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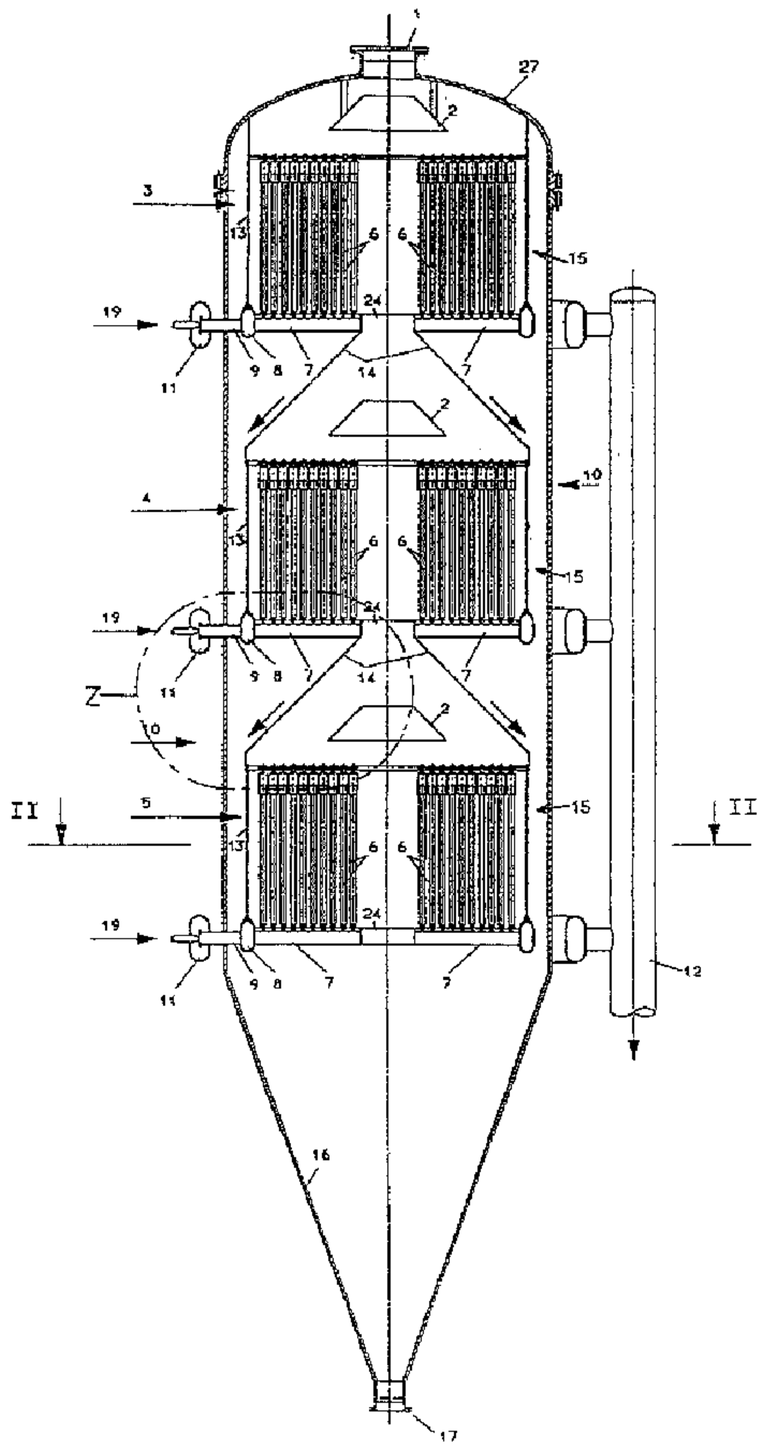

(57) Abrégé/Abstract:
A filter for the cleaning of dust laden possibly hot gas includes ceramic filter candles which are closed at one end and positioned in multiple levels one above the other and are connected to laterally spaced apart candle supporting clean gas collectors. The

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(57) Abrégé(suite)/Abstract(continued):
collectors and the filter candles within one level form a filter module which is divided into several mutually separate filter segments in the shape of a circular sector. The collectors of each filter segment are connected to a clean gas collecting channel located on the same level. A collector free space remains at the center of each module. A cleaning lance protrudes into each clean gas collecting channel either directly or indirectly for the supply of pressurized, pulsed cleaning gas. This allows the groupwise cleaning of the filter candles and substantially reduces the amount of cleaning gas required for the cleaning of the whole filter unit.

ABSTRACT

A filter for the cleaning of dust laden possibly hot gas includes ceramic filter candles which are closed at one end and positioned in multiple levels one above the other and are connected to laterally spaced apart candle supporting clean gas collectors. The collectors and the filter candles within one level form a filter module which is divided into several mutually separate filter segments in the shape of a circular sector. The collectors of each filter segment are connected to a clean gas collecting channel located on the same level. A collector free space remains at the center of each module. A cleaning lance protrudes into each clean gas collecting channel either directly or indirectly for the supply of pressurized, pulsed cleaning gas. This allows the groupwise cleaning of the filter candles and substantially reduces the amount of cleaning gas required for the cleaning of the whole filter unit.

APPARATUS FOR THE CLEANING OF DUST LADEN GAS

The invention relates to an apparatus for the cleaning of dust laden gas. More particularly, the invention relates to an apparatus for the cleaning of hot gas by way of ceramic filter candles which are stacked in a filter housing.

A hot gas filter with ceramic filter candles is known from EP-PS 0 433 637, which filter candles stand on collector channels or are suspended therefrom. These collector channels are positioned spaced apart parallel and at multiple levels within the filter housing. The collector channels open into a clean gas collector chamber which is formed in the filter housing and to which an exit flange is connected. The filter candles are periodically cleaned by way of pulsed gas. The dust which is thereby detached from the filter candles can admix in the lower levels with the raw gas proceeding to the filter candles and will once again deposit on the these filter candles. This redepositing of the dust and the thereby necessary dual or triple removal of the same dust significantly increases the consumption of the pulsed cleaning gas which must be clean, and possibly especially processed, but always highly pressurized.

In the hot gas filter known from EP-PS 0 129 053 the filter candles are suspended from multiple, stacked perforated plates which are respectively proceeded by a conical hood for the removal of the clean gas. The dust detached from the filter candles is intended to slide along the slope of the hood located respectively below. However, in this arrangement the detached dust is also carried along by the raw gas because of turbulence below the perforated plates and can deposit once again on the filter candles of the lower levels.

All perforated floors of the hot gas filter known from EP-PS 0 129 053 are connected with a central guide conduit for the removal of the clean gas, which conduit is supported on the filter housing. Since the guide conduit cannot be

indefinitely loaded, the number of perforated floors and filter candles in a filter housing is limited.

It is an object of the invention to modify the conventional apparatus so that the filter candles can be groupwise cleaned and that the consumption of pulsed cleaning gas can be reduced.

This object is achieved by dividing the filter apparatus into mutually independent filter modules. The filter modules are divided into filter segments which are mutually separate with respect to the gas flow. This provides the possibility to select the cleaning sequence such that the filter candles which are positioned directly above one another are not simultaneously cleaned. The pulsating cleaning gas back flow is diverted to both sides by the symmetrical arrangement of the supporting collectors so that expensive diverting arrangements are obviated.

