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(54) Title: ROTARY DISC FILTER DEVICE

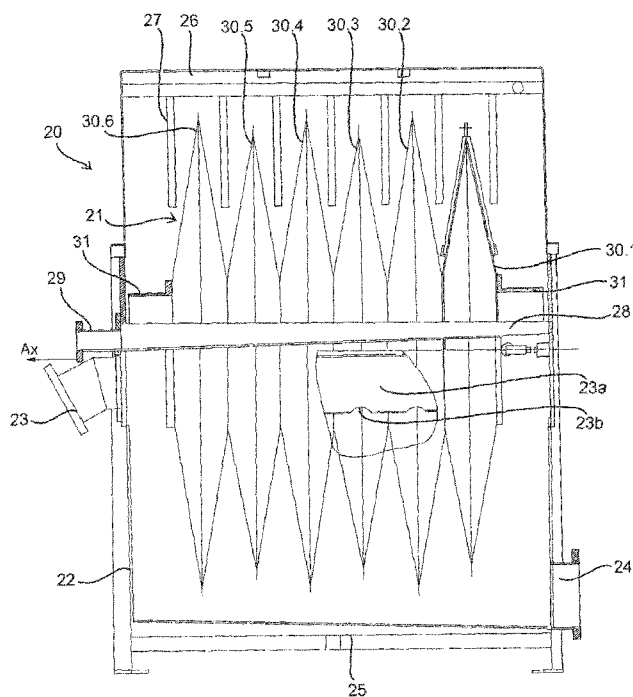


FIG. 2

(57) Abstract: A rotary disc filter device includes a rotor rotatable about an axis of rotation, having a plurality of disc-shaped filter members. Each disc-shaped filter member has two walls extending outwardly from the axis of rotation. At least one of the walls has the form of a frustum.



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ROTARY DISC FILTER DEVICE

FIELD OF THE INVENTION

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The present invention relates to a rotary disc filter device comprising a rotor rotatable about an axis of rotation, the rotor comprising a plurality of disc-shaped filter members, each disc-shaped filter member having two walls extending outwardly from the axis of rotation.

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BACKGROUND ART

Filtering devices, for instance rotary disc filter devices, are used especially for filtering off particles from liquids.

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A common rotary disc filter is disclosed, for instance, in SE-C-224 131 and the principle thereof is illustrated in Fig. 1. The rotary disc filter 1 comprises a rotor having a horizontal, slowly rotating drum 11, which supports a number of parallel, disc-shaped filter members 12 which are successively arranged in spaced-apart relationship along the center axis of the drum 11 and which extend radially away from the drum (just partly shown in Fig. 1). The disc-shaped filter members 12 have, on their parallel orientated opposite lateral surfaces, openings which are covered with a filter cloth 13. Each rotary disc filter member 12 has a central opening through which a liquid A which is to be filtered can flow to the interior of the disc-shaped filter member 12. The liquid A is conducted through an inlet into the drum 11 and falls down to the interior of the disc-shaped filter elements 12, from which liquid A continues to flow out through the filter cloth 13 so that the particles which are to be filtered off adhere at the inside of the filter cloth 13.

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The rotary disc filter 1 can be cleaned by backwashing by means of a cleaning device of the type described, for instance, in WO 00/37159. This filter cleaning device is provided with spray nozzles 14 which are mounted on a plurality of fixed flush tubes 15, which project between the disc-shaped filter members 12. The flush tubes 15 are adapted to conduct flushing liquid to the spray nozzles 14

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and are connected to an elongate liquid-conducting tube 16 which extends parallel to the centre axis of the drum 11. The spray nozzles 14 spray liquid onto the filter cloth 13 axially from outside, in a direction opposite the filtering direction and flushed-off particles are collected in a discharge duct 17 which is placed inside the drum 11 above the inlet.

US 7,972,508 B2 discloses a rotary disc filter including a plurality of disc-shaped filter members secured about a drum. Each disc-shaped filter member has parallel orientated opposite lateral surfaces. The disc-shaped filter member is made of a plurality of modular frame members secured on the drum.

The rotary disc filter devices according to the prior art have a voluminous design. Further, the construction of the rotor is complicated or requires the expensive manufacture of specific parts. Furthermore, the rotors according to the prior art are relatively heavy in weight. In order to support such a rotor, it is necessary to provide a supporting structure having a high stability. Such a supporting structure is expensive in manufacture.

