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(54) Title: SEPARATING MEANS

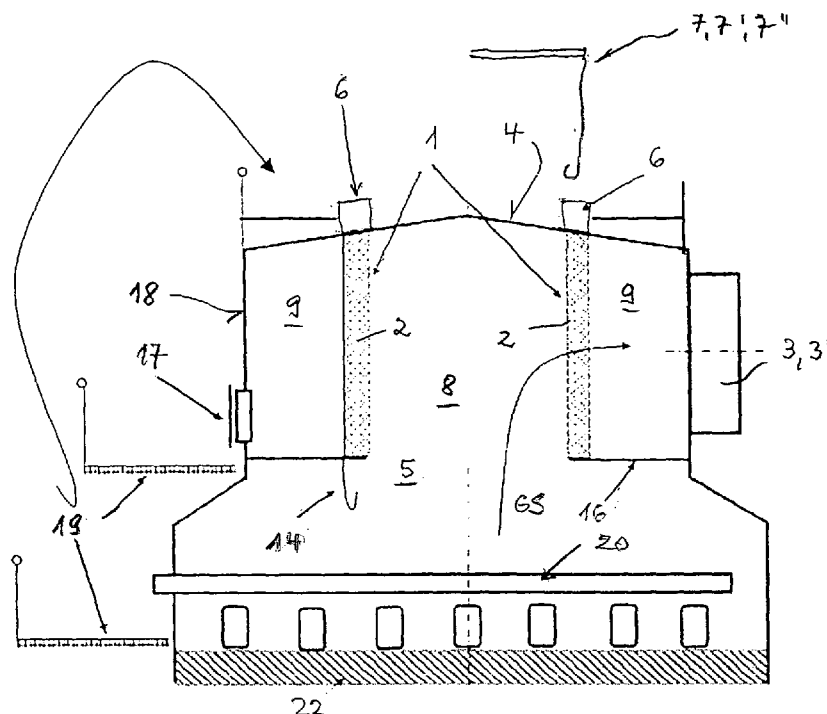


Fig. 1

(57) Abstract: This invention relates to a means for separating liquid droplets and/or solid particles from a waste gas stream, e.g. for a plant for sulfuric acid production, wherein the waste gas stream is passed through at least one vertical plate-like separating element (1) made of a wire mesh (2), which is arranged before a gas outlet (3) of an enclosed gas space (5) having a roof (4). A closable opening (6) in the roof (4) of the gas space (5) and means (7) for vertically withdrawing the separating element (1) from the gas space (5) are associated to the separating element (1).



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- 1 -

Separating Means

5 This invention relates to a means for separating liquid droplets and/or solid particles from a waste gas stream, in which the waste gas stream is passed through at least one vertical plate-like separating element which is arranged before a gas outlet of an enclosed gas space having a roof.

10 Such separating means should be used in particular in plants for sulfuric acid production. The separating means at the outlet of the drying tower of such a plant gradually are obstructed by deposition of droplets and particles and must be cleaned. So far, the separating elements are arranged horizontally in the drying tower and are laterally withdrawn from the tower for cleaning with water,
15 which is inconvenient due to their large weight and their dimensions (of e.g. more than 3000 mm in length) as well as the risk of tilting. Withdrawing laterally also requires a great plate shape with a width corresponding to at least half the tower diameter, with collecting plates disposed thereunder for dirt and acid falling down and with a drainage to the bottom of the plant. During cleaning,
20 droplets of the acid can splash around, and the maintenance personnel must wear acid protection clothing. After cleaning, the separating element must be pushed back into the tower from the side, and the operating personnel must climb the tower above the separating element, in order to check the proper mounting position.

25

From DE 17 19 559 B2, for instance, such device for the absorption of SO_3 from gas mixtures and/or for drying SO_2 -containing gases by means of sulfuric acid is known, in which in the upper part of a housing and below a gas outlet opening a wire mesh filter is mounted horizontally for separating liquid droplets contained
30 in the gas.