According to one aspect of the present invention there is provided apparatus for cleaning dust laden hot gas comprising: ceramic filter candles closed at one end and stacked one above another in several levels; a filter housing for holding said candles; supporting collectors spaced apart and connected to said candles, a plurality of candles being connected to one supporting collector; a plurality of supporting collectors communicating with a clean gas collecting channel lying in the same level a clean gas line connected to the clean gas collecting channels; a plurality of supporting collectors forming together with the associated clean gas collecting channel a filter segment of a circular-shaped sector; a plurality of filter segments separated from each other forming together a filter module within a level, each level having a center with a space free of supporting collectors; a cleaning lance projecting into each clean gas collecting channel.

According to a further aspect of the present invention there is provided apparatus for cleaning dust laden hot gas comprising: ceramic filter candles closed at one end and stacked one above another in several levels; a filter housing for holding said candles; supporting collectors spaced apart and connected to said candles, a plurality of candles being connected to one supporting collector; a plurality of supporting collectors communicating with a clean gas collecting channel lying in the same level, a clean gas line connected to the clean gas collecting channels; a plurality of supporting collectors forming together with the associated clean gas collecting channel a filter segment of a circular-shaped sector; a plurality of filter segments separated from each other forming together a filter module within a level, each level having a center with a space free of supporting collectors; a cleaning lance projecting into each clean gas collecting channel; said supporting collectors of each filter segment being positioned symmetrically to a center line extending through a center of said filter module; said clean gas collecting channels being positioned along a center line of said filter segment, said collecting supports communicating at both sides into said clean gas collecting channel.

According to another aspect of the present invention there is provided apparatus for cleaning dust laden hot gas comprising: ceramic filter candles closed at one end and stacked one above another in several levels; a filter housing for holding said candles; supporting collectors spaced apart and connected to said candles, a plurality of candles being connected to one supporting collector; a plurality of supporting collectors communicating with a clean gas collecting channel; lying in the same level a clean gas line connected to the clean gas collecting channels; a plurality of supporting collectors forming together with the associated clean gas collecting channel a filter segment of a circular-shaped sector; a plurality of

filter segments separated from each other forming together a filter module within a level, each level having a center with a space free of supporting collectors; a cleaning lance projecting into each clean gas collecting channel; said supporting collectors of each filter segment being positioned symmetrically to a center line extending through a center of said filter module; said clean gas collecting channels being positioned along a center line of said filter segment, said collecting supports communicating at both sides into said clean gas collecting channel; said clean gas collecting channels being configured so that flow through a cross-section of said clean gas collecting channels increases in the direction of flow; clean gas collecting channels extending through said filter housing to the outside; said clean gas collecting channel being annular shaped and surrounding said collecting supports of a filter segment on the outside; said annular-shaped clean gas collecting channel having a central clean gas exhaust conduit extending through a wall of said filter housing to the outside; the clean gas exhaust conduits having outwardly protruding ends opening into an annular clean gas collector positioned at the same level outside said filter housing and connected to a common clean gas conduit; said cleaning lance protruding into an end of each clean gas exhaust conduit, said clean gas exhaust conduit protruding outward through a wall of said filter housing; each filter segment being individually supported on a wall of said filter housing by support means; a support member on said support for supporting slidingly said filter segment; each clean gas collecting channel being held in said filter housing as a fixed point for the respective filter segment; said support means comprising pipe elements and being cooled; said filter housing, said annular clean gas collectors and said clean gas conduit having on their inside a fire-proof coating.

Symmetrical flow characteristics of the raw gas stream are achieved, since the raw gas stream comes centrally from above and the clean gas is immediately removed at each level of a

filter module. This leads to a relatively even loading of all filter candles with dust and thereby to a further reduction in the amount of pulsed gas required for cleaning.

The separation of the filter apparatus into mutually independent filter modules and their respective separation into a number of filter segments allows each filter segment to be individually supported on the wall of the filter housing. The filter apparatus for weight reasons can thereby be equipped with a large number of filter modules which are positioned one above the other. For example six or more filter modules can be positioned above one another, whereby the filter housing can be made comparatively slim for a given filter surface to be included. The free space which remains at the center of each filter module serves to compensate the thermal expansion of the filter segments. In addition, the free space can be used as an installation opening.

The invention will now be further described by example only and with reference to the drawing wherein

Fig. 1 shows a longitudinal section through a preferred embodiment of an apparatus in accordance with the invention for the cleaning of dust laden gas;

Fig. 2 is a section through Fig. 1 taken along line II-II;

Fig. 3 is an enlargement of the detail Z of the apparatus shown in Fig. 1;

Fig. 4 is a section through Fig. 3 taken along line IV-IV;

Fig. 5 is a longitudinal section through another preferred apparatus for cleaning dust laden gas,

Figs. 6-8 respectively illustrate a section through a further preferred embodiment of the apparatus shown in Fig. I and taken along line II-II;

Fig. 9 is a longitudinal section through another apparatus in accordance with the invention for the cleaning of dust laden gas; and

Fig. 10 is a longitudinal section through yet another apparatus in accordance with the invention for the cleaning of dust laden gas.

In a preferred embodiment, the apparatus in accordance with the invention includes a cylindrical, possibly pressurizable filter housing 10 closed by a cover 27. The cover 27 is provided with a centrally positioned inlet conduit 1 for the raw gas to be cleaned. The lower end of the filter housing 10 is shaped as a dust collector funnel 16 which is provided with an exit conduit 17 for removal of the dust loosened during cleaning. A distributor arrangement 2 with downwardly inclined deflector surfaces is positioned below the inlet conduit 1. The flow of raw gas which centrally enters through the inlet conduit 1 is deflected by the distributor arrangement 2 downwardly and radially from the center outward to the filter candles 6.

The filter candles 6 are hollow ceramic bodies which are open at one end and stand upright with their open end on elongated tubular filter candle supporting collectors 7. The collectors 7 are spaced apart and positioned side by side parallel. Multiple collectors 7 are connected, preferably at both ends, a common clean gas collecting channel 8 and the clean gas collecting channel 8 and the collectors 7 are positioned in the same plane. The filter candles 6 can also be provided with a flange surrounding the open end and suspended thereby from the collectors 7 instead of being supported thereon.

This object is achieved in a process in accordance with the invention by separating the flow path of the raw gas to be cleaned from that of the loosened dust. This prevents that the already loosened dust admixes with the raw gas and redeposits on the filter candles. Repeated removal of the same dust, which would be associated with a higher consumption of pulsed cleaning gas, is thereby substantially avoided. In a filter apparatus with multiple levels of stacked filter

candles connected to individual supporting collectors this separation of the flow paths is preferably achieved by way of an ash removal funnel.

Accordingly, the invention provides a method for the cleaning of dust laden gas including the steps of providing ceramic filter candles which are open at one end, stacked above one another in levels in a raw gas space, and connected to a clean gas space, cleaning of the filter candles by blowing a pulsed cleaning gas for a short period of time into the filter candles from the side of the clean gas space and against the direction of raw gas flow, separately guiding the raw gas to be cleaned and the loosened dust in such a manner that the loosened dust is guided to a dust removal structure connected to the raw gas space without once again mixing with the raw gas to be cleaned, and removing the loosened dust from the dust removal structure.

