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System for Purifying Gas

The invention relates to a system for purifying gas comprising at least one housing with a first chamber into which the gas to be purified can flow and a second chamber, which forms a filter chamber, from which the purified gas issues and which contains a filter device through which the gas can flow and which has filter media for both separating out solid particles and also for dehydrating the gas for precipitation of the coalesced fluid, wherein the first chamber comprises a cyclone that serves to pre-dehydrate the gas and from which the dirt particles and fluids can be discharged into a third chamber of the housing.

Systems of this type that are designed not only to eliminate pollutants due to solid loading, but also to dehydrate the relevant gaseous media, are known and are also referred to as coalescers if the fluid particles coalesce on the filter device located inside a housing. Systems of this type are often used in conjunction with exhaust gas-generating processes, where exhaust gas flows of comparatively high temperatures and optionally very high pressures are handled. In light of these requirements, a system of the above-described type that is known from document DE 10 2005 062 245 A1 has a housing that is designed as a pressure-tight container.

On the basis of this prior art, the object of the invention is to provide a system of this type that can be manufactured in a simple and efficient way at low production costs.

This object is achieved according to the invention by a system having the features specified in claim 1 in its entirety.

According to the characterizing part of claim 1, the major distinction with respect to the prior art lies in the fact that the housing comprises individual components, that is, an upper housing part comprising the chamber forming the filter chamber, a middle housing part comprising the chamber containing the cyclone, and a lower housing part forming a third chamber, wherein the housing parts can be clamped together by means of at least one tie rod in order to form the closed pressure container. Constructing the housing from a plurality of housing parts that are clamped together significantly simplifies the processing steps, as compared to a housing design wherein the housing wall extends over more than one inner working chamber, because there is no need to provide different working chambers inside the individual housing sections. In addition, the assembly work is simplified, because the system components, such as the filter device, the filter element holder, and the cyclone, that are to be installed are easier and simpler to install into the individual housing parts than into a housing that extends over several working chambers.

In advantageous exemplary embodiments, the lower housing part has the form of a cup that encloses the third chamber, which is connected to the outlet of the cyclone and has a bottom that forms the anchorage for several tie rods. The cup bottom, which can be constructed with a suitable wall thickness, forms an especially secure anchorage base for an appropriate number of tie rods, so that the housing parts can be securely clamped together, in order to form a composite container that is pressure tight.

In addition, the arrangement is configured preferably in such a way that the side wall of the cup of the lower housing part is formed by a cylinder jacket with a wall thickness that is adequate enough for the passage of several tie rods extending parallel to the cylinder axis.

In order to achieve a particular structural strength, the tie rods can be arranged on a circular line that concentrically encircles the interior of the cup, so that the clamping forces act in a distributed manner relatively uniformly over the periphery of the housing.

In an especially advantageous way, the cylinder jacket of the middle housing part is contiguously aligned with the cylinder jacket of the lower housing part, wherein the tie rods extend through the cylinder jacket of the middle housing part as far as into the cylinder jacket of the upper housing part, which is also contiguously aligned with the cylinder jacket of the middle housing part and with which the ends of the tie rods are screwed together. As a result, each tie rod forms a clamping means, which clamps the lower housing part and the upper housing part against the middle housing part located between said upper and lower housing part.

In especially advantageous exemplary embodiments, the butt joint between the cylindrical jackets of the upper housing part and the middle housing part and the butt joint between said middle housing part and the lower housing part can exhibit plane surfaces that form metal sealing surfaces subject to the action of the clamping force of the tie rods. Owing to the clamping force of the tie rods acting as the sealing force, the pressure-tight sealing of the housing is guaranteed so that there is no need to install sealing arrangements between the housing parts.

The installation of the system components into the housing can be done in an especially simple and advantageous way so that a transition piece is axially secured in position at the butt joint between the upper housing part and the middle housing part. Said transition piece has a ring

flange, which is clamped at the butt joint, and forms the element holder for a filter element of the filter device located in the second chamber.

In an analogous manner, a second transition piece can be axially secured in position at the butt joint between the middle housing part and the lower housing part. Said second transition piece is clamped at the butt joint with a ring flange and forms a component of the cyclone.

The arrangement can be configured in such an especially advantageous way that the cylinder jacket of the lower housing part has at least one passage for a forcing rod, which extends parallel to the axis from the bottom to the butt joint on the cylinder jacket of the middle housing part and can be pushed against the cylinder jacket of the middle housing part by means of the forcing screw of the bottom part. Such exemplary embodiments are distinguished by especially good operating behavior, because opening the housing – for example, for maintenance work – can be done very simply and easily because after loosening the tie rods, the lower housing part can be easily detached by means of the forcing rod from the middle housing part even if said middle housing part is firmly seated at the butt joint.