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DE 39 22 105 A1 describes a device for concentrating sulfuric acid containing metal sulfate, in which in the upper region of a container below a vapor inlet region a demister is arranged horizontally, in order to separate sulfuric acid droplets or dilute acid droplets from the vapors.

From DE 199 63 509 A1, a plant for producing high-purity sulfuric acid is known, in which the gases originating from an evaporator are passed through a demister with vertically arranged separating plates. The problem of the replacement of plates and/or of how the plates might be replaced is not discussed here.

Finally, DE 20 2004 002 483 U1 describes a filtering separator for particle-loaded gases with a filter housing of rectangular cross-section, which is divided into a raw gas space and a clean gas space, furthermore with a gas inlet, a filter element, a gas outlet for the cleaned gas and a particle collecting means, wherein the filter element is a filter block which is configured substantially cuboid and comprises four filter units arranged substantially vertical and at right angles to each other, which are closed towards the raw gas space and are open upwards towards the clean gas space, as well as frame and supporting elements. Above the filter block nozzle lances and a central suction blower are located in the separator housing, so that a replacement of the filter block disadvantageously only is possible from the side.

It is the object of the present invention to avoid the disadvantages described for the known separating means and to propose a separating means in which the replacement of the separating elements can be effected easily, with little expenditure of time and also conveniently with regard to the safety of the operating personnel.

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This object is solved in a separating means with the features of claim 1 for instance in that a preferably closable opening and means for vertically withdrawing the separating element from the gas space are associated to the at least one separating element in the roof of the gas space.

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In this way, the separating elements can simply be withdrawn upwards through the opening in the roof of the gas space by using a means provided for this purpose, such as a hoisting gear or a crane, so that there is no weight problem. A wide plate shape for putting down the separating elements and for cleaning the same is not required, since the hoisting gear can be used to lower the vertically positioned separating elements down to the bottom of the plant, where cleaning is performed for instance by immersion into a basin.

10

Positioning the separating elements when reinserting the same into the gas space can be facilitated by vertical U-shaped sliding frame rails open to the inside.

15

Due to their own weight, the separating elements can be arranged with their lower edge in a horizontal, U-shaped receiving rail open to the top, so that sealing is effected there necessarily.

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The correct position of the separating element can easily be checked by the operating personnel from outside by walking around the separating means.

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When withdrawing the separating elements from the gas space, the same can in any case be provided with a collecting pan and/or a collecting jacket in the vicinity of their lower edge, in order to catch falling acid droplets for the safety of the operating personnel.

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Lifting the separating elements out of the gas space through the upper opening in the roof can be accomplished particularly easily, when the separating elements are provided with at least one lifting lug at their upper edge, which can be engaged e.g. by the hoisting gear.

5

Mounting the separating elements in the gas space advantageously is supported in that the respective separating element can be placed on a supporting tray, which for instance defines the outer clean gas space in downward direction.

10

In a particular aspect of the invention, a plurality of separating elements provided e.g. in a polygonal arrangement can enclose an inner raw gas space, and the raw gas stream can be passed from the inner raw gas space through the separating elements into an outer clean gas space surrounding the same, from which a peripheral gas outlet is branched off.

15

For a gas space with a central upper gas outlet it is provided, for instance, that a plurality of separating elements provided e.g. in a polygonal arrangement define an outer raw gas space on the inside, and the raw gas stream is passed from the outer raw gas space transversely through the separating elements into an inner clean gas space enclosed by the same, from which the central gas outlet is branched off e.g. through the roof of the gas space.

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Further developments, advantages and possible applications of the invention can be taken from the following description of embodiments and the drawing. All design features described and/or illustrated form the subject-matter of the invention, also independent of their inclusion in individual claims or their back-reference.