The invention further provides an apparatus including ceramic filter candles for the cleaning of dust laden gas, which candles are closed at one end, stacked in several levels within a filter housing and connected to laterally spaced apart candle supporting clean gas collectors, a central region at the center of each level of candles being free of collectors, and an ash removal mantle for separating the filter candles at one level from the filter candles in the level thereabove, the ash removal mantle including a cylindrical section and a conical section and extending from the collectors at the one level to the collectors at the other level and being affixed thereto.

According to Figs. 7 and 8, each clean gas collecting channel 8 is positioned along the axis of symmetry of the respective filter segment 18, whereby the collectors 7 open into the clean gas collecting channel 8 from both sides. Each of these clean gas collecting channels 8 is guided through the wall of the filter housing 10 to the outside. The flow-through cross-

section of the clean gas collecting channels 8 increases in the direction of flow of the clean gas to the same extent as the flow volume increases. The increase in the flow-through cross-section can be achieved by an increase in the width or height of the respective clean gas collecting channel 8 or both.

The clean gas exhaust conduits 9 (Figs. 1, 2, 3, 6) which are guided to the outside, or the clean gas collecting channels 8 (Figs. 7, 8) open into an annular clean gas collector 11 positioned at the same level but outside the filter housing 10. The annular clean gas collectors 11 are connected to a common clean gas conduit 12. A cleaning lance 19 respectively protrudes into that end of each clean gas exhaust conduit 9 or clean gas collecting channel 8 which protrudes outward through the wall of the filter housing 10. A pulsed cleaning gas is blown through that lance and into the respectively associated channel or conduit for the cleaning of the filter candles 6. Each filter segment 18 is individually cleaned.

As shown in Fig. 5, the wall, the cover 27 and the funnel 16 of the filter housing 10 as well as the annular clean gas collectors 11 and the clean gas conduit 12 are preferably provided with an internal fire proof coating 23 for the handling of hot dust laden gas.

Each filter segment 18 of each filter module 3, 4, 5 is supported on the wall of the filter housing 10 by way of one or more support structures. The support structure is preferably in the form of a wall console including one or more angled pipe elements 21 as shown in Figs. 3 and 4. When the apparatus is used as a hot gas filter, a cooling medium is preferably pumped through the pipe elements 21. The support structure can also be provided with a double wall to allow the cooling medium to flow therethrough. A support 22 is provided on the pipe elements 21 of each support structure which support consists of a vertical web that carries two lateral

webs. The collectors 7 of two adjacent filter segments 18 slidingly rest on the webs of this support 22. The fixed point of a filter segment 18 is located at the point where the respectively associated clean gas exhaust conduit 9 or clean gas collecting channel 8 penetrates the filter housing. The individual filter segment 18 can thereby slidingly expand upon an increase in temperature on the supports 22 towards the housing center without the need for a special compensator which can create problems at high temperatures or pressure differentials. Thus, when the filter is operated with hot gases of up to 1000°C the material expansion upon an increase in temperature affects only the individual filter segments 18. In this arrangement of mechanically separate filter segments 18 only the weight of a single filter segment 18 respectively rests on the support structure. The filter apparatus can therefore be provided with a large number of filter modules positioned one above the other. The filter housing can be made slim even when a large filter area is to be included.

Fig. 10 shows a filter apparatus wherein four filter modules of the above principle construction are positioned one above the other. Each filter module 4, 5 is separated from the filter module 3, 4 thereabove by an ash guide mantle 15 made of sheet steel. The ash guide mantle 15 includes a cylindrical section 13 and a conical section 14 and bridges the interior of the filter housing 10 between two filter modules 3, 4, 5 located above one another. In the embodiment according to Figs. 1 and 2 the cylindrical section 13 of the ash guide mantle 15 surrounds the filter candles 6 of the respective filter module 3, 4, 5 on the outside and extends at least to the upper edge of the filter candles 6. The lower edge of the ash guide mantle 15 is sealingly welded onto the clean gas collecting channel 8. If the collectors 7 are positioned as shown in Figs. 7 and 8, the cylindrical section 13 is connected to the outer collectors 7. The conical section 14 tapers upwardly and merges with the central collector-free opening 24 of the filter module 4, 3

thereabove. It is connected to the support structure formed by the pipe elements 21. The juncture 20 between the cylindrical section 13 and the conical section 14 is overlapped and constructed as a sliding connection. The conical section 14 is omitted from that ash guide mantle 15 which surrounds the upper filter module 3. Instead, the cylindrical section 13 is connected at the upper edge with the cover 27 or the wall of the filter housing 10 and that connection also can be constructed as a sliding connection.

The dust deposited on the filter candles 6 is periodically removed from the surface of the candles by way of pulsed cleaning gas which is injected through the cleaning lances 19 for a short period of time. The loosened dust is guided by the ash guide mantle 15 through the gap between the ash guide mantle 15 and the wall of the filter housing 10 and eventually enters the funnel 16. The loosened dust thereby no longer comes into contact with the raw gas, since the latter flows along the interior of the ash guide mantle 15 to the filter candles 6 of the filter module 4, 5 respectively below. A mixing of already removed dust with the raw gas on its way to the filter candles 6 and a redepositing of the same dust is no longer possible. In this way a large amount of pulsed cleaning gas required for the cleaning of the filter candles 6 is saved which is advantageous since the cleaning gas must be clean, possibly especially processed, but always highly pressurized.

The annular dust removal gap between the wall of the filter housing 10 and the ash guide mantle 15 can be made small. The danger of bridging is reduced. The ash guide mantle 15 need only have a small wall thickness since the same pressure is present on both sides of the ash removal mantle 15.

Symmetrical flow characteristics of the raw gas stream are achieved, since the raw gas stream comes centrally from above and the clean gas is immediately removed at each level of the

filter module 3, 4, 5. This leads to a relatively even loading of all filter candles 6 with dust and thereby to a further reduction in the pulsed cleaning gas required.

A variant of the ash guide mantle 15 is shown in Fig. 9. The cylindrical section 13 of the ash guide mantle 15 is therein positioned in the space free of collectors 7 which forms the central opening 24. The cylindrical section 13 is positioned inward of and adjacent to the filter candles 6 of one filter module 3, 4, 5 and is affixed to the collectors 7. The inverted conical section 14 which is directly adjacent the cylindrical section 13 is upwardly flared and according to Fig. 9 is attached to the clean gas collecting channels 8 of the filter module 4, 5 respectively positioned thereabove. The central, collector-free space of the uppermost filter module 3 is closed by a plate 26. The filter candles 6 of each filter module 3, 4, 5 are outwardly surrounded by a guide wall 25. The operation of the ash guide mantle 15 in this variant corresponds in principle to the one of the aforedescribed ash guide mantle 15. The raw gas to be cleaned enters through the entry flange 1 and vertically impinges on the filter candles 6 of the upper filter module 3 from above. A further portion of the raw gas flows downward and between the ash guide mantle 15 and the wall of the filter housing 10 towards the filter modules 4, 5 below. There the raw gas guided between the guide wall 25 and the cylindrical section 13 of the ash guide mantle 15 impinges vertically from above onto the filter candles of the respective filter module 4, 5. The dust loosened from the filter candles 6 by the cleaning operation is guided along the inside of the ash guide mantle 15 and past the filter candles 6 of the filter module respectively below without once again coming into contact with the raw gas.

Changes and modifications in the specifically described embodiments can be carried out without departing from the

scope of the invention which is intended to be limited only by the scope of the appended claims.

