

DESCRIPTION

The invention relates to a method for the separation of undesired components out of an exhaust gas by adsorption at a lumpy or granular adsorption medium, wherein the exhaust gas to be treated flows through at least one reaction space followed by at least one adsorption medium layer.

Furthermore, the invention relates to a device for the performance of this method.

The DE-A-26 26 939 shows a method of the kind according to the species, in which the exhaust gas within the reaction chamber is conducted through two layers wandering one parallelly to the other and the adsorption medium in the layer at the outflow side is moved at a higher speed and is loaded less than the layer upon the inflow side. As far-reaching as possible a purification of the exhaust gas is to take place by this known method, since still sufficient fresh adsorbant is offered to the exhaust gas at the outflow side. On the other hand, adsorbant which has been exploited to only a limited degree must be drawn off and regenerated continuously in a relatively thick layer at the outflow side. The reaction chamber is subdivided by vertical partitions. The individual compartments are supplied with adsorption medium from a central filling opening and have discharge openings or funnels associated with the individual layers.

It is known from the DE-C-34 27 905 to even out the adsorbant particle flow by fittings across the cross-section of the fluidised bed.

The DE-A-352 3417 shows a fluidised bed reactor with a distributor base of funnels connected together at the head part, in which the exhaust gas is guided from below into the fluidised bed and

In known adsorption apparatuses, essential parts, in particular the hopper funnel in the head region and the discharge funnel in the foot region of the reactor, cannot be reached or only insufficiently by the exhaust gas flowing across. The consequence are hot spots (heat concentrations) up to sources of fire in the head region and condensate collections connected with particle encrustations in the foot region of the reactor.

The invention is based on the task of taking care of a better throughflow of the adsorption medium bed by the exhaust gas to be treated and to avoid operational disturbances particularly in the critical head and discharge regions of the adsorber.

Starting out from a method of the initially named kind, the invention provides for the solution of this problem that the adsorption medium is introduced, distributed in the shape of a raster, into and withdrawn from the reaction chamber through several separate charging and discharging funnels and the exhaust gas is introduced partially from the side transversely to the adsorption medium layer and partially from above over the loose material cones formed by the charging funnels and led through the reaction chamber so that the adsorption medium participates in the adsorption substantially uniformly in all zones of the reaction chamber. It is in that case particularly advantageous, that, on the one hand, the exhaust gas is conducted through at least two separate adsorption layers and that, on the other hand, the exhaust gas is introduced partially from above into the reaction chamber.

In terms of device, the solution of the aforementioned problem consists according to the invention in that the charging means are formed by a raster of several charging funnels arranged one beside and behind the other and the discharging means are formed by a further raster of discharging funnels arranged one beside and behind the other and exhaust gas passages are provided at at least one side as well as also in the head region of the reaction chamber.

The pockets of material, which are difficult to reach for the exhaust gas flow in the head and foot regions of the reactor are minimised by the division of the charging and discharging regions of the adsorption medium into a plurality of conical partial regions. Beyond that, the particle flow and the pourable material mechanics within the reaction chamber during the charging as well as also during the extracting of the adsorption medium are improved by the division into partial flows. Although the main flow of the exhaust gas is directed transversely to the adsorption medium column, fresh adsorbant in the head region of the reactor participates more strongly in the reaction due to the exhaust gas there led into the reaction chamber or led out of the reaction chamber.

Different harmful substances, such as for example SO_2 and NO_x , have as is known different reaction speeds with the usual active carbon adsorption media. The better adjustability, which is made possible by breaking-up of the charging and discharging cones, of the adsorption fronts

lets itself be utilised advantageously in development of the invention, thereby, that different undesired exhaust gas components, such as for example Hg, SO₂, HCl and NO_x, are separated in different vertical adsorption layers and conducted away out of the reaction chamber in separate flows. The adsorption media drawn off in separate flows can then be subjected to different further processing steps. The adsorption media flows, which are laden by particularly rapid reaction heavy metals, such as for example Hg, are removed separately. Similar also applies to adsorption medium which is laden by SO₂ and HCl. Sufficing both cases as adsorption medium is so-called hearth furnace coat (HOK), i.e. brown coal active coke, the regeneration of which is uneconomic. In the case of the NO_x reduction, thereagainst, pelletised mineral coal active carbon is preferred as adsorption medium. The price thereof makes the recovery and re-use in an NO_x reduction stage economically sensible.