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In the drawing:

Fig. 1 schematically shows a vertical section through a separating means including the invention in a plant for sulfuric acid production,

Fig. 2A and 2B show a vertical section and a horizontal section through the upper region of a gas space, in which a plurality of separating elements are provided in a polygonal arrangement and a central gas outlet is provided in the roof of the gas space,

Fig. 3A to 3D show a separating element to be used in the invention in a front view, in a side view and in details at the upper and the lower edge of such separating element, and

Fig. 4A to 4C show a front view (partly broken away at the bottom), a top view and a side view (partly broken away at the bottom) of a further aspect of a separating element to be used in accordance with the invention.

Fig. 1 schematically shows the upper portion of a drying tower or an absorber of a sulfuric acid plant, in which sulfuric acid is introduced for instance through a sprinkling system and traverses the tower in counterflow to a gas stream containing for instance SO_3 . From the gas counterflowing to the top, the trickling acid absorbs the SO_3 , wherein the acid concentration rises correspondingly, or water, whereby the acid is diluted. In standard configurations, the absorber constitutes a packed tower constructed as counterflow apparatus, whose container is divided into three zones: the lower part is formed by the bottom with the acid outlet, the middle part for instance contains the packed bed on a grate, through which the acid, which is uniformly distributed by a sprinkling system

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lying on the bed, trickles downwards, and above the packed bed the acid inlet to the sprinkling system and the gas outlet are located.

5 The plant illustrated in the drawing includes a tower-like gas space 5 above the acid distributor 20, wherein upon traversing the sulfuric acid trickling down through a packed bed 22 the gas stream GS is passed from an inner raw gas space 8 via e.g. polygonally arranged vertical separating elements 2 preferably including a wire mesh 2 into an outer clean gas space 9 surrounding the separating elements 1 and from there through a peripheral gas outlet 3, 3'. Above the
10 separating elements 1, closable openings 6 are located in the roof 4 of the gas space 5, through which the separating elements 1 can be withdrawn vertically to the top by using a means 7, 7', 7'' constituting a hoisting gear, such as a crane.

15 In the plant as shown in Fig. 2A and 2B, a central gas outlet 3, 3'' is located in the roof 4 of the gas space 5, wherein a plurality of separating elements 1 provided in a polygonal arrangement define an outer raw gas space 10 on the inside and the raw gas stream GS is passed from the outer raw gas space 10 through the separating elements 1 into an inner clean gas space 11 enclosed by the same, from which the central gas outlet 3, 3'' is branched off in the roof 4.

20 For introducing and retaining the respective separating elements 1 into or in the gas space 5, there are provided vertical U-shaped open sliding frame rails 12 facing each other towards the inside, as shown in Fig. 4A to 4C. As shown in Fig. 3A to 3D, the lower edges of the respective separating elements 1 can be
25 arranged in a horizontal, U-shaped receiving rail 13 open to the top, whereby the separating elements 1 are safely and tightly seated due to their own weight.

During withdrawal, the respective separating element 1 can be provided with a collecting pan 14 in the vicinity of its lower edge, as shown in Fig. 1 and 3B.

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As can be taken from Fig. 3C and 3D, the separating elements 1 expediently are equipped with a lifting lug 15 at their upper edge for engagement of a hoisting gear 7', wherein the lifting lug 15 is attached to the upper end of a supporting rod 21 extending in the separating element 1 down to its lower edge.

5

Fig. 1 furthermore illustrates that when being mounted in the gas space 5 the separating elements 1 support on a supporting tray 16, which defines the outer clean gas space 9 in downward direction.

10

For inspection purposes, a manhole 17 can be provided in the wall 18 of the gas space 5. Furthermore, the plant expediently is equipped with two or three platforms 19, in order to on the one hand reach the manhole 17 and on the other hand inspect the openings 6 in the roof 4 of the gas space 5.