CLAIMS:

1. Apparatus for cleaning dust laden hot gas comprising: ceramic filter candles closed at one end and stacked one above another in several levels; a filter housing for holding said candles; supporting collectors spaced apart and connected to said candles, a plurality of candles being connected to one supporting collector; a plurality of supporting collectors communicating with a clean gas collecting channel lying in the same level a clean gas line connected to the clean gas collecting channels; a plurality of supporting collectors forming together with the associated clean gas collecting channel a filter segment of a circular-shaped sector; a plurality of filter segments separated from each other forming together a filter module within a level, each level having a center with a space free of supporting collectors; a cleaning lance projecting into each clean gas collecting channel.

2. Apparatus as defined in claim 1, wherein said supporting collectors of each filter segment are positioned symmetrically to a center line extending through a center of said filter module.

3. Apparatus as defined in claim 1, wherein said clean gas collecting channels are positioned symmetrically along a center line of said filter segment, said collecting supports communicating at both sides into said clean gas collecting channel.

4. Apparatus as defined in claim 1, wherein said clean gas collecting channel is annular shaped and surrounds said collecting supports of a filter segment on the outside.

5. Apparatus as defined in claim 1, wherein each filter segment is individually supported on a wall of said filter

housing by support means; a support member on said support for supporting slidingly said filter segment; each clean gas collecting channel being held in said filter housing as a fixed point for the respective filter segment.

6. Apparatus for cleaning dust laden hot gas comprising: ceramic filter candles closed at one end and stacked one above another in several levels; a filter housing for holding said candles; supporting collectors spaced apart and connected to said candles, a plurality of candles being connected to one supporting collector; a plurality of supporting collectors communicating with a clean gas collecting channel lying in the same level, a clean gas line connected to the clean gas collecting channels; a plurality of supporting collectors forming together with the associated clean gas collecting channel a filter segment of a circular-shaped sector; a plurality of filter segments separated from each other forming together a filter module within a level, each level having a center with a space free of supporting collectors; a cleaning lance projecting into each clean gas collecting channel; said supporting collectors of each filter segment being positioned symmetrically to a center line extending through a center of said filter module; said clean gas collecting channels being positioned along a center line of said filter segment, said collecting supports communicating at both sides into said clean gas collecting channel.

7. Apparatus as defined in claim 1, wherein said supporting collectors of each segment are positioned symmetrically to a center line extending through a center of said filter module, said clean gas collecting channel being annular-shaped and surrounding said collecting supports of a filter segment on the outside.

8. Apparatus as defined in claim 6, wherein each filter segment is individually supported on a wall of said filter housing by support means; a support member on said support for supporting slidingly said filter segment; each clean gas collecting channel being held in said filter housing as a fixed point for the respective filter segment.

9. Apparatus as defined in claim 7, wherein each filter segment is individually supported on a wall of said filter housing by support means; a support member on said support for supporting slidingly said filter segment; each clean gas collecting channel being held in said filter housing as a fixed point for the respective filter segment.

10. Apparatus as defined in claim 3, wherein said clean gas collecting channels extend through said filter housing to the outside.

11. Apparatus as defined in claim 4, wherein said annular-shaped clean gas collecting channel has a central clean gas exhaust conduit and extends through a wall of said filter housing to the outside.

12. Apparatus as defined in claim 11, wherein the clean gas exhaust conduits have outwardly protruding ends opening into an annular clean gas collector positioned at the same level outside said filter housing and connected to a common clean gas conduit.

13. Apparatus as defined in claim 5, wherein said support means comprises pipe elements.

14. Apparatus as defined in claim 5, wherein said support means is cooled.

15. Apparatus as defined in claim 12, wherein said filter housing, said annular clean gas collectors and said clean gas conduit have on their inside a fire-proof coating.

16. Apparatus as defined in claim 3, wherein said clean gas collecting channels are configured so that flow through a cross-section of said clean gas collecting channels increases in the direction of flow.

17. Apparatus as defined in claim 11, wherein said cleaning lance protrudes into an end of each clean gas exhaust conduit, said clean gas exhaust conduit protruding outward through a wall of said filter housing.

18. Apparatus for cleaning dust laden hot gas comprising: ceramic filter candles closed at one end and stacked one above another in several levels; a filter housing for holding said candles; supporting collectors spaced apart and connected to said candles, a plurality of candles being connected to one supporting collector; a plurality of supporting collectors communicating with a clean gas collecting channel; lying in the same level a clean gas line connected to the clean gas collecting channels; a plurality of supporting collectors forming together with the associated clean gas collecting channel a filter segment of a circular-shaped sector; a plurality of filter segments separated from each other forming together a filter module within a level, each level having a center with a space free of supporting collectors; a cleaning lance projecting into each clean gas collecting channel; said supporting collectors of each filter segment being positioned symmetrically to a center line extending through a center of said filter module; said clean gas collecting channels being positioned along a center line of said filter segment, said collecting supports communicating at both sides into said clean gas collecting channel; said clean gas collecting

channels being configured so that flow through a cross-section of said clean gas collecting channels increases in the direction of flow; clean gas collecting channels extending through said filter housing to the outside; said clean gas collecting channel being annular shaped and surrounding said collecting supports of a filter segment on the outside; said annular-shaped clean gas collecting channel having a central clean gas exhaust conduit extending through a wall of said filter housing to the outside; the clean gas exhaust conduits having outwardly protruding ends opening into an annular clean gas collector positioned at the same level outside said filter housing and connected to a common clean gas conduit; said cleaning lance protruding into an end of each clean gas exhaust conduit, said clean gas exhaust conduit protruding outward through a wall of said filter housing; each filter segment being individually supported on a wall of said filter housing by support means; a support member on said support for supporting slidingly said filter segment; each clean gas collecting channel being held in said filter housing as a fixed point for the respective filter segment; said support means comprising pipe elements and being cooled; said filter housing, said annular clean gas collectors and said clean gas conduit having on their inside a fire-proof coating.

