Claims

1. A filter module, especially for gas filtration purposes, the filter module comprising

one or more block-shaped units, each unit comprising

a plurality of filter elements having a longitudinal, porous tubular wall part having an open first end serving as a raw gas inlet and a closed second end, wherein said filter elements are arranged coextensive and in parallel orientation with their tubular wall parts, their open ends being all located on one side of the filter module serving as a feed side thereof, and

a plurality of clean gas ducts which are substantially coextensive with, oriented parallel to, and regularly interposed between the filter elements, the clean gas ducts being open at one end forming a clean gas outlet and closed at their opposite end, whereas the closed ends of the clean gas ducts being located at the feed side of the filter module, and whereas their open ends are located adjacent to a discharge side of the filter module opposite to the feed side of the filter module;

wherein said open ends of the filter elements and said closed ends of the clean gas ducts form a feed side surface of a block-shaped unit, and wherein said open ends of the clean gas ducts and said closed ends of the filter elements form a discharge side surface of a block-shaped unit;

said filter module further comprising at the discharge side a clean gas collecting and discharge arrangement extending across all of the clean gas outlets of the clean gas ducts of the one or more units and providing a clean gas discharge opening for the filter module, said clean gas collecting and discharge arrangement comprising one or more clean gas channels in fluid communication with said clean gas outlets of the clean gas ducts deflecting and directing the clean gas flow from the open ends of the clean gas ducts in a direction transverse to the vertical of the discharge side surface.

2. The filter module according to claim 1, the module is designed as a candle type filter module, comprising at one end thereof said clean gas discharge opening provided by the clean gas collecting and discharge arrangement, preferably further comprising at said one end a mounting flange.

3. The filter according to claim 1 or 2, wherein the clean gas ducts are defined by longitudinal sections of tubular wall parts of three or more of the filter elements, preferably wherein the tubular wall parts of adjacent filter elements are in direct contact with one another delimiting the clean gas ducts between their closed and open ends.

4. The filter module according to any one of claims 1 to 3, wherein the cross section of the tubular wall parts of the filter elements is of a polygonal, circular or oval shape.

5. The filter module according to any one of claims 1 to 4, wherein the tubular wall parts have a cross-sectional area corresponding to the area of a square with an edge length of about 3 to about 20 mm, preferably of about 5 to about 10 mm.

6. The filter module according to any one of claims 1 to 5, wherein the length of the tubular wall parts of the filter elements amounts to about 300 mm or less, preferably to about 30 to about 200 mm, more preferably about 50 to about 150 mm.

7. The filter module of any one of claims 1 to 6, wherein the one or more channels of the clean gas collecting and discharge arrangement have a height, measured as the clearance in the direction of the vertical of the discharge side surface of the block-shaped unit(s), in the range of from about 0.1 to about 0.7 times, preferably about 0.3 to about 0.5 times the length of the tubular wall parts of the filter elements.

8. The filter module according to any one of claims 1 to 6, wherein the filter module comprises
one or more first block-shaped units, the filter elements of which opening in a first direction and
one or more second block-shaped units, the filter elements of which open in a second direction,
the first and second block-shaped units being arranged back-to-back with their discharge side surfaces and spaced apart from and facing one another,
said clean gas collecting and discharge arrangement being positioned in between said first and second block-shaped units receiving clean gas from the first and second block-shaped units;
preferably, the one or more channels of the clean gas collecting and discharge arrangement have a height, measured as the clearance in the direction of the vertical of the discharge side surfaces of the block-shaped unit(s), in the range of from about 0.2 to about 1.4 times, more preferably about 0.6 to about 1 times the length of the tubular wall parts of the filter elements.

9. The filter module according to any one of claims 1 to 8, wherein the tubular wall parts and optionally the closed ends of the filter elements and/or the clean gas ducts have an average pore size of about 0.1 to about 150 µm, preferably of about 1 to about 100 µm, more preferably of about 2 to about 10 µm.