15

List of Reference Numerals:

	1	separating elements
5	2	wire mesh
	3;3';3"	gas outlet; peripheral gas outlet; central gas outlet
	4	roof
	5	gas space
	6	opening
10	7;7';7"	means for vertical withdrawal; hoisting gear; crane
	8	inner raw gas space
	9	outer clean gas space
	10	outer raw gas space
	11	inner clean gas space
15	12	sliding frame rails
	13	receiving rail
	14	collecting pan
	15	lifting lug
	16	supporting tray
20	17	manhole
	18	wall
	19	platform
	20	acid distributor
	21	supporting rod
25	22	packed bed
	GS	gas stream

Claims:

1. A means for separating liquid droplets and/or solid particles from a waste gas stream, e.g. for a plant for sulfuric acid production, wherein the waste gas stream is passed through at least one vertical plate-like separating element (1) which is arranged before a gas outlet (3) of an enclosed gas space (5) having a roof (4), **characterized in** that a preferably closable opening (6) in the roof (4) of the gas space (5) and means (7) for vertically withdrawing the separating element (1) from the gas space (5) are associated to the at least one separating element (1).
2. The means according to claim 1, **characterized in** that the separating element (1) includes a wire mesh (2) through which the waste gas stream is passed.
3. The means according to claim 1 or 2, **characterized in** that the means (7) for vertically withdrawing the separating elements (1) are formed by a hoisting gear (7'), such as a crane (7").
4. The means according to any of the preceding claims, **characterized by** vertical, U-shaped sliding frame rails (12) open to the inside for introducing and retaining the respective separating elements (1).
5. The means according to any of the preceding claims, **characterized in** that the lower edges of the respective separating elements (1) can be arranged in a horizontal, U-shaped receiving rail (13) open to the top.
6. The means according to any of the preceding claims, **characterized in** that during withdrawal the respective separating element (1) in any case is

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provided with a collecting pan (14) and/or a collecting jacket in the vicinity of its lower edge.

5 7. The means according to any of the preceding claims, **characterized in** that the respective separating element (1) has at least one lifting lug (15) at its upper edge.

10 8. The means according to any of the preceding claims, **characterized in** that a plurality of separating elements (1) provided e.g. in a polygonal arrangement enclose an inner raw gas space (8) and the raw gas stream is passed from the inner raw gas space (8) through the separating elements (1) into an outer clean gas space (9) surrounding the same, from which a peripheral gas outlet (3') is branched off.

15 9. The means according to any of the preceding claims, **characterized in** that a plurality of separating elements (1) provided e.g. in a polygonal arrangement define an outer raw gas space (10) on the inside and the raw gas stream is passed from the outer raw gas space (10) through the separating elements (1) into an inner clean gas space (11) enclosed by the same, from which a central gas outlet (3'') is branched off e.g. through the roof (4).

20

10. The means according to any of the preceding claims, **characterized in** that the respective separating element (1) can be received on a supporting tray (16), which downwardly defines e.g. the outer clean gas space (9, 11).

25

11. The means according to any of the preceding claims, **characterized in** that in the wall (18) of the gas space (5) a manhole (17) is provided.

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12. The means according to any of the preceding claims, **characterized by** a walkable area between cylinder jacket and filter elements for inspection of the filter elements.