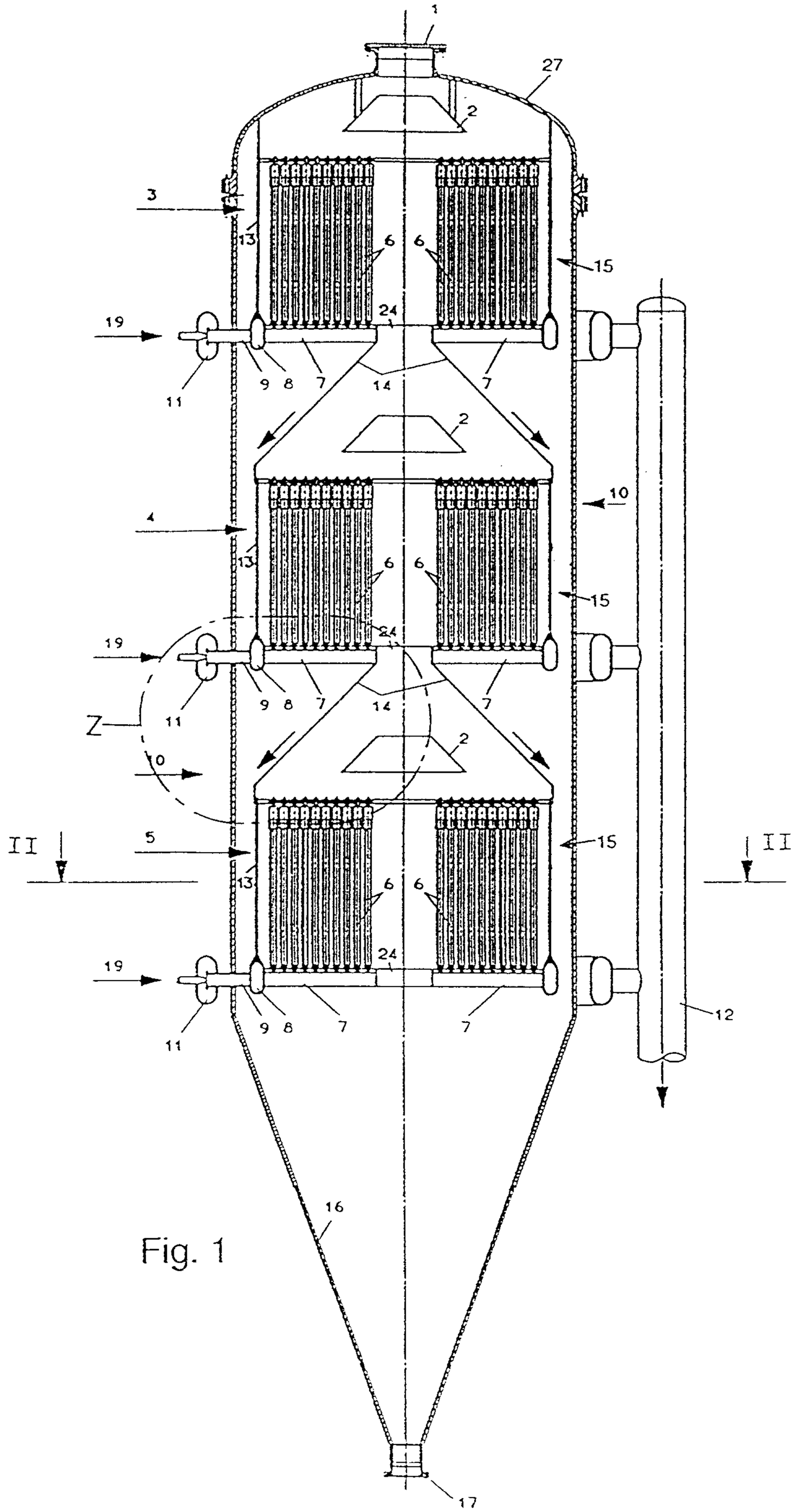

Fig. 1

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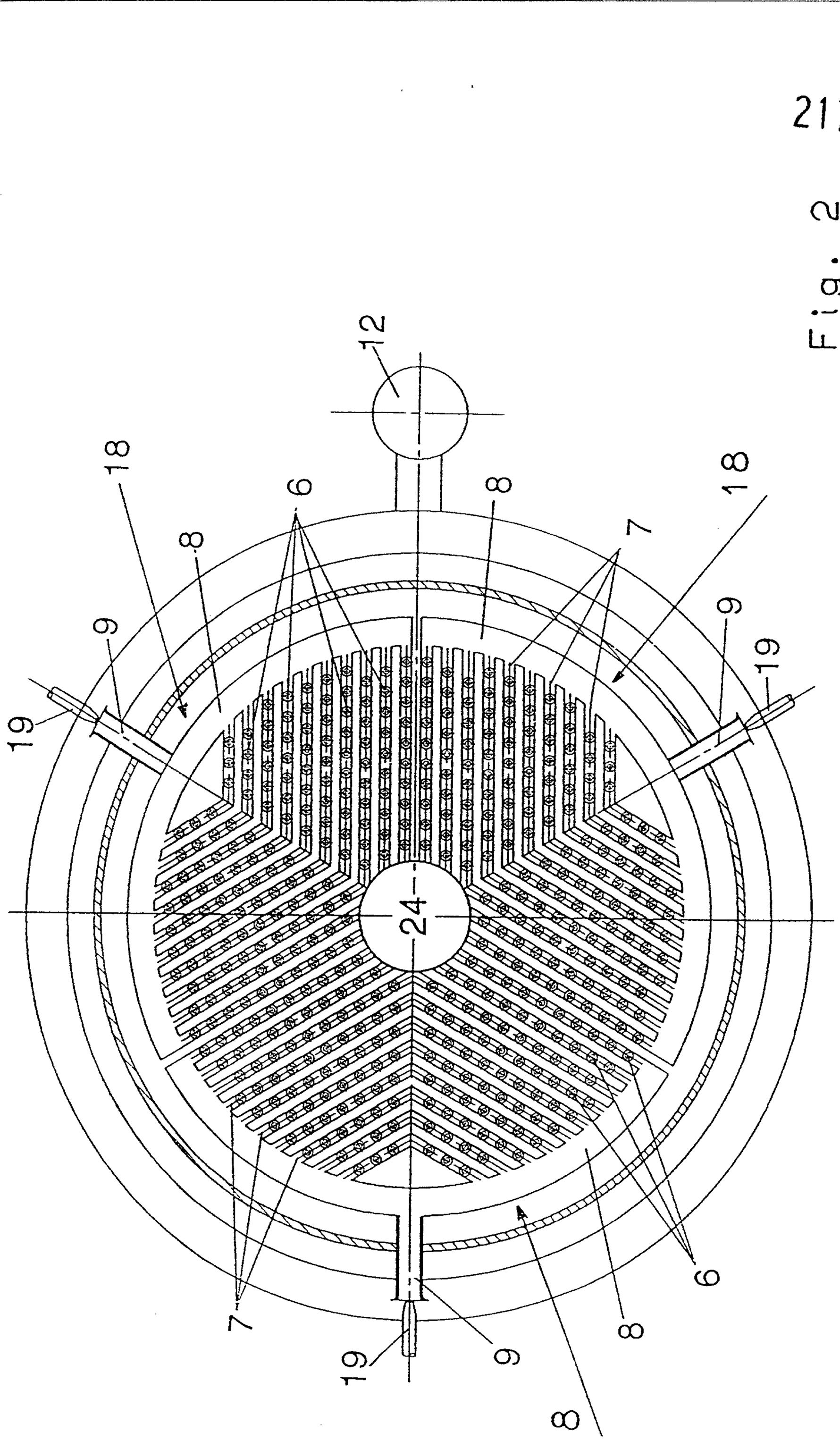
Fig. 2