10. The filter module according to any one of claims 1 to 9, wherein the tubular wall parts and optionally the closed ends of the filter elements and/or the clean gas ducts are made of a ceramic material, metal or plastic material.

11. The filter module according to any one of claims 1 to 10, wherein the tubular wall parts of the filter elements are arranged with respect to the

vertical of the feed side surface of the filter module at an angle of from about 10° to about 60°, preferably from about 30° to about 60°.

12. The filter module according to any one of claims 1 to 11, wherein the one or more channels of the clean gas collecting and discharge arrangement are oriented with their longitudinal direction in an angle of about 30° or more, preferably of about 60° or more, more preferably of about 90° to the surface of the discharge side of the filter module.

13. The filter module of according to any one of claims 1 to 12, wherein the block-shaped units comprise a safety fuse element extending across the open ends of the clean gas ducts.

14. The filter module according to any one of claims 1 to 13, wherein the one or more channels of the clean gas collecting and discharge arrangement are closed at one end and open at the opposite end and optionally have a cross-sectional area which increases from the closed end of the channel(s) to the open, opposite end of the channel(s).

15. A filter system comprising
a housing comprising a raw gas and a clean gas chamber as well as one or more filter modules according to any one of claims 1 to 14, said housing comprising an interior space separated into a raw gas and a clean gas chamber, said filter module(s) being arranged within said interior space, the feed side of the module(s) oriented substantially vertical, said feed side(s) of the filter module(s) being in fluid communication with the raw gas chamber and said clean gas discharge opening(s) of the filter module(s) being in fluid communication with the clean gas chamber of the housing, the system optionally comprising a back-pulse arrangement.

16. The filter system of claim 15, wherein the housing comprises a tube sheet separating the interior of the housing into the raw gas and clean

gas chamber, said tube sheet comprising openings accommodating the two or more filter modules, preferably in parallel orientation to one another.

17. The filter system of claim 15 or 16, wherein the filter modules are accommodated in the housing with a parallel orientation of their feed sides, optionally the feed side of one module facing the discharge side of an adjacent module, the filter modules being preferably arranged in a staggered configuration.

18. The filter system of claim 15 or 16, wherein the filter modules are accommodated in the housing with a parallel orientation of their feed sides, the feed sides of one module facing the feed side of an adjacent module, preferably the system further includes partition plates positioned in between two adjacent filter modules.

19. The filter system according to any one of claims 15 to 18, wherein two or more filter modules are mounted in a common rack and preferably having their clean gas collecting and discharge arrangements fluidly connected to one another, preferably the system comprises a clean gas discharge channel into which the discharge ends of the clean gas collecting and discharge arrangements substantially directly feed the clean gas.

Amended Claims

1. A filter module, especially for gas filtration purposes, the filter module comprising

one or more block-shaped units, each unit comprising

a plurality of filter elements having a longitudinal, porous tubular wall part having an open first end serving as a raw gas inlet and a closed second end, wherein said filter elements are arranged coextensive and in parallel orientation with their tubular wall parts, their open ends being all located on one side of the filter module serving as a feed side thereof, and

a plurality of clean gas ducts which are substantially coextensive with, oriented parallel to, and regularly interposed between the filter elements, the clean gas ducts being open at one end forming a clean gas outlet and closed at their opposite end, whereas the closed ends of the clean gas ducts being located at the feed side of the filter module, and whereas their open ends are located adjacent to a discharge side of the filter module opposite to the feed side of the filter module;

wherein said open ends of the filter elements and said closed ends of the clean gas ducts form a feed side surface of a block-shaped unit, and wherein said open ends of the clean gas ducts and said closed ends of the filter elements form a discharge side surface of a block-shaped unit;

said filter module further comprising at the discharge side a clean gas collecting and discharge arrangement extending across all of the clean gas outlets of the clean gas ducts of the one or more units and providing a clean gas discharge opening for the filter module, said clean gas collecting and discharge arrangement comprising one or more clean gas channels in fluid communication with said clean gas outlets of the clean gas ducts deflecting and directing the clean gas flow from the open ends of the clean gas ducts in a direction transverse to the vertical of the discharge side surface,

and wherein the one or more channels of the clean gas collecting and discharge arrangement have a height, measured as the clearance in the direction of the vertical of the discharge side surface of the block-shaped unit(s), in the range of from about 0.3 to about 0.5 times the length of the tubular wall parts of the filter elements.