In an expedient further development of the method, different speeds of flow are imparted to the exhaust gas on flowing through different adsorption layers. Such different speeds of flow are sensible particularly when different adsorption media, such as for example brown coal and mineral coal active coke come into use in a series connection of several adsorption layers or reaction chambers. The brown coal, which as a rule arises as a relatively fine-grained fraction mixture with a particle size between 1 and 4 millimetres, should be flowed through by the exhaust gas substantially more slowly than the mineral coal active coke which is as a rule pelletised uniformly, for example to four millimetres. If the same exhaust gas flow is conducted one after the other through several adsorption layers, the speeds of flow in these adsorption layers can be set through the dimensioning of the inflow surfaces respectively associated with the adsorption layers.

The invention is in itself independent of the kind of the adsorption medium bed used. By contrast to the usual fluidised bed methods, a fixed bed, which is not continuously exchanged, but cyclically, i.e. after extensive loading, preferably finds use in the invention. The use of fixed beds with particularly simple pourable material mechanics and operational manipulation offers itself for the invention by reason of the possibility of the exact setting of the adsorption fronts of different harmful materials and the better throughflow across the entire adsorption medium column.

A still more reliable prevention of the condensate formation in the foot region of the reactor lets itself be achieved in development of the invention thereby, that the discharge funnels and/or discharge pipes adjoining thereat are washed around by the exhaust gas and heated by the exhaust gas. The exhaust gas, which issues from a first reaction stage and is cleaned of at least some harmful substances, is guided back below the distributor base and thereby heats the discharge funnels and their discharge pipes filled with the adsorption medium.

A part of the exhaust gas can however also be introduced into the reaction chamber from below through the adsorption medium discharge funnels. The effect of that part of the exhaust gas to be purified, which is introduced so-to-speak in counter current from below, corresponds to that exhaust gas partial flow which is introduced or extracted at the head side, i.e. the adsorption medium quantity disposed in the funnels at the discharge side participates directly in the adsorption so that also small residues of still unladen grains are exploited completely before their discharge.

Since a separate separation of different harmful substances in different vertical adsorption medium layers or reaction stages one behind the other is possible with the aid of the method according to the invention, the method according to the invention is particularly suitable for the complex flue gas purification in refuse incineration plants, in which typically greatly different harmful substances arise. The invention enables a separation of greatly different components in a basically uniform on-line process.

A preferred embodiment of the device according to the invention, which combines the advantages of a particularly compact mode of construction with optimum adjustability of the inflow surfaces and exhaust gas speeds in the individual adsorption layers, distinguishes itself according to the invention thereby, that at least two annular reaction chambers are arranged concentrically in a cylindrical housing, that both the annular spaces are each flowed through substantially radially by the exhaust gas flow and are connected in series for the exhaust gas flow and that the inflow surface of the first annular space, as seen in flow direction for the exhaust gas flow, is greater than the inflow surface of

the second annular space as seen in flow direction for the exhaust gas flow. A compact mode of construction as well as also short flow paths result in the case of an intercalation of the at least two annular spaces. The size of the predominantly cylindrical inflow surfaces lets itself be set simply by suitable dimensioning of the radii. A uniform flow in the at least two annular spaces lets itself be achieved by radial flow through the annular spaces or the annular adsorption medium beds.

Expedient developments of the device according to the invention are characterised in the subclaims. Partial combinations and subcombinations of the features of the patent claims also count as disclosed to be significant for the invention.

The invention is explained more closely in the following with the aid of examples of embodiment illustrated schematically in the drawing. In the drawing, there show:

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| Figure 1 | a vertical section through an example of embodiment of the adsorption device according to the invention, |
| Figure 2 | a view along the section line II-II in Figure 1, |
| Figure 3 | a view corresponding to Figure 1 onto a modified example of embodiment of the invention, |
| Figure 4 | a vertical section through another example of embodiment of the adsorption device according to the invention and |
| Figure 5 | a sectional view along the section line V-V in Figure 4. |

The adsorber 1, which is illustrated in vertical and horizontal sections in the Figures 1 and 2, has a raw gas inlet 2 and a pure gas outlet 3. Between the inlet and the outlet, the exhaust gas flows through a first reaction stage 4 and a second reaction stage which is divided into two parallelly connected reaction chambers 5a and 5b (Figure 2).