It is desirable to reduce the volume of a rotary disc filter device. It would also be desirable to reduce the cost of manufacture of a rotary disc filter device.

SUMMARY OF THE INVENTION

An object of the present invention is to suggest a solution to the above problems by providing an improved rotary disc filter device.

A specific object is to provide a rotary disc filter device which has a compact design and which requires less effort and cost in manufacture.

According to the invention, these objects are achieved by a rotary disc filter device comprising the features of the first aspect, with preferred embodiments in other aspects.

In the inventive rotary disc filter device, at least one of the walls of the disc-shaped filter member has a form of a frustum. In this manner, it is no longer necessary to mount adjacent disc-shaped filter members with their inner circumference in an axially spaced apart relationship on a drum. As a result, the rotary disc filter device can be designed in a more compact manner. Furthermore,

it is no longer necessary to provide a drum on which the disc-shaped filter members are to be mounted. When forming at least one of the walls of each disc-shaped filter member in the form of a frustum, it is possible to directly connect adjacent disc-shaped filter members to form the rotor. This simplifies the manufacture of the rotor. The rotor has less weight. As a result, a supporting structure for supporting the rotor can be manufactured at less expense.

The frustum may be a cone or a pyramid. Preferably the disc-shaped filter element has a form of a bifrustum, in particular a form of a bipyramid. A disc-shaped filter element having the form of a bifrustum and arranged symmetrical with respect to a plane extending perpendicular to the axis of rotation can be manufactured by using a small number of identical frame elements. Costs for manufacture of the rotary disc filter device can be saved thereby.

According to a preferred embodiment, the walls lie against each other at an outer circumference of the disc-shaped filter element, i. e. according to this embodiment a circumferential edge of the walls has not to be connected by a separate circumferential wall extending parallel to the axis of rotation. The abutting walls form an acute angle at the outer circumference of the disc-shaped filter element. This again simplifies the construction of the rotary disc filter device.

At least one of the walls is advantageously connected at its inner circumference with a further wall of an adjacent disc-shaped member. It is also possible that both walls are connected nearby its inner circumference with a further wall of an adjacent disc-shaped member. According to this embodiment, the disc-shaped members are arranged in a stack-like manner, each disc-shaped filter member being directly connected with an adjacent disc-shaped filter member. In the proposed arrangement, the provision of a drum on which the disc-shaped filter members are mounted, is not necessary.

In a further embodiment, resulting from the arrangement in a stack-like manner, a clearance is formed between adjacent walls of two disc-shaped members in a radial sectional view, the clearance increasing with a radial distance from the axis of rotation. An opening angle β between two adjacent walls may be in the range of 10° to 40° , preferably in the range of 15° to 35° . In the radial

sectional view, the clearance is preferably symmetrical with respect to the plane extending perpendicular to the axis of rotation.

At least one of the walls arranged at an axial end of the rotor is preferably connected with a pipe section arranged coaxially with respect to the axis of rotation. Such pipe section serves to rotatably support the rotor in a support structure.

In a preferred embodiment, the wall is formed of a frame defining several openings therein, each opening being covered by a filter element. The frame may be formed at its inner circumference by a ring-shaped mounting plate extending in a radial direction or perpendicular direction, respectively, with respect to the axis of rotation. The ring-shaped mounting plate may have advantageously a circular inner breakthrough and a polygonal outer circumference. The proposed ring-shaped mounting plate is preferably used to connect adjacent disc-shaped filter elements with each other. The adjacent disc-shaped filter elements can be aligned in a proper manner by aligning the inner circular breakthroughs of the ring-shaped mounting plates and then by fixing the adjacent ring-shaped mounting plates, e. g. by the use of screws or bows with each other.

The frame may further comprise a plurality of spikes extending from the ring-shaped mounting plate, advantageously at an angle α of 160° to 185° . Radial outer ends of the spikes may be connected with an outer circumferential frame member. The frame may have an opening which is preferably limited by two spikes, an inner spike connecting plane and a section of the circumferential frame member. The manufacture of such a frame requires a small amount of identical frame elements. The proposed frame is simple in construction and can be manufactured at less expense.