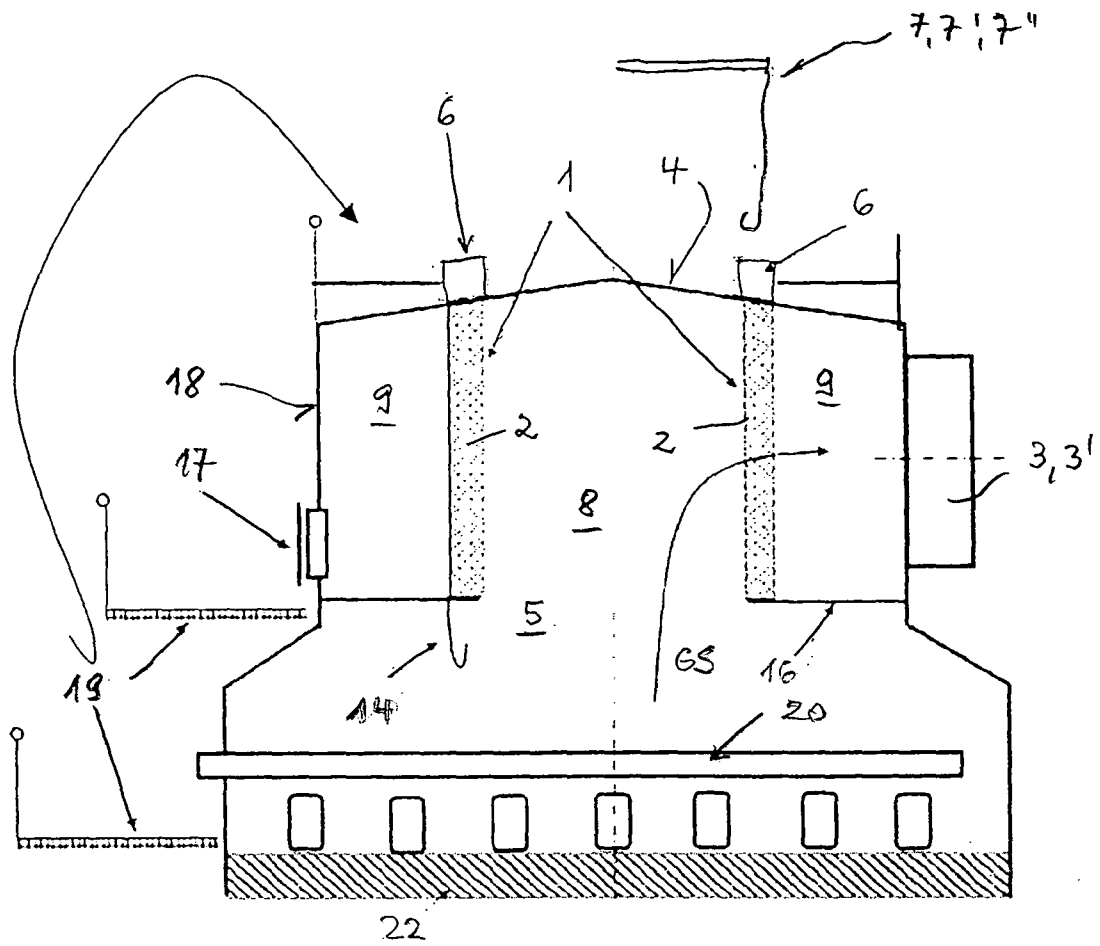
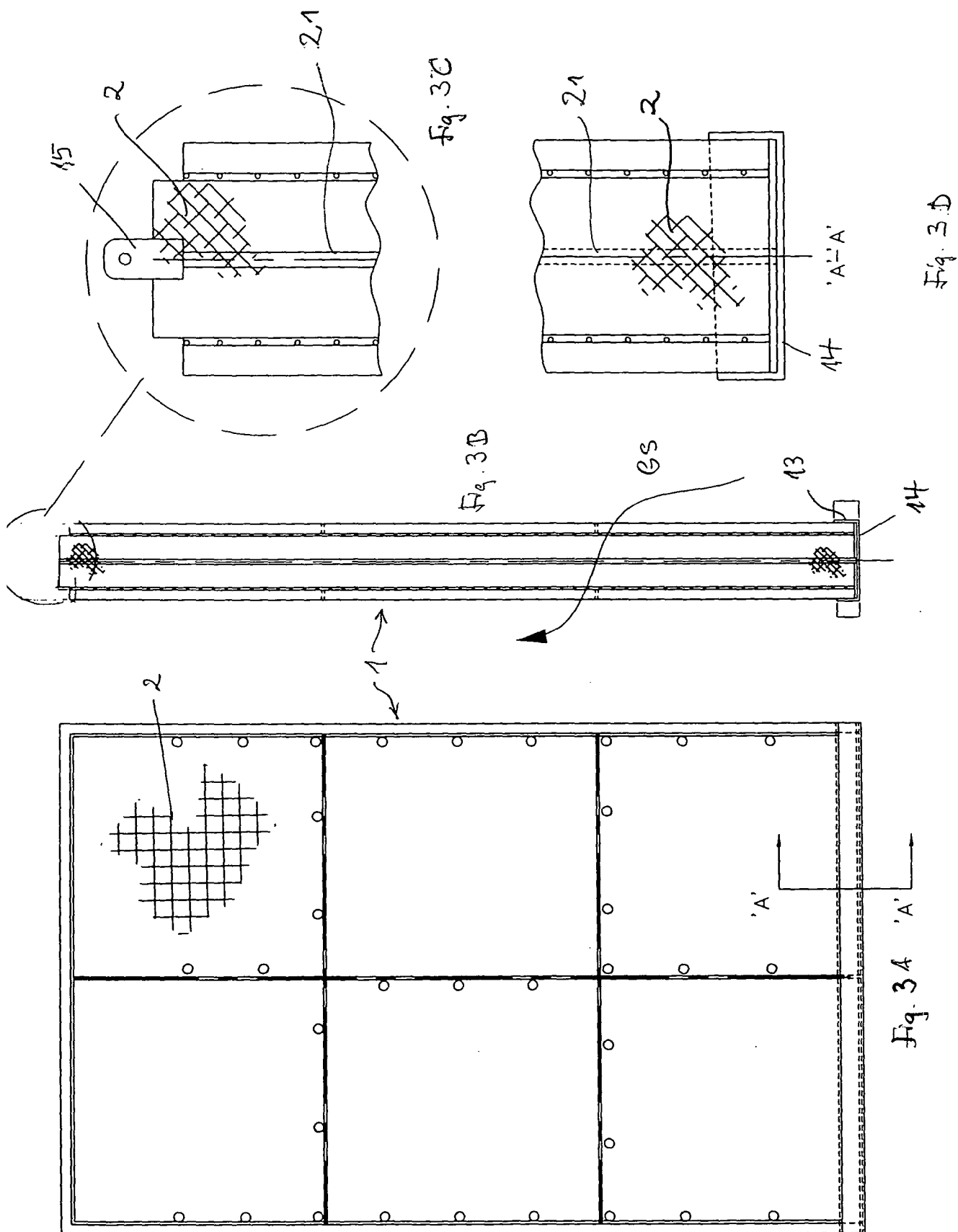