The first reaction stage 4 has a reaction chamber 14, which is rectangular in cross-section and in operation filled by a pourable material bed of lumpy or granular adsorption medium. The chamber 14 is bounded at the inlet side by louver shutters 15 extending over the full height of the chamber and at the outlet side by louver shutters 16 reaching only to a

limited height. The adsorption medium charging takes place from a stock container 7, which is placed onto the chamber 14, by way of a distributor base 8 at the head side. The distributor base consists of a raster, which is uniform in the illustrated example of embodiment, of square charging funnels 18, which are arranged one beside and behind the other in rows and columns and adjoined by charging pipes 19 opening into the chamber 14.

An intermediate base 8a is built in at about half the height of the chamber 14. It serves above all for the relief of pressure in the case of high adsorption beds and in the illustrated example of embodiment has the same structure and arrangement (raster of charging funnels 18a and charging pipes 19a and blocking section 30a) as the distributor base 8. The exhaust gas conduction through the heaped cones underneath the intermediate base 8a also corresponds to that in the head region. The installation of one or more intermediate bases 8a into the reaction chamber is not necessary, but frequently expedient.

A discharge base 9 is built up similarly to the distributor base 8 of a raster of discharge funnels 20 arranged one beside and behind the other. The discharge funnels 20 are adjoined by discharge pipes 21 or 22. The discharge pipes 21 are closed by closure elements, such as flaps or slides 23, and the discharge pipes 22 are closed by closure elements 24. The closure elements 23 and 24 are actuated in known manner for the extraction of the heaped material from the chamber 14. The discharge pipes open into different collecting containers 25 and 26, from which the adsorption medium laden with the separated harmful substances can be conducted away for further processing with the aid of suitable conveying means, here illustrated as bucket wheel sluice 27 and 28.

The pourable material layer, which corresponds to the inlet row 18' of charging funnels and correspondingly also of discharge funnels 20, is preferably divided off from the remaining pourable material column by a suitable louvre shutter 17 or other suitable guide elements (Figure 3) so that the adsorption layer 40 between the inlet louvre shutters 15 and the partition 17 lets itself be conveyed away separately by way of the associated discharge funnels 20, discharge pipes 21, collecting container 25 and conveying device 27. The corresponding applies of course also to the pourable material layers 41 on the outflow side of the partition 17.

The raw gas inlet 2 widens out to the entire height dimension of the reaction chamber 14 and namely up to the region of the charging funnels 18 and charging pipes 19. The exhaust gas can therefore enter into the adsorption medium bed from the side through the louvre shutters 15 as well as also between the charging pipes 19 from above through the pouring cones 37, as illustrated by the solid arrows A in Figure 1. The exhaust gas can therefore reach all pourable material bed zones not only in the case of a fluidised bed, but also in the case of a fixed bed. Thereby, practically all particles participate in like manner in the reaction.

A blocking section in the shape of closed wall 30, which prevents a short-circuit of the exhaust gas from above directly into the outlet channel 31, is provided at the exit side between the uppermost layer (pouring cone 37) and the upper end of the outflow side louvre shutters 16.

The outlet channel 31 passes over into an horizontal channel portion 32, which extends below the discharge base 9. The preliminarily purified exhaust gas, which leaves the reaction chamber 14 through the outlet channel 31, washes around the discharge funnels 20 and the discharge pipes 21 and 22 in the channel portion 32 and in that case heats the adsorption medium disposed in these elements so far that a condensation is reliably prevented. The exhaust gas is deflected upwardly out of the channel portion 32 into an exhaust gas inlet region 35a and 35b for both the chambers 5a and 5b of the second reaction stage (Figure 2). The exhaust gas distribution in both the chambers 5a and 5b corresponds in principle to the aforescribed exhaust gas distribution at the inlet louvre shutters 15 and the head heaped cones 37 of the first reaction stage 4. Charging and discharging funnels are also arranged in raster shape in both the chambers 5a and 5b in order to assure as uniform as possible a participation of the adsorption medium in the entire interior space of the chambers 5a and 5b. The discharge of the laden absorption medium however as a rule takes place simultaneously through all discharge funnels and pipes of the second reaction stage 5a and 5b. The outlet channels 36a and 36b, too have a structure corresponding to the outlet channel 31 in the region of the outflow side louvre shutters of both the reaction chambers 5a and 5b so that a large area crossflow of the exhaust gas is also taken care of in the chambers 5a and 5b. Both the channels 36a and 36b unite in the pure gas outlet 3 according to the illustration in Figure 2.