According to a further embodiment, the filter element comprises a filter frame having a further inner circumference corresponding to the opening, the filter frame holding a filter cloth. The filter frame is preferably made of two further sheet metal elements. The further sheet metal elements are preferably connected by welding. They may also be connected by rivets or screws. It is also possible to produce the filter frame by a plastic material, e. g. by injection molding. The filter

element can be made of one modules. This facilitates a mounting of the filter element and/or a replacement thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

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- Fig. 1 is a perspective view which schematically illustrates the principal of a rotary disc filter device according to the prior art.
- Fig. 2 is a partly broken up side view of a rotary disc filter device in accordance with the invention.
- 10 Fig. 3 is a sectional view according to section line A-A in Fig. 2.
- Fig. 4 is an end view of the rotary disc filter device in accordance with Fig. 2.
- Fig. 5 is a perspective view of a disc-shaped filter member.
- Fig. 6 is a top plane view according to Fig. 5.
- 15 Fig. 7 is a sectional view according to section line B-B in Fig. 6.
- Fig. 7a is a perspective view of a disc-shaped filter member in accordance with Fig. 5 having filter cloths.
- Fig. 8 is a perspective view of a rotor.
- Fig. 9 is a top plane view according to Fig. 8.
- 20 Fig. 10 is a sectional view according to section line C-C in Fig. 9.
- Fig. 11 is a partly broken up side view of a further rotary disc filter device in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

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The invention will in the following be described in more detail with reference to the accompanying drawings which by way of example illustrate preferred embodiments of the invention.

A rotary disc filter device according to the present invention comprises a
30 supporting structure 20 which rotatably supports a rotor 21 which is rotatable about an axis Ax of rotation.

The support structure 20 comprises a housing 22 having an inflow port 23 arranged at one end side of the housing 22 in the vicinity of the axis Ax. The inflow port 23 is connected to an inflow pipe 23a extending through a central portion of the housing 22. The inflow pipe 23b, which is fixed at its both ends at the housing 22, has openings 23b arranged opposite to an interior of a disc-shaped filter member 30. The interior of the disc-shaped filter member 30 is formed by a space limited by opposing walls thereof. An outflow port 24 is arranged at the opposing end side of the housing 22 nearby a bottom 25 of the housing 22. From a cover 26 of the housing 22, there extend flush tubes 27 (not shown in detail here). Through a centre of the housing 22; there extends a discharge duct 28 which leads to a further outflow port 29 arranged nearby the axis Ax at the one end side of the housing 22.

The rotor 21 comprises a plurality of the disc-shaped filter members 30 which surrounds the discharge duct 28 as well as the inflow pipe 23a. Each disc-shaped member 30 arranged at an axial end of the rotor 21 comprises a pipe section 31 extending in an axial direction thereof. As can be seen from Fig. 3, pipe sections 31 are supported on driving wheels 32 provided at the support structure 20. From Fig. 4, it can be seen that outside the housing 22 there is provided a driving unit 33 for driving the driving wheels 32 (not shown here).

With reference to Figs. 5 to 7, there will now be described in detail an embodiment of a disc-shaped filter member 30. The disc-shaped filter member 30 is formed of two opposing walls 34a and 34b each of which has the form of a pyramidal frustum. Walls 34a and 34b abut against an outer circumference 35 (see Fig. 7). The disc-shaped filter member 30 has therefore the form of a pyramidal bfrustum. The pyramidal bfrustum may have 6 to 12 opposing pyramidal faces. In the shown embodiment, the pyramidal bfrustum has 8 opposing pyramidal faces. The disc-shaped filter member 30 comprises a frame which defines both opposing walls. The disc-shaped filter member 30 is advantageously made of a limited number of sheet metal elements which differ in shape.

Each wall 34a, 34b has a central breakthrough 36a, 36b which is formed within a ring-shaped mounting plate 37a, 37b. A central section 371a, 371b of the

ring-shaped mounting plate 37a, 37b has a plane arranged perpendicular to the axis of rotation Ax in the mounted state. From the central section 371a, 371b, there extends an outer spike connecting section 372a, 372b at a first angle α of 160° to 185°.

5 Between the opposition central sections 371a, 371b, there may be provided axially running stiffeners 40. The stiffeners 40 may be made of cylindrical rods which may be fixed by screws. The stiffeners 40 may be arranged in an equal circumferential distance between the opposing central sections 371a, 371b. There may be arranged e. g. 6 to 12 of the stiffeners 40 running parallel to each other
10 and to the axis of rotation Ax.