In an analogous manner, at least one additional forcing rod in a passage of the cylinder jacket of the middle housing part can be pressed against the butt joint of the upper housing part on its cylinder jacket so that the upper housing part and the middle housing part can also be separated from one another, if desired, even if they are firmly seated at the butt joint.

The invention is explained in detail below with reference to one exemplary embodiment depicted in the drawings.

- FIG. 1 is a highly schematized, perspective oblique view of an exemplary embodiment of the inventive system, wherein the wall portions of the housing are rendered transparent for a better understanding of the construction, and
- FIG. 2 is a schematic drawing of a simplified longitudinal view of the exemplary embodiment from FIG. 1.

A housing, which is designated as a whole as 2, has a middle housing part 4 that surrounds an inner chamber 6, an upper housing part 8 that surrounds a second inner chamber 10, and a lower housing part 12, in which a third inner chamber 14 is located. The upper housing part 8 has as a side wall a cylinder jacket 16, the upper end of which is screwed to a housing cover 18, which forms a pressure-tight housing closure. The side wall of the middle housing part 4 is formed by a cylinder jacket 20. In the drawing, the upper end of said cylinder jacket is in contiguous alignment with the bottom end of the cylinder jacket 16 of the upper housing part 8. The bottom end of the cylinder jacket 20 of the middle housing part 4 is in turn contiguously aligned with the cylinder jacket 22 of the lower housing part 12. The latter has the shape of a cup with a bottom that is designated as 24 and that sealingly closes the inner third chamber 14, which serves as a dirt and fluid chamber, except for a discharge port 26, which can be closed by a device (not illustrated) and can be opened to remove the content substances of the chamber 14. A gas inlet pipe connection 28 for the infeed of the gas to be cleaned empties into the first chamber 6 of the middle housing part 4. A gas outlet, through which the cleaned gas can flow out of the third chamber 14 located in the upper housing part 8, is designated as 30.

As most clearly seen in FIG. 1, the housing parts 4, 8, and 12 are clamped together so as to form a unified, pressure-tight housing 2 by means of tie rods 32 in the form of steel rods. The tie rods 32 extend with their ends (lower ends in the drawing) through bores, which are arranged in a uniformly distributed manner on a circular line, which is concentric to the cylinder axis, in the bottom 24 of the lower housing part 12, and said tie rods extend through the passages in the

cylinder jacket 22 of the lower part 12 and the passages in the cylinder jacket 20 of the middle part 4 as far as to the threaded bores in the cylinder jacket 16 of the upper part 8, where they are screwed together with their outer thread 34. The ends of the tie rods 32 that extend through the bottom 24 of the lower part 12 also have an outer thread with which the tightening nuts 36 are screwed to the outside of the bottom 24. Hence, by tightening the nuts 36, the upper housing part 8 can be clamped at the butt joint 38 against the middle housing part 4; and similarly the lower housing part 12 can be clamped at the butt joint 40 against the middle housing part 4. At the butt joints 38 and 40, the cylinder jackets 16, 20, and 22 which are in alignment with one another form plane surfaces that act as a metal seal, subject to the action of the sealing force generated by the clamping force of the tie rods 32, so that the housing parts 4, 8, and 12 are connected together so as to be pressure tight.

The cylinder jacket 22 of the lower housing part 12 has, besides the passages for the tie rods 32, two additional passages 42 that extend parallel to the axis (see FIG. 2). A forcing rod 44 is located in each passage. The bottom ends of the forcing rods 44 terminate in front of the threaded bores 46 in the bottom 24, whereas the upper ends of the forcing rods 44 are adjacent to the butt joint 40 on the cylinder jacket 20 of the middle housing part 4. When the forcing screws (not illustrated) are turned into the threaded bores 46 of the bottom 24 and when the tightening nuts 36 on the tie rods 32 are loosened, the lower housing part 12 can be pushed away from the middle housing part 4 by means of the forcing rods 44, if an opening of the housing 2 is desired. In an analogous manner, the forcing rods 48 extend from the cylinder jacket 22 at the butt joint 40 through the passages of the cylinder jacket 20 to the butt joint 38, where they rest against the cylinder jacket 16 of the upper housing part 8, so that, when the forcing rods 48 are moved upward by means of the forcing screws (not illustrated), the upper housing part 8 can also be pushed away from the middle housing part 4.