Both the reaction stages 4 and 5 are arranged one beside the other, wherein the second reaction stage is divided up into two partial chambers 5a and 5b. This combination combines the advantages of a compact mode of construction with a good utilisation and loading of the adsorption media and simple possibilities of control of the adsorption fronts.

The channel portion 32 can in some circumstances also be made so wide that it extends over the full width of the three reaction chambers 5a, 4 and 5b, which are arranged one beside the other, and thereby also heats the discharge pipes of the chambers 5a and 5b.

As is to be seen in the Figures 1 and 3, the reduction medium NH_3 is injected at the deflection point between the outlet channel 31 and the horizontal channel portion 32. Of course, other charging points or a preliminary loading of the mineral coal active coke in the chambers 5a and 5b are also possible.

The invention is not subject to any special conditions of exception also in respect of the shapes and dimensions of the individual funnels 18 and 20. The illustrated square or, in a given case, a rectangular cross-sectional shape takes care of a particularly large area utilisation of the cross-sectional area in the distribution of the pourable material and of favourable pourable material mechanics. Other shapes are however possible with in principle the same advantages of the invention.

Frequently, differently large inflow areas of both the reactor stages, in particular larger inflow areas of the first stage 4 relative to the second stage 5, are expedient in order to achieve an exhaust gas flow speed matched to the pourable material and the adsorption behaviour. The first reactor stage can in place of the second reactor stage be divided up into two parallel partial chambers especially for enlargement of its inflow areas. The exhaust gas conduction is then of course the converse of that of the illustration in Figure 2.

New pourable material for the exchange of consumed adsorption medium is disposed in the collecting containers 7 separated for all chambers 5a, 4 and 5b. It is important that a separation of the laden adsorption medium takes place in the case of the adsorption of highly toxic substances and less aggressive media. This occurs in the described arrangement simply by the adsorption medium layers being drawn off into separate collecting

containers 25 and 26 (or into collecting containers of the chambers 5a and 5b) in correspondence with different adsorption fronts and conveyed further from there. Different adsorption layers 40 and 41 of that kind are illustrated in Figure 3. For example, the largest part of heavy metals, in particular Hg, can be adsorbed in the entry side adsorption layer 40 and drawn off by way of the discharge pipes 21 and the collecting container 25.

The example of embodiment illustrated in Figure 3 differs from the example of embodiment according to Figure 1 however also in that the distributor base 8' is arranged to be rising from the inlet side towards the outflow side of the reactor 1'. Thereby, the blocking path 30' is prolonged with the structure of the adsorber 1' for the remainder remaining the same. The sectional view according to Figure 2 applies also to the example of embodiment according to Figure 3.

The raw gas inlet 2 can however also reach to below the discharge base 9, for which suitable openings towards the interior space of the reaction chamber 14 are then formed in the discharge funnels 20, through which openings the raw gas can enter, but no granular adsorption medium can come out into the exhaust gas entry distributor. Such inflow bases are for example known from the DE-GM G 87 06 893.8. In the case of the construction of the discharge base 9 as inflow base, a blocking path corresponding to the wall 30 must also be provided at the rear wall directly above the base 9 in order to avoid exhaust gas short-circuits towards the outer channel 31.

A blower 38 is arranged with a connecting duct between the larger connecting container 26 and the channel portion 32 and serves to break up possible clumps in the individual funnels or in the discharge pipes by means of an artificially forced flow at the beginning of the discharge of adsorbant.

In the Figures 4 and 5, a preferred embodiment of a two-stage reactor 40' is illustrated, the essential components of which are built into a cylindrical reactor housing 41'. Two annular reaction chambers 44 and 45 are arranged concentrically intercolated one into the other in the housing 41'. The annular spaces 44 and 45 in the described example of embodiment are filled with different adsorption media, for example the outer annular space 44 with brown coal coke and the inner annular space with pelletised

mineral coal active carbon. Correspondingly, the outer annular space 44 serves for the separation of the better adsorbable harmful substances (corresponding to the first stage 4 of the aforescribed example of embodiment) at the inner annular space 45 for the NO_x reduction corresponding to the chambers 5 of the aforescribed example of embodiment. The first and second annular spaces 44 and 45 are each surrounded by respective annular exhaust gas outlet channels 46 and 47. The exhaust gas inlet 48 is likewise an annular channel which is arranged on the radially inward side of the annular space 44. The exhaust gas inlet of the inwardly disposed second reactor stage 45 is a central channel 49, which extends along the centre line 50 of the reactor 40'. The annular exhaust gas inlet 48 of the first reactor stage 44 and the likewise annular exhaust gas outlet 47 of the second reactor stage 45 are separated by a partition 51, which is cylindrical in the present case.