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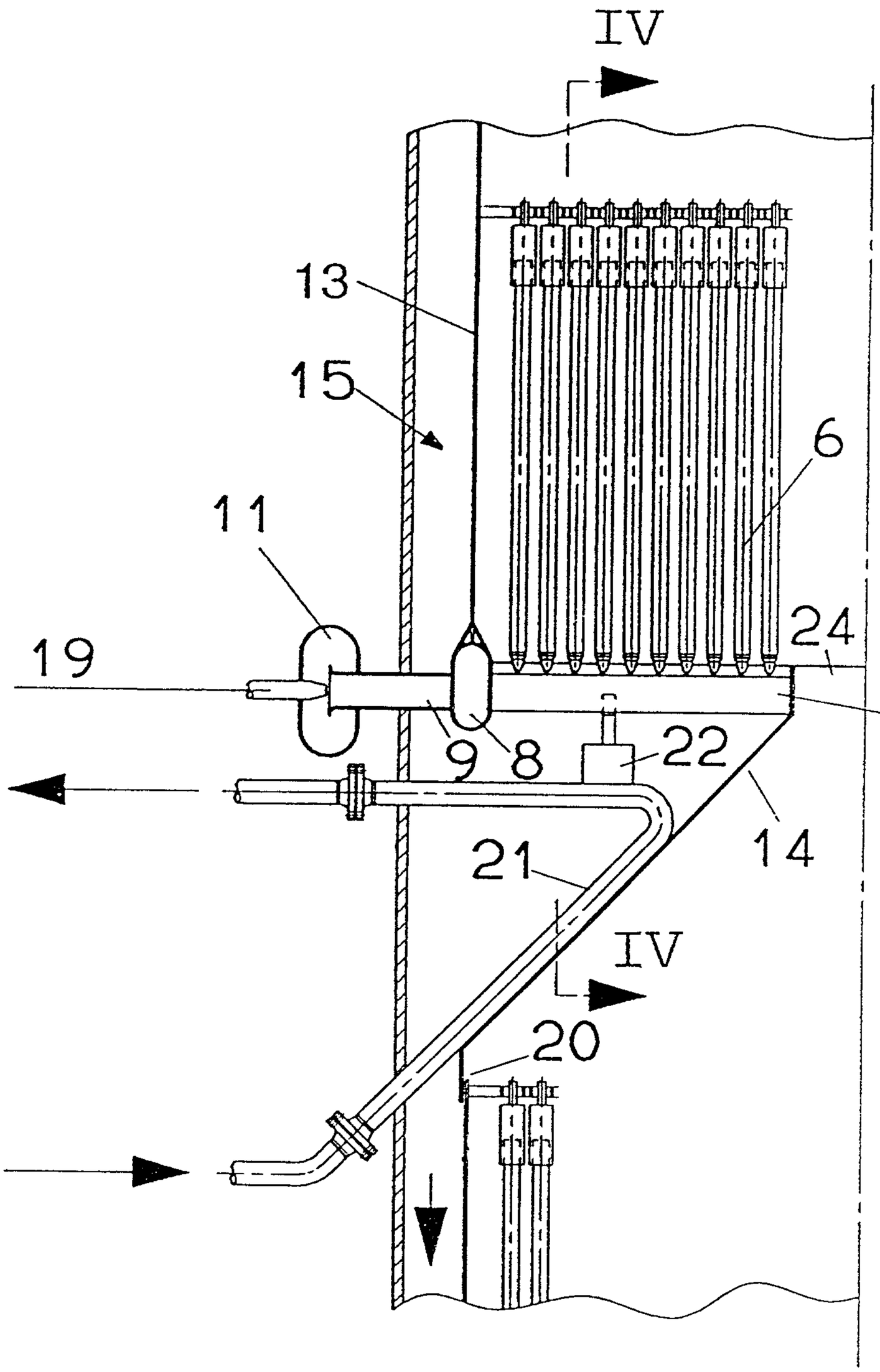

Fig. 3

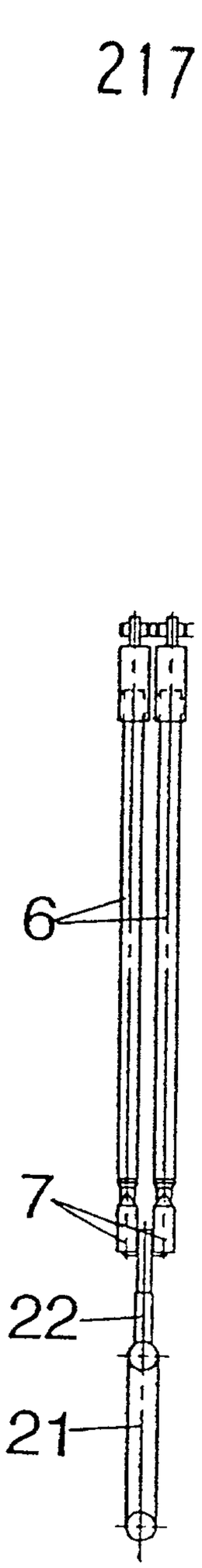

Fig. 4

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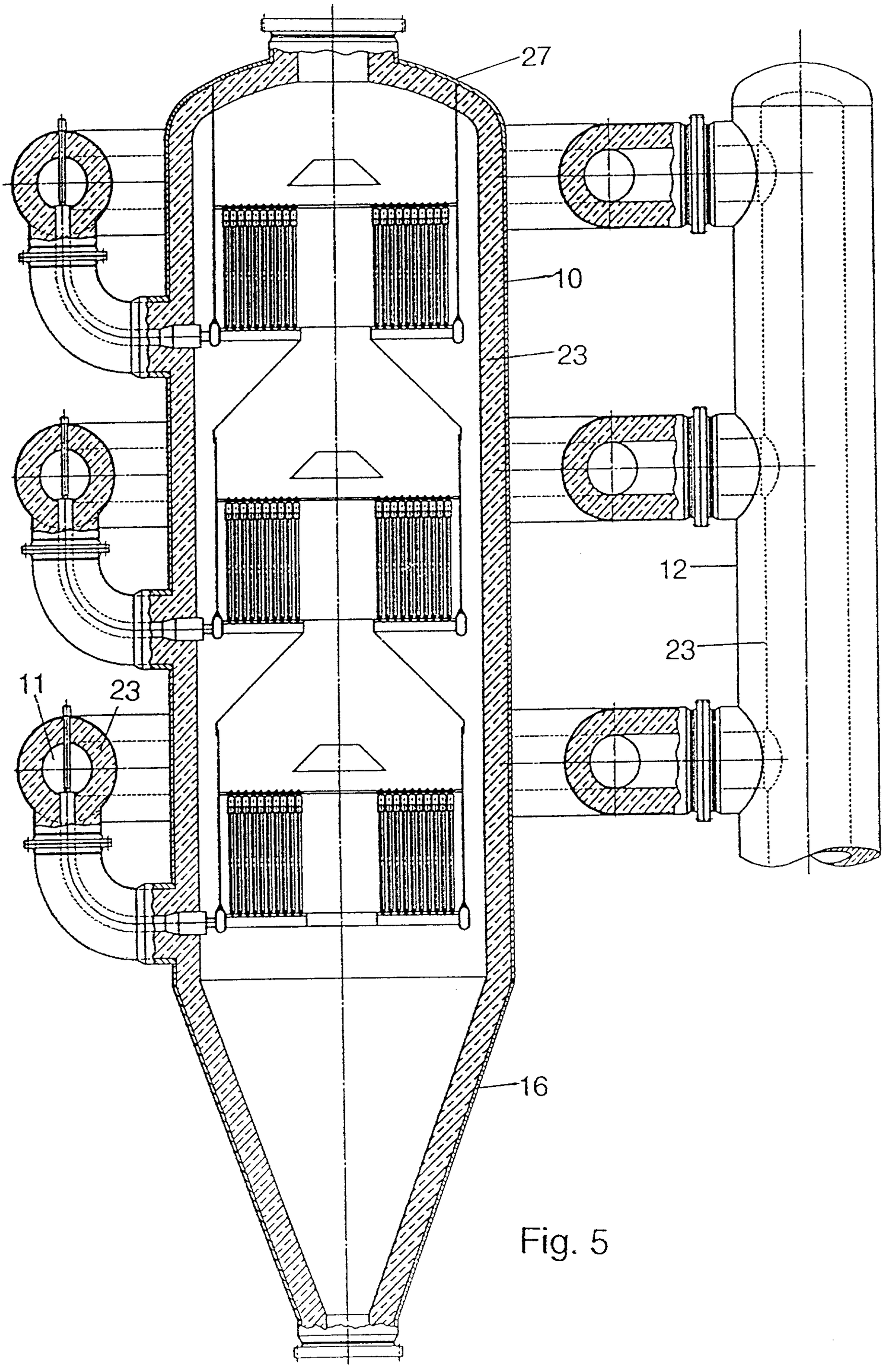