2. A filter module, especially for gas filtration purposes, the filter module comprising

block-shaped units, each unit comprising

a plurality of filter elements having a longitudinal, porous tubular wall part having an open first end serving as a raw gas inlet and a closed second end, wherein said filter elements are arranged coextensive and in parallel orientation with their tubular wall parts, their open ends being all located on a side of the filter module serving as a feed side thereof, and

a plurality of clean gas ducts which are substantially coextensive with, oriented parallel to, and regularly interposed between the filter elements; the clean gas ducts being open at one end forming a clean gas outlet and closed at their opposite end, whereas the closed ends of the clean gas ducts being located at a feed side of the filter module, and whereas their open ends are located adjacent to a discharge side of the filter module opposite to a feed side of the filter module;

wherein said open ends of the filter elements and said closed ends of the clean gas ducts form a feed side surface of a block-shaped unit, and wherein said open ends of the clean gas ducts and said closed ends of the filter elements form a discharge side surface of a block-shaped unit;

wherein said block shaped units comprise

one or more first block-shaped units, the filter elements of which opening in a first direction and

one or more second block-shaped units, the filter elements of which open in a second direction,

the first and second block-shaped units being arranged back-to-back with their discharge side surfaces and spaced apart from and facing one

another;

said filter module further comprising a clean gas collecting and discharge arrangement extending across all of the clean gas outlets of the clean gas ducts,

said clean gas collecting and discharge arrangement being positioned in between said first and second block-shaped units receiving clean gas from the first and second block-shaped units;

said one or more channels of the clean gas collecting and discharge arrangement having a height, measured as the clearance in the direction of the vertical of the discharge side surfaces of the block-shaped unit(s), in the range of from about 0.2 to about 1.4 times, preferably about 0.6 to about 1 times the length of the tubular wall parts of the filter elements.

3. The filter module according to claim 1 or 2, the module is designed as a candle type filter module, comprising at one end thereof said clean gas discharge opening provided by the clean gas collecting and discharge arrangement, preferably further comprising at said one end a mounting flange.

4. The filter module according to any one of claims 1 to 3, wherein the clean gas ducts are defined by longitudinal sections of tubular wall parts of three or more of the filter elements, preferably wherein the tubular wall parts of adjacent filter elements are in direct contact with one another delimiting the clean gas ducts between their closed and open ends.

5. The filter module according to any one of claims 1 to 4, wherein the cross section of the tubular wall parts of the filter elements is of a polygonal, circular or oval shape.

6. The filter module according to any one of claims 1 to 5, wherein the tubular wall parts have a cross-sectional area corresponding to the area

of a square with an edge length of about 3 to about 20 mm, preferably of about 5 to about 10 mm.

7. The filter module according to any one of claims 1 to 6, wherein the length of the tubular wall parts of the filter elements amounts to about 300 mm or less, preferably to about 30 to about 200 mm, more preferably about 50 to about 150 mm.

8. The filter module according to any one of claims 1 to 7, wherein the tubular wall parts and optionally the closed ends of the filter elements and/or the clean gas ducts have an average pore size of about 0.1 to about 150 µm, preferably of about 1 to about 100 µm, more preferably of about 2 to about 10 µm.

9. The filter module according to any one of claims 1 to 8, wherein the tubular wall parts and optionally the closed ends of the filter elements and/or the clean gas ducts are made of a ceramic material, metal or plastic material.

