en ce que le réseau est disposé essentiellement perpendiculairement à la direction de l'écoulement du fluide, les parties des surfaces extérieures d'éléments guides adjacents en regard l'une de l'autre définissant un passage ayant, dans le sens de l'écoulement du fluide, une partie qui se rétrécit, une partie étroite et une partie qui s'élargit, et en ce que les éléments guides sont munis d'un dispositif pour introduire du fluide additionnel dans le passage, ce dispositif étant disposé le long de la partie qui se rétrécit ou bien au niveau ou à proximité de la partie étroite du passage.

6. Dispositif selon la revendication 5, caractérisé en ce qu'un élément guide comprend un couvercle d'amenée du fluide, triangulaire, comportant deux parois latérales et une paroi de fond, ce couvercle d'amenée du fluide étant supporté par une poutre support dont la surface extérieure a une section droite en forme de triangle retourné.

7. Dispositif selon la revendication 6, caractérisé en ce qu'une paroi latérale du couvercle d'amenée du fluide est formée par au moins deux bandes s'étendant le long de l'élément guide et disposées les unes au-dessus des autres de telle manière que la partie inférieure de la bande supérieure recou-

vre la partie supérieure de la bande inférieure, des passages de fluide étant disposés dans la zone où la bande supérieure recouvre la bande inférieure.

8. Dispositif selon la revendication 6 ou 7, caractérisé en ce que la paroi de fond du couvercle d'amenée du fluide est si large que la paroi de fond se prolonge au-delà de la poutre support, les dispositifs d'introduction de fluide additionnel comprenant des ouvertures disposées dans la partie de la paroi de fond se prolongeant au-delà de la poutre support.

9. Dispositif selon l'une quelconque des revendications 5-8, caractérisé en ce que la surface totale de la section droite des passages est dans l'intervalle de 30% à 60% de la surface de la section droite du récipient.

10. Dispositif selon l'une quelconque des revendications 5-9, caractérisé en ce que l'angle aigu entre la partie de la surface extérieure d'un élément guide définissant la partie qui se rétrécit du passage et la verticale est dans l'intervalle de 10° à 40°.

11. Dispositif selon l'une quelconque des revendications 5-10, caractérisé en ce que l'angle aigu entre la partie de la surface extérieure d'un élément guide définissant la partie qui s'élargit du passage et la verticale est dans l'intervalle de 3° à 10°.

12. Dispositif selon l'une quelconque des revendications 5-11, caractérisé en ce que le réacteur de conversion catalytique comprend deux ou plus de deux réseaux d'éléments guides disposés à différents niveaux dans le récipient.

13. Dispositif selon la revendication 12, caractérisé en ce que les éléments guides d'un réseau sont décalés par rapport aux éléments guides d'un réseau adjacent.