 A polygonal outer circumference of the ring-shaped mounting plates 37a, 37b corresponds to the outer circumference 35 of the disc-shaped filter element 30. From each of the ring-shaped mounting plates 37a, 37b, especially the outer spike connecting sections 372a, 372b, there extend spikes 38a, 38b in an outer
15 direction. Spikes 38a, 38b are made of sheet metal. The end portions of two opposing spikes 38a, 38b are connected to each other. Further, the end portions of spikes 38a, 38b adjacent to each other in a circumferential direction are connected by elongated circumferential frame members 39. For connecting the circumferential frame members 39, there are advantageously provided connecting
20 plates 391. The provision of the connecting plates 391 makes it possible to manufacture the circumferential frame member 39 with a simple geometry and at less effort.

 Each wall 34a, 34b comprises a plurality of openings O. Each opening O is defined by two spikes 38, the circumferential frame member 39 as well as an inner
25 spike connecting plate 40a, 40b connecting inner ends of the spikes.

 Reference numerals 41a and 41b, respectively, designate a filter frame holding the filter cloth 13 (see Fig. 7a). The filter cloth 13 may be made of stainless steel having a mesh in the range of 5 to 50 μm , in particular in the range of 10 to 30 μm . The filter frame 41a, 41b forms together with the filter cloth a filter element,
30 which covers the opening O.

 In a preferable embodiment the ring-shaped mounting plate 37a, 37b, the spikes 38a, 38b and the circumferential frame members 39 are made of sheet

metal elements, which are preferably folded to enhance the stability thereof. The sheet metal elements are preferably made from stainless steel. They may have a thickness in the range of 1 mm to 10 mm. The sheet metal elements are preferably connected to each other by rivets. A disc-shaped filter member 30 shown in Figs. 5 to 7 can be made by a small number of identical sheet metal elements which can be produced simply and at low expense. By the proposed manufacture of the disc-shaped filter element 30 of sheet metal elements the weight of the rotor 21 can be reduced remarkably.

Figs. 8 to 10 show a preferable embodiment of a rotor 21 according to the present invention. The rotor 21 comprises a plurality of disc-shaped filter elements 30.1 to 30.6 as shown in Figs. 5 to 7. The disc-shaped filter elements 30.1 to 30.6 are connected to each other with their ring-shaped mounting plates 37.1a, 37.1b, e. g. by the use of screws and nuts. As can be seen from Figs. 8 to 10, two adjacent disc-shaped filter elements 30.1 to 30.6 are mounted to each other in such manner that the spikes 38.1a, 38.1b thereof are offset to each other. The spikes 38.1a, 38.1b of a first disc-shaped filter element 30.1 and third disc-shaped filter member 30.3 are in alignment with each other. The central breakthrough 36a, 36b of all disc-shaped filter members 30.1 to 30.6 are in alignment with each other forming a central channel circumventing the inlet pipe 23a as well as the discharge duct 28. The proposed offset arrangement of the polygonal disc-shaped filter members 30.1 to 30.6 results in a smooth rotational movement of the rotor.

The function of the rotary disc filter device according to the present invention is as follows:

Water to be cleaned is supplied via inflow port 23 to inflow pipe 23a. The water is discharged through openings 23b provided opposite the interior of each of the disc-shaped filter members 30.1 to 30.6. The water passes the filter cloth 13 held by filter frames 41a, 41b, 41.1a, 41.1b, 41.2a. Particles contained in the water adhere to an inner side of the filter cloth 13. When the rotor 21 rotates, the filter cloth 13 passes flush tubes 27 by which the particles adhering at the inner side of the filter cloth 13 are released and washed into the discharge duct 28. The particles are removed from the device via the further discharge port 29. The filtered water is discharged from the housing 22 via the discharge port 24.

As can in particular be seen from Figs. 2 and 10, the disc-shaped filter elements 30.1 to 30.6 have opposing walls 34a, 34b. In a radial sectional view, a clearance between the opposing walls of two adjacent disc-shaped members increases with a radial distance from the axis of rotation A. A second angle β between two adjacent walls may be in the range of 10° to 40°, preferably in the range of 15° to 35°.

The proposed design of the rotor 21 is compact. This allows an overall compact design of the rotary disc filter device.