Fig. 5

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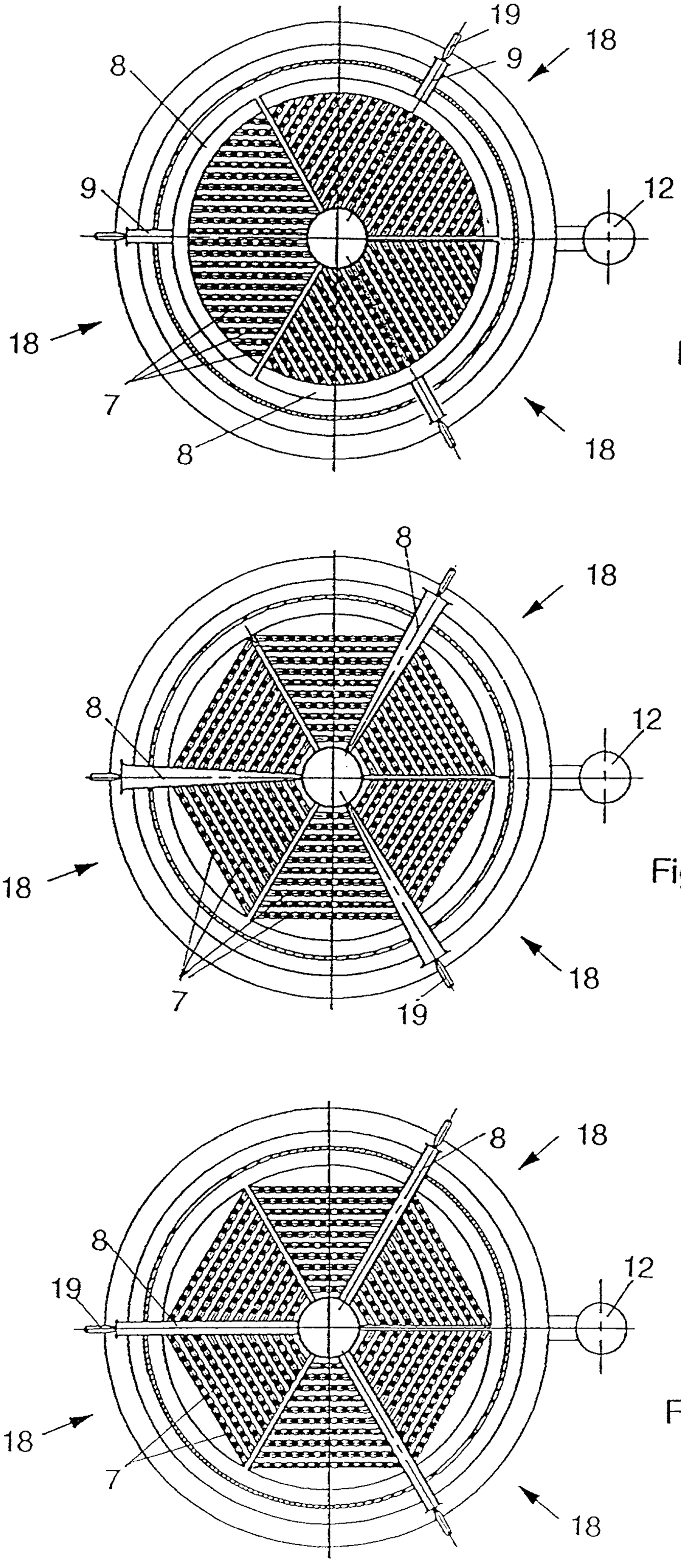

Fig.6

Fig.7

Fig.8

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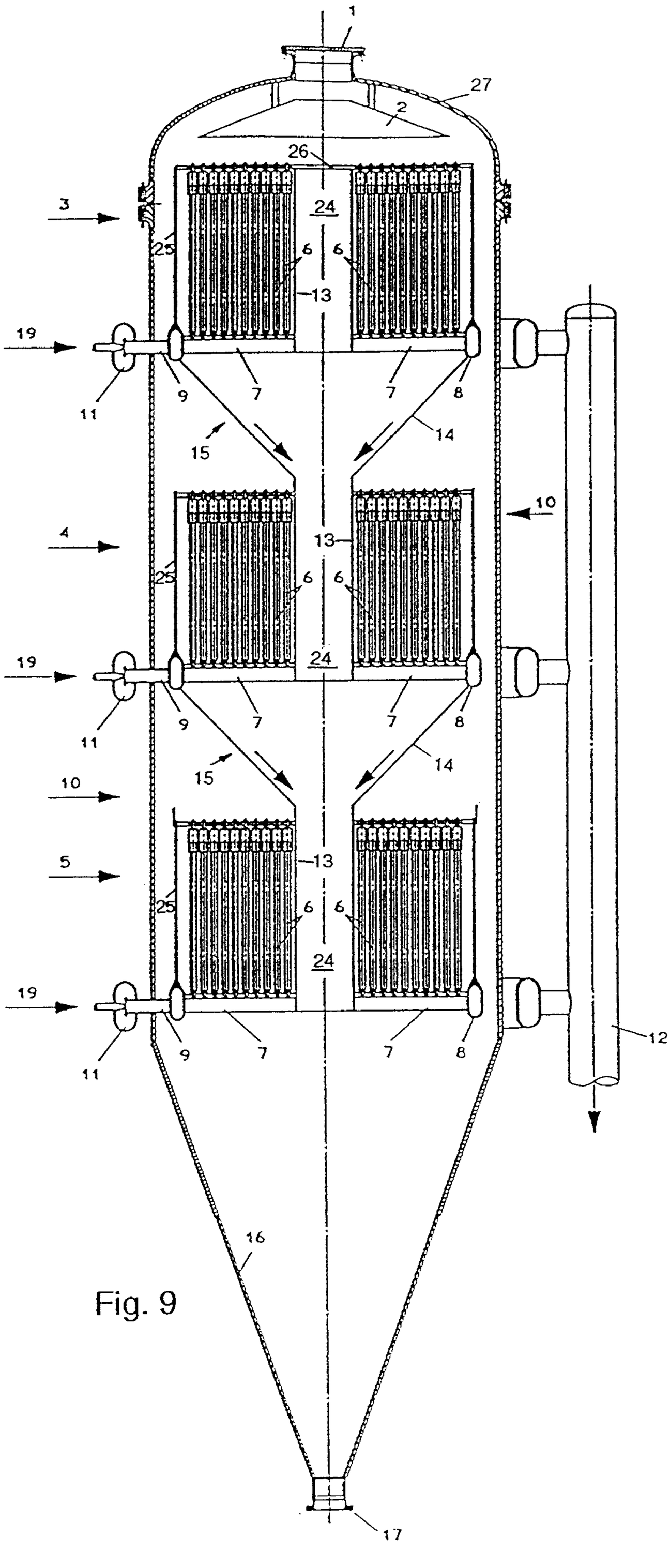