In order to install the system components that are necessary for operating as a gas purifier, a transition piece 50 is inserted between the upper housing part 8 and the middle housing part 4 at the butt joint 38. The upper end of this transition piece forms the element holder 52 for the filter element 54 of the filter device that is located in the second chamber 10. The bottom end of this transition piece 50 which is designed as a hollow body forms a connecting piece 56, which projects into the first chamber 6, as a connection between the gas inflow chamber 6 and the inner filter cavity of the filter element 54.

Between the latter chamber 6 and the third chamber 14, which serves as the dirt and fluid chamber, the lower housing part 12 has a second transition piece 58, whose conical interior, which is open toward the chamber 6 by way of an outlet 51, forms the cyclone 60. In the same way as the first transition piece 50, the second transition piece 58 is also axially secured in position inside the housing 2 by means of a ring flange 62 or 64, which protrudes slightly in the radial direction, each flange being clamped at the assigned butt joint 38 or 40 between the adjacent housing parts 4 and 8 or 4 and 12. Owing to the divided design of the composite housing 2, the installation and assembly of the inner system components, like the filter element 54, the element holder 52, and the cyclone 60, is especially easy and fast.

The operating principle of the system and the filter device that is used may correspond to the prior art. In particular, the type of design described in document DE 10 2005 062 245 A1 can be provided for the filter element 54 of the filter device.

Claims

1. A system for purifying gas comprising at least one housing (2) with a first chamber (6) into which the gas to be purified can flow and a second chamber (10), which forms a filter chamber, from which the purified gas issues and which contains a filter device through which the gas can flow and which has filter media (54) for both separating out solid particles and for dehydrating the gas for precipitation of the coalesced fluid, wherein the first chamber (6) comprises a cyclone (60) that serves to pre-dehydrate the gas and from which the dirt particles and fluids can be discharged into a third chamber (14) of the housing (2), characterized in that the housing (2) comprises an upper housing part (8) comprising the second chamber (10) forming the filter chamber, a middle housing part (4) comprising the first chamber (6) containing the cyclone (60), and a lower housing part (12) forming the third chamber (14), wherein the housing parts can be clamped together by means of at least one tie rod (32) in order to form a closed pressure container.
2. The system according to claim 1, characterized in that the lower housing part (12) has the form of a cup that encloses the third chamber (14), which is connected to the outlet (51) of the cyclone (60) and has a bottom (24) that forms the anchorage for several tie rods (32).
3. The system according to claim 2, characterized in that the side wall of the cup of the lower housing part (12) is formed by a cylinder jacket (22) with a wall thickness that is adequate enough for the passage of several tie rods (32) extending parallel to the cylinder axis.
4. The system according to claim 3, characterized in that the tie rods (32) are arranged on a circular line that concentrically encircles the interior of the cup.

5. The system according to claim 3 or 4, characterized in that the cylinder jacket (20) of the middle housing part (4) is contiguously aligned with the cylinder jacket (22) of the lower housing part (12), and that the tie rods (32) extend through the cylinder jacket (20) of the middle housing part (4) as far as into the cylinder jacket (16) of the upper housing part (8), which is also contiguously aligned with the cylinder jacket of the middle housing part and with which the ends of the tie rods (32) are screwed together.
6. The system according to claim 5, characterized in that the butt joint (38) between the cylindrical jackets (16 or 20 respectively) of the upper housing part (8) and the middle housing part (4) and the butt joint (40) between said middle housing part and the lower housing part (12) exhibit plane surfaces that form metal sealing surfaces subject to the action of the clamping force of the tie rods (32).
7. The system according to claim 5 or 6, characterized in that a transition piece (50) is axially secured in position at the butt joint (38) between the upper housing part (8) and the middle housing part (4), and that said transition piece has a ring flange (62), which is clamped at the butt joint (38), and forms the element holder (52) for a filter element (54) of the filter device located in the second chamber (10).
8. The system according to claim 6 or 7, characterized in that a second transition piece (58) is axially secured in position at the butt joint (40) between the middle housing part (4) and the lower housing part (12), and that said second transition piece is clamped at the butt joint (40) with a ring flange (64) and forms a component of the cyclone (60).
9. The system according to one of claims 3 to 8, characterized in that the cylinder jacket (22) of the lower housing part (12) has at least one passage (42) for a forcing rod (44), which extends parallel to the axis from the bottom (24) to the butt joint (40) on the cylinder jacket

(20) of the middle housing part (4) and can be pushed against the cylinder jacket (20) of the middle housing part (4) by means of a forcing screw from the bottom (24).

10. The system according to claim 9, characterized in that at least one additional forcing rod (48) in a passage of the cylinder jacket (20) of the middle housing part (4) can be pressed against the butt joint (40) of the upper housing part (8) on its cylinder jacket (16).