A helically shaped entry channel 52 is arranged in the head region of the reactor housing 41' co-axially about its centre line 50 and connected with the annular channel 48 serving as exhaust gas inlet of the first reaction stage 44. By reason of the helically shaped arrangement of the entry channel 52, the exhaust gas, which is to be cleaned and in some circumstances laden with solid substance particles and/or water droplets, receives a relatively strong spin which urges the particles or droplets of higher weight outwardly into the region above the hopper funnels 37 and between the charging funnels or pipes 18 and 19 of the first reaction stage. The construction and arrangement of the charging and discharging funnels as well as the introduction of the exhaust gas into both the reaction stages 44 and 45 correspond to the conditions explained by reference to the Figures 1 to 3. Due to the circular arrangement and subdivision of the distributor bases 8 and the discharge spaces 9, the funnels 18 and 20 however preferably have a trapezoidal structure, as is recognisable from the left-hand half of the Figure 5.

The construction of the louvre shutters or other partition elements for bounding the reaction chambers 44 and 45 can also correspond to that of the aforescribed example of embodiment, wherein however the partitions 55 and 56 (or 65 and 66) at the inflow and outflow sides have a structure, which is approximated to circularly annular shape through adequate segmentation, in correspondence with the chamber cross-section.

As already mentioned, the unpurified exhaust gas enters through the entry channel 52, which imparts a spin, into the reactor housing 41, reaches the predominantly cylindrical inflow areas in the region of the partition elements 55, crosses the annularly shaped first reaction stage 44, issues at its outflow side through the partition elements 56 at the outflow side into the outer annular channel 46, is deflected downwardly into a circularly shaped flow chamber 58 and there flows radially inwards in direction of the central exhaust gas inlet 49 of the second reaction stage 45. In the circularly shaped flow chamber 58, the exhaust gas washes around the discharge funnels 20 and the discharge pipes 22 similarly as for the aforescribed example of embodiment. The exhaust gas, which is freed of the more rapidly adsorbed harmful substances, i.e. partially purified, is initially distributed axially in the central exhaust gas inlet 49 and flows from there according to the arrows in cross flow or between the charging pipes 19 from above into the pourable material ring of the second reaction stage 45. The partition elements 65 separate the pourable material ring 45 at the inlet side and the partition elements 66 at the outlet side from the adjoining exhaust gas channels 49 and 47, respectively. The outlet side exhaust gas channel 47 opens in the head part into a discharge funnel 59 from where the pure gas can be led into a centrally arranged chimney 60.

The inflow area, which corresponds to the partition elements 55, of the first reaction stage 45 is larger in about the ratio of the radii than the inflow surface 65 of the second reaction stage 45. Correspondingly, the flow speed of the exhaust gas in the first annular space is smaller by comparison with that in the second annular space 45. This is also desired, in particular on the use of the different adsorption media in both the annular spaces 44 and 45.

Arranged above the annular charging bases 8 are likewise annular stock chambers 61 and 62. A motor-driven distributing device in the shape of a rotating rake 63 is arranged in or above the inner stock chamber 62. The rotating rake 63 levels the pourable material situated in the annular chamber 62 even in the case of charging by way of a single fixed charging nipple 64.

The stock chamber 61 associated with the first reaction stage 44 is charged with the aid of a rail track 67 through cover wall openings 68

distributed in circular shape about the centre line 50. The track runs on a rail ring 69 likewise concentric with the centre line 50. Preferably, the track is provided with means for the air-tight docking at the charging openings 68, a load space closable to be air-tight and a blower for the pressure-charging of the loading space. With this construction, the excess pressure, which prevails in the reaction chamber 44 and thereby also in the stock chamber 61, can be compensated for in the loading space of the track 67 so that no flue gas can issue into the track and from there into the ambient atmosphere.