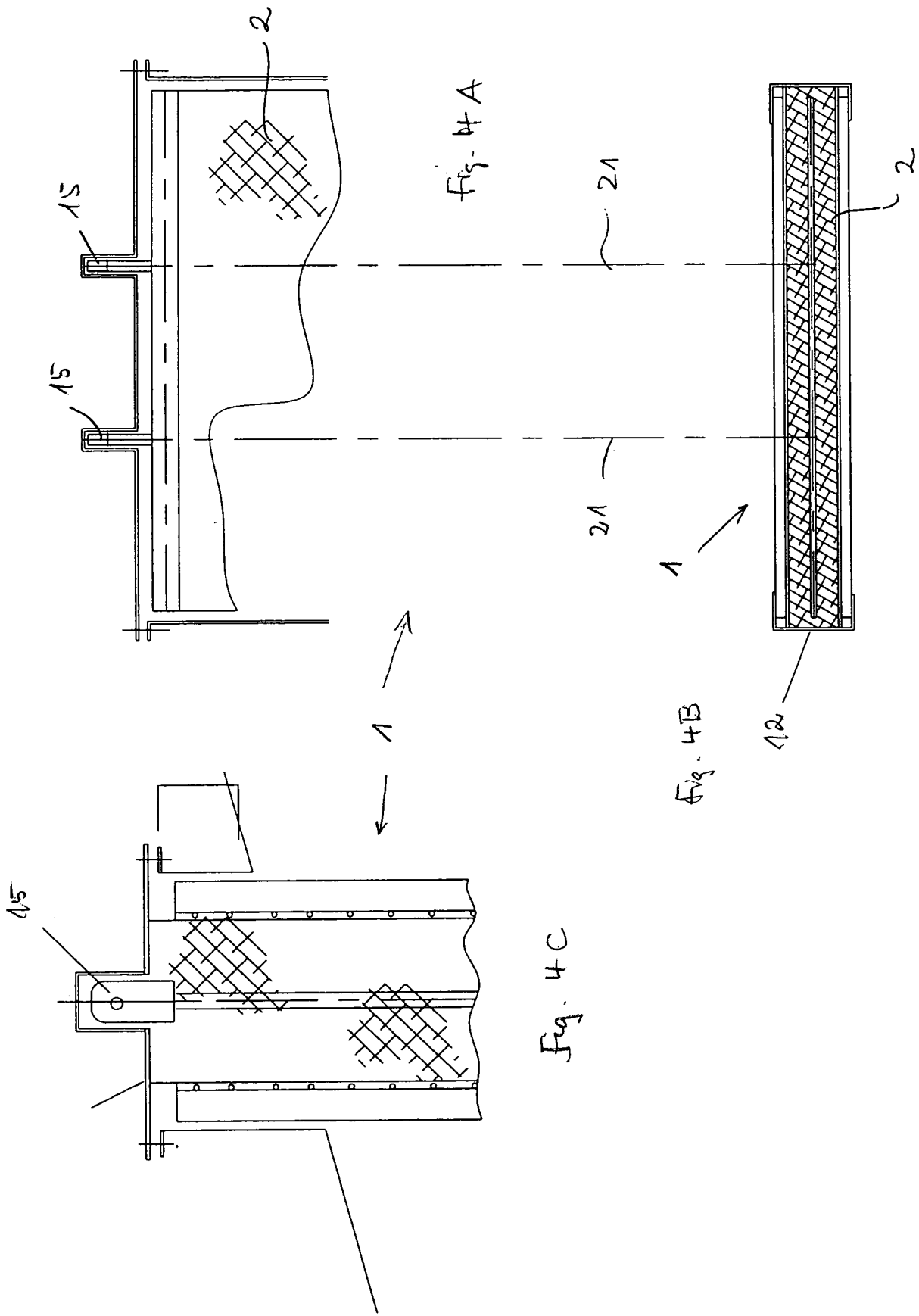