Fig. 9

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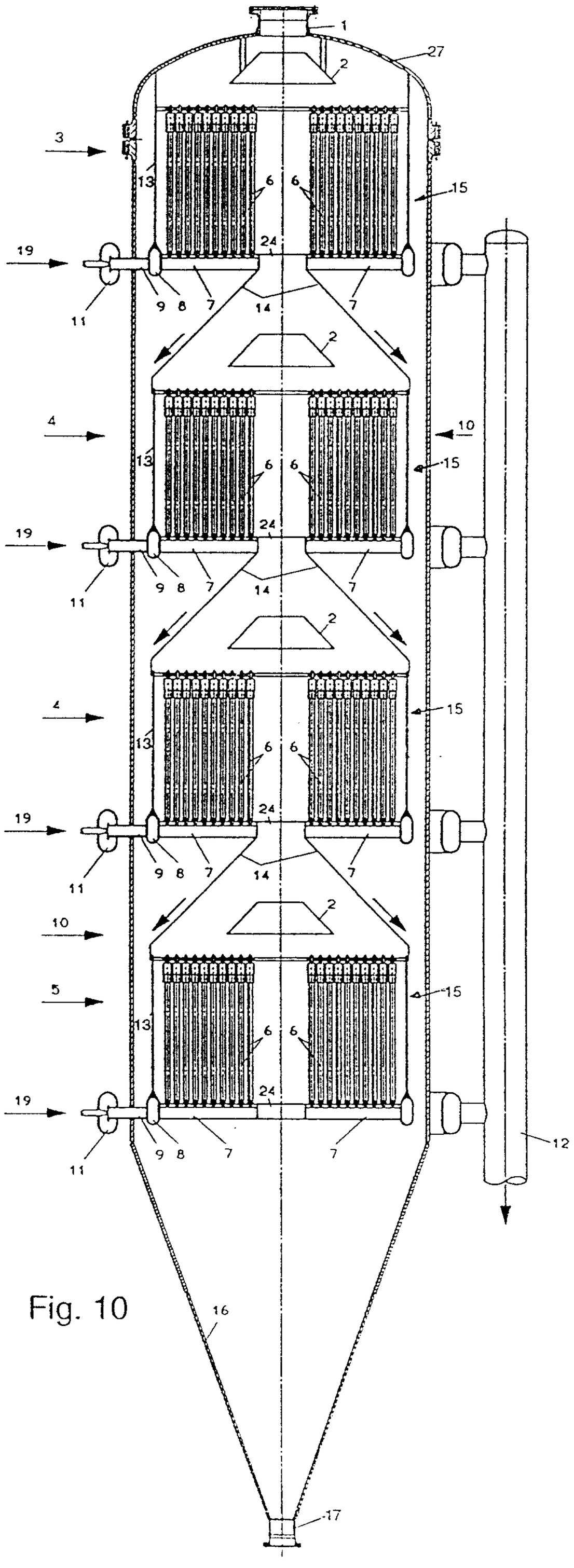

Fig. 10

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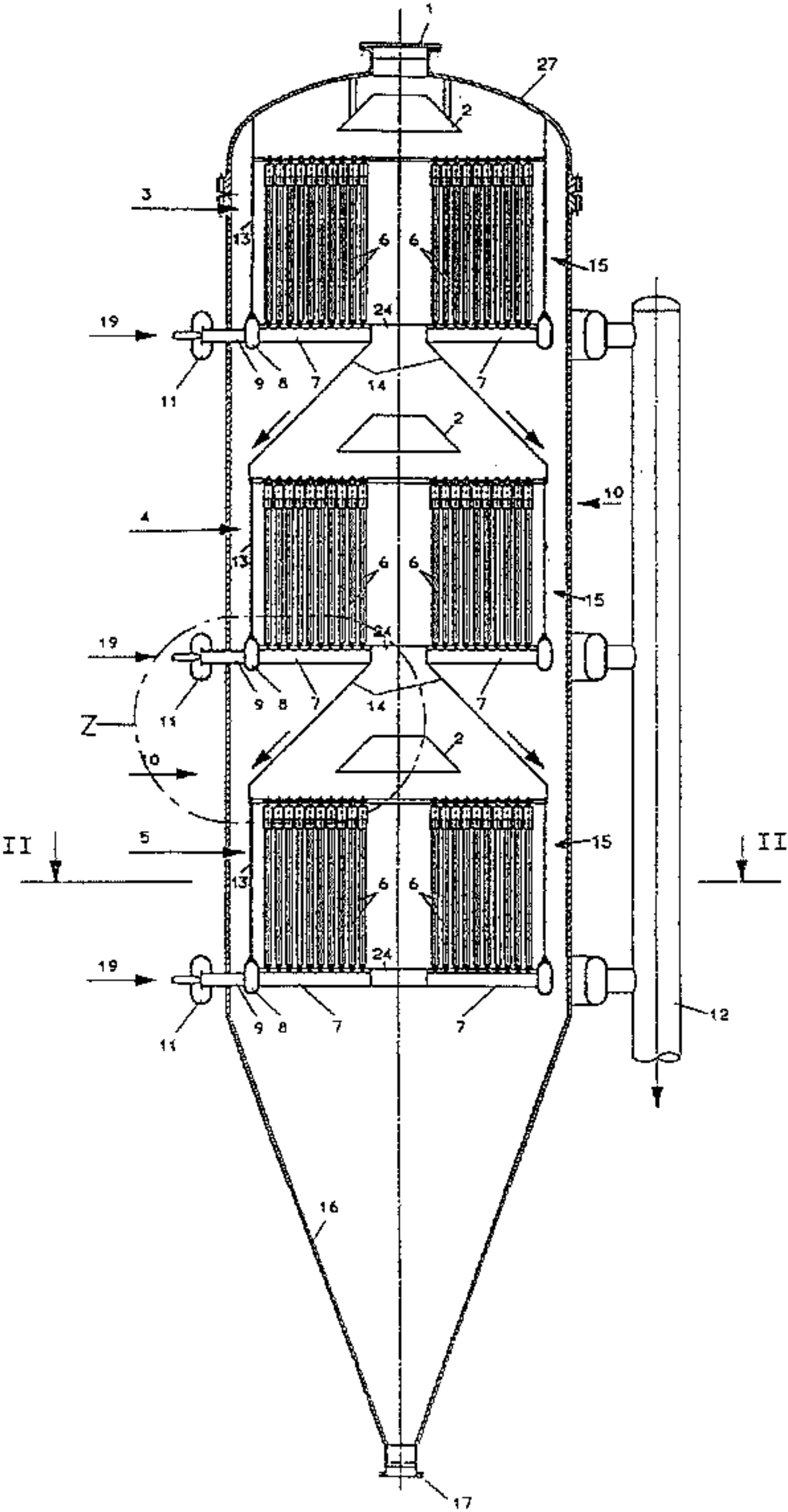
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