The invention is not restricted to the illustrated examples of embodiment. Thus, it is readily possible within the scope of the invention to operate with a single adsorption layer. The flow direction of the exhaust gas can also for example be reversed in Figure 1 so that the raw gas enters into the adsorber 1 at 3 and leaves it at 2. An exit of the raw gas from the adsorption layer then takes place at the head side.



CLAIMS

1. Method for the separation of undesired components out of an exhaust gas by adsorption at a lumpy or granular adsorption medium, wherein the exhaust gas to be treated flows through at least one reaction space filled with at least one adsorption medium layer, the adsorption medium is introduced, distributed in the shape of a raster, into and withdrawn from the reaction space through several separate charging and discharging funnels and the exhaust gas is introduced partially from the side transversely to the adsorption medium layer and partially from above over the loose material cones formed by the charging funnels and led through the reaction space so that the adsorption medium participates in the adsorption substantially uniformly in all zones of the reaction space.
2. Method according to claim 1, characterised thereby, that different undesired exhaust gas components, for example Hg, SO₂, HCl and NO_x, are separated out in different vertical adsorption layers and conducted away out of the reaction space in separate flows.
3. Method according to claim 1 or 2, characterised thereby, that different adsorption media, for example hearth furnace coke and active coal coke, are used in at least two different adsorption layers.
4. Method according to claim 3, characterised thereby, that the exhaust gas flows at different speeds of flow through at least two different adsorption layers.
5. Method according to claim 4, characterised thereby, that the same exhaust gas flow is led through the adsorption layers one after the other and the speeds of flow are set by dimensioning of the leading surfaces associated with the adsorption layers.
6. Method according to one of the claims 2 to 5, characterised thereby, that the adsorption media drawn off in named layers are subjected to different further processing steps.
7. Method according to one of the claims 1 to 6, characterised thereby, that the reaction space is filled and emptied charge by charge and that the exhaust gas treatment takes place in at least one fixed bed.



8. Method according to one of the claims 1 to 7, characterised thereby, that the discharge funnels and/or discharge pipes thereat are flowed around and heated by the exhaust gas.

9. Method according to one of the claims 1 to 8, characterised thereby, that heavy metals are separated out from the exhaust gas in a first adsorption layer, easily adsorbable gaseous components, such as SO_2 and HCl , are separated out from the exhaust gas in a second adsorption layer and the exhaust gas is finally subjected to a NO_x reduction in a further reaction stage.

10. Method according to one of the claims 1 to 9, characterised thereby, that a part of the exhaust gas is led into the reaction space from below through the adsorption medium discharge funnels.

11. Use of the method according to one of the claims 1 to 10 for the flue gas purification in refuse incineration plants.

12. Device for the separation of undesired components out of an exhaust gas, with a reactor (4), which bounds at least one reaction space (14) and comprises charging means at the head end and funnel-shaped discharging means at the foot end for the charge and discharge of a lumpy or granular adsorption medium, wherein the charging means are formed by a raster of several charging funnels (18) arranged one beside and behind the other and the discharging means are formed by a further raster of discharging funnels (20) arranged one beside and behind the other and exhaust gas inlets are provided at at least one side as well as also in the head region of the reaction space (14).

13. Device according to claim 12, characterised thereby, that the reaction space (14) is subdivided by at least one row of partition elements (16, 17) into at least two reactor compartments (40, 41) extending substantially vertically and transversely to the direction of flow of the exhaust gas and that each reactor compartment comprises several charging funnels and discharging funnels (20) with separately actuatable closure and/or metering devices (23, 27 and 24, 28).



14. Device according to claim 13, characterised thereby, that the ~~partition elements~~ are constructed as louvre shutters (16) or double louvre shutters (17).

15. Device according to one of the claims 12 to 14, characterised thereby, that at least two separate reaction chambers (4, 5a, 5b; 40, 41), which are each fillable and emptiable independently of the other, are arranged one spatially beside the other and connected one behind the other for the exhaust gas flow.

16. Device according to one of the claims 12 to 15, characterised thereby, that the discharge funnels (20) and/or discharge pipes (21, 22) adjoining thereat are arranged in the flow path (32) of the exhaust gas to be purified.