10. The filter module according to any one of claims 1 to 9, wherein the tubular wall parts of the filter elements are arranged with respect to the vertical of the feed side surface of the filter module at an angle of from about 10° to about 60°, preferably from about 30° to about 60°.

11. The filter module according to any one of claims 1 to 10, wherein the one or more channels of the clean gas collecting and discharge arrangement are oriented with their longitudinal direction in an angle of about 30° or more, preferably of about 60° or more, more preferably of about 90° to the surface of the discharge side of the filter module.

12. The filter module of according to any one of claims 1 to 11, wherein the block-shaped units comprise a safety fuse element extending across the open ends of the clean gas ducts.

13. The filter module according to any one of claims 1 to 12, wherein the one or more channels of the clean gas collecting and discharge arrangement are closed at one end and open at the opposite end and optionally have a cross-sectional area which increases from the closed end of the channel(s) to the open, opposite end of the channel(s).

14. A filter system comprising

a housing comprising a raw gas and a clean gas chamber as well as one or more filter modules said one or more filter modules comprising one or more block-shaped units, each unit comprising

a plurality of filter elements having a longitudinal, porous tubular wall part having an open first end serving as a raw gas inlet and a closed second end, wherein said filter elements are arranged coextensive and in parallel orientation with their tubular wall parts, their open ends being all located on one side of the filter module serving as a feed side thereof, and

a plurality of clean gas ducts which are substantially coextensive with, oriented parallel to, and regularly interposed between the filter elements, the clean gas ducts being open at one end forming a clean gas outlet and closed at their opposite end, whereas the closed ends of the clean gas ducts being located at the feed side of the filter module, and whereas their open ends are located adjacent to a discharge side of the filter module opposite to the feed side of the filter module;

wherein said open ends of the filter elements and said closed ends of the clean gas ducts form a feed side surface of a block-shaped unit, and wherein said open ends of the clean gas ducts and said closed ends of the filter elements form a discharge side surface of a block-shaped unit;

said filter module(s) further comprising at the discharge side a clean gas collecting and discharge arrangement extending across all of the clean gas outlets of the clean gas ducts of the one or more units and providing a clean gas discharge opening for the filter module, said clean gas collecting and discharge arrangement comprising one or more clean gas channels in fluid communication with said clean gas outlets of the clean gas ducts deflecting and directing the clean gas flow from the open ends of the clean gas ducts in a direction transverse to the vertical of the discharge side surface;

said housing of the filter system comprising an interior space separated into a raw gas and a clean gas chamber, said filter module(s) being arranged within said interior space, the feed side of the module(s) oriented substantially vertical, said feed side(s) of the filter module(s) being in fluid communication with the raw gas chamber and said clean gas discharge opening(s) of the filter module(s) being in fluid communication with the clean gas chamber of the housing, and wherein the filter module(s) are accommodated in the housing with a parallel orientation of their feed sides, the system optionally comprising a back-pulse arrangement

15. The filter system of claim 14, wherein the housing comprises a tube sheet separating the interior of the housing into the raw gas and clean gas chamber, said tube sheet comprising openings accommodating the two or more filter modules, preferably in parallel orientation to one another.

16. The filter system of claim 14 or 15, wherein the feed side of one module facing the discharge side of an adjacent module, the filter modules being preferably arranged in a staggered configuration.

17. The filter system of claim 14 or 15, wherein the feed sides of one module facing the feed side of an adjacent module, preferably the

system further includes partition plates positioned in between two adjacent filter modules.

18. The filter system according to any one of claims 14 to 17, wherein two or more filter modules are mounted in a common rack and preferably having their clean gas collecting and discharge arrangements fluidly connected to one another, preferably the system comprises a clean gas discharge channel into which the discharge ends of the clean gas collecting and discharge arrangements substantially directly feed the clean gas.

19. The filter system of any one of claims 14 to 18, wherein the filter modules are in accordance with any one of claims 1 to 13.