Fig. 1





INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. B01D29/05 B01D46/10 B01D46/12 B01D46/48 B01D46/00 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B01D		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 225 893 A (OSCAR VERNON GREENE) 12 December 1924 (1924-12-12) page 1, line 55 - page 2, line 56; claims 1, 5 page 2, line 90 - line 100 -----	1,2,5,6, 8-12
X	US 2005/139557 A1 (RICKETTS DONALD D [US]) 30 June 2005 (2005-06-30) paragraphs [0046], [0 48] - [0049], [0 61] - [0063]; figures 12-17 -----	1,4,7
X	EP 0 498 037 A1 (ECOTECNICA SRL [IT]) 12 August 1992 (1992-08-12) figures 5, 12 -----	1,3
X	US 2 996 189 A (SALTERBACH PHILIP C) 15 August 1961 (1961-08-15) column 3, line 25; figures 1, 2 -----	1,3
-/--		
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 522 717 A (BRUST JOHN E [US]) 11 June 1985 (1985-06-11) column 4, line 20 - line 25; figures 1, 3 -----	5,10
A	DE 39 10 203 A1 (BISSINGER GMBH [DE]) 4 October 1990 (1990-10-04) figure 1 -----	1
A	US 3 495 320 A (WAPNER STANLEY H ET AL) 17 February 1970 (1970-02-17) figure 1 -----	1,3,6

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/007621

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 225893	A	12-12-1924	NONE	
US 2005139557	A1	30-06-2005	NONE	
EP 0498037	A1	12-08-1992	IT 1247819 B	02-01-1995
US 2996189	A	15-08-1961	NONE	
US 4522717	A	11-06-1985	NONE	
DE 3910203	A1	04-10-1990	NONE	
US 3495320	A	17-02-1970	BE 718924 A	16-01-1969
			CH 493261 A	15-07-1970
			ES 356619 A1	01-04-1970
			FR 1575329 A	18-07-1969
			NL 6810959 A	04-02-1969