Fig. 11 shows a partly broken up side view of a further rotary disc filter device. The further rotary disc filter device is similar to the rotary disc filter device shown in Figs. 2 to 10, in particular shown in Fig. 2. The further rotary disc filter device differs from the rotary disc filter device shown in Fig. 2 in that in a lower portion of the housing 22, there are provided below the pipe sections 31 containers 42. The containers 42 are limited by the housing 22, the bottom 25 as well as separating walls 43. Each container 42 is provided with a bypass discharge duct 44.

The further rotary disc filter device has a bypass function. If e. g. discharge port 24 becomes clogged, water to be cleaned cannot be discharged through openings 23b. Water to be cleaned then escapes through a slit formed between pipe section 31 and housing 22. Said water is collected by containers 42 and discharged through bypass discharge ducts 44. By providing the containers 42, it is avoided that cleaned water collected in the lower part of the housing 22 is mixed with uncleaned water. In case of clogging of the discharge port 24, it is further avoided that the further rotary disc filter device is over flooded.

LIST OF REFERENCE SIGNS

	1	Rotary disc filter
	11	rotor
5	12	disc-shaped filter member
	13	filter cloth
	14	spray nozzle
	15	flush tube
	16	liquid-conducting tube
10	17	discharge duct
	20	support structure
	21	rotor
	22	housing
	23	inlet port
15	23a	inflow pipe
	23b	opening
	24	discharge port
	25	bottom
	26	cover
20	27	flush tube
	28	discharge duct
	29	further discharge port
	30, 30.1 to 30.6	disc-shaped filter member
	31	pipe section
25	32	driving wheel
	33	driving unit
	34a, 34b	wall
	35	outer circumference
	36a, 36b	central breakthrough
30	37a, 37b, 37.1a, 37.1b	ring-shaped mounting plate
	371a, 371b, 371.1a, 371.1b	control section
	372a, 372b, 372.1a, 372.1b	outer spike connection section

	38a, 38b, 38.1a, 38.1b	spike
	39, 39.1, 39.2	circumferential frame member
	391, 391.1, 391.2	connection plate
	40	stiffener
5	41a, 41b, 41.1a, 41.1b, 41.2a	filter frame
	42	container
	43	separating wall
	44	bypass discharge duct
10	A	liquid
	Ax	axis of rotation
	α	first angle
	β	second angle
	O	opening
15		

CLAIMS

1. A rotary disc filter device comprising:
a rotor rotatable about an axis of rotation,
5 the rotor comprising a plurality of disc-shaped filter members,
each disc-shaped filter member having two walls extending outwardly from
the axis of rotation,
wherein at least one of the walls has a form of a frustum.
- 10 2. The rotary disc filter of claim 1, wherein the frustum is a cone or a pyramid.
3. The rotary disc filter of claim 1, wherein the disc-shaped filter member has a
form of a bifrustum.
- 15 4. The rotary disc filter of claim 3, wherein the bifrustum is a bipyramid.
5. The rotary disc filter of claim 1, wherein the walls lie against each other at
an outer circumference of the disc-shaped filter member.
- 20 6. The rotary disc filter of claim 1, wherein at least one of the walls is
connected at or nearby its inner circumference with a further wall of an adjacent
disc-shaped member.
7. The rotary disc filter of claim 1, wherein a clearance is formed between
25 adjacent walls of two disc-shaped members in a radial sectional view, the
clearance increasing with a radial distance from the axis of rotation.
8. The rotary disc filter of claim 1, wherein at least one of the walls arranged at
an axial end of the rotor is connected with a pipe section arranged coaxially with
30 respect to the axis of rotation.

9. The rotary disc filter of claim 1, wherein the wall is formed of a frame defining several openings therein, each opening being covered by a filter element.

10. The rotary disc filter of claim 9, wherein the frame is formed at its inner
5 circumference by a ring-shaped mounting plate extending in a radial direction with respect to the axis of rotation.

11. The rotary disc filter of claim 10, further comprising a plurality of spikes extending from the mounting plate, and having radial outer ends connected with
10 an outer circumferential frame member.

12. The rotary disc filter of claim 11, wherein the frame has an opening limited by two spikes, an inner spike connecting plate and a section of the circumferential frame member.

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13. The rotary disc filter of claim 12, wherein the filter element comprises a filter frame having an inner circumference corresponding to the opening, the filter frame holding a filter cloth.

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