17. Device according to claim 12, characterised thereby, that an exhaust gas channel (32) is connected downstream of the exhaust gas outlet (31) of a reactor stage (4) and arranged below its base (9) in such a manner that the discharge funnels (20) and pipes (21, 22) are flowed around by the exhaust gas while being heated.

18. Device according to one of the claims 12 to 17, characterised thereby, that the funnel raster (20) at the foot end is provided with openings for the passage of the exhaust gas to be purified and that the openings are connected with the exhaust gas inlet (2).

19. Device according to one of the claims 12 to 18, characterised thereby, that the exhaust gas inlet (2) extends over about the entire height of the reactor space, whilst the exhaust gas outlet (31) spans only a limited height on the exit side of the reactor (4) in order to avoid flow short-circuits in the head region of the reaction space.

20. Device according to claim 17, characterised thereby, that a first reactor stage (4) is flanked at both sides by second reactor stages (5a, 5b) and that the exhaust gas flow, which is led back below the base (9) of the first reactor stage (4), is divided up into at least two parallel partial flows and introduced into both the reactor stages (5a, 5b) flanking the first reactor stage (4).



21. Device according to one of the claims 12 to 20, characterised thereby, that several rows (18') of charging funnels (18) are arranged at stepped heights one behind the other out from the exhaust gas inlet (2).

22. Device for the separation of undesired components out of an exhaust gas, with a reactor (40'), which bounds at least one reaction space (44, 45), wherein the reaction space (44, 45) is constructed according to the claims 12 to 19, characterised thereby that, at least two annular reaction spaces (44, 45) are arranged concentrically in a cylindrical housing (41'), that both the annular spaces (44, 45) are each flowed through substantially radially by the exhaust gas flow and connected in series for the exhaust gas flow and that the leading surface of the first annular space (44) - as seen in direction of flow for the exhaust gas flow - is greater than the leading surface of the second annular space (45) - as seen in direction of flow for the exhaust gas flow.

23. Device according to claim 22, characterised thereby, that the leading and trailing surfaces of both the annular spaces (44, 45) are so arranged that the annular spaces are flowed through substantially radially from the inside outwardly by the exhaust gas.

24. Device according to claim 23, characterised thereby, that the first and second annular spaces (44, 45) are surrounded by annular exhaust gas outlet channels (46, 47), that the exhaust gas inlet for the first annular space (44) is likewise formed as annular channel (48) and that the exhaust gas inlet (48) of the first annular space and the exhaust gas outlet (47) of the second annular space (45) are separated by a cylindrical partition (51).

25. Device according to claim 24, characterised thereby, that the annular channel (46) forming the exhaust gas outlet of the first annular space (44) is bounded by the outer reactor wall.



26. Device according to one of the claims 22 to 25, characterised thereby, that a circular flow chamber (58), which connects the exhaust gas outlet (46) of the first annular space (44) with the exhaust gas inlet (49) of the second annular space (45), is arranged below the discharge bases (9) in such a manner that the discharge funnels (20) and/or discharge pipes (22) are flowed around and heated by the partially purified exhaust gas flowing radially inwards from the outside.

27. Device according to one of the claims 22 to 26, characterised thereby, that a helically shaped entry channel (52) is arranged in the head region of the reactor housing (41) around the central axis (50) thereof and connected with the exhaust gas inlet (47) of the first annular space (44).

28. Device according to one of the claims 22 to 27, characterised thereby, the charge bases (8) and the discharge bases (9) are structured to be annular and their funnels (18, 20) are structured to be trapezoidal.

29. Device according to one of the claims 22 to 28, characterised thereby, that annular reservoir chambers (61, 62) are arranged above the annular charge bases (8).

30. Device according to claim 29, characterised thereby, that a motor-driven rotating distributor device (63) is borne in one annular reservoir chamber (62) on a rotational axis co-inciding with the vertical housing axis (50).

31. Device according to claim 29 or 30, characterised thereby, that uniform charging openings (68) are arranged distributed at equal spacing about the housing axis (50) in a ceiling wall of one annular reservoir chamber (61) and that a rail ring (69) is arranged at a corresponding spacing above the ceiling wall.



32. Device according to claim 31, characterised thereby, that a rail vehicle (67) running on the rail ring (69) is provided with means for the preferably air-tight docking at the charging openings (68), a charging space which is closable to be air-tight and a blower for the pressure loading of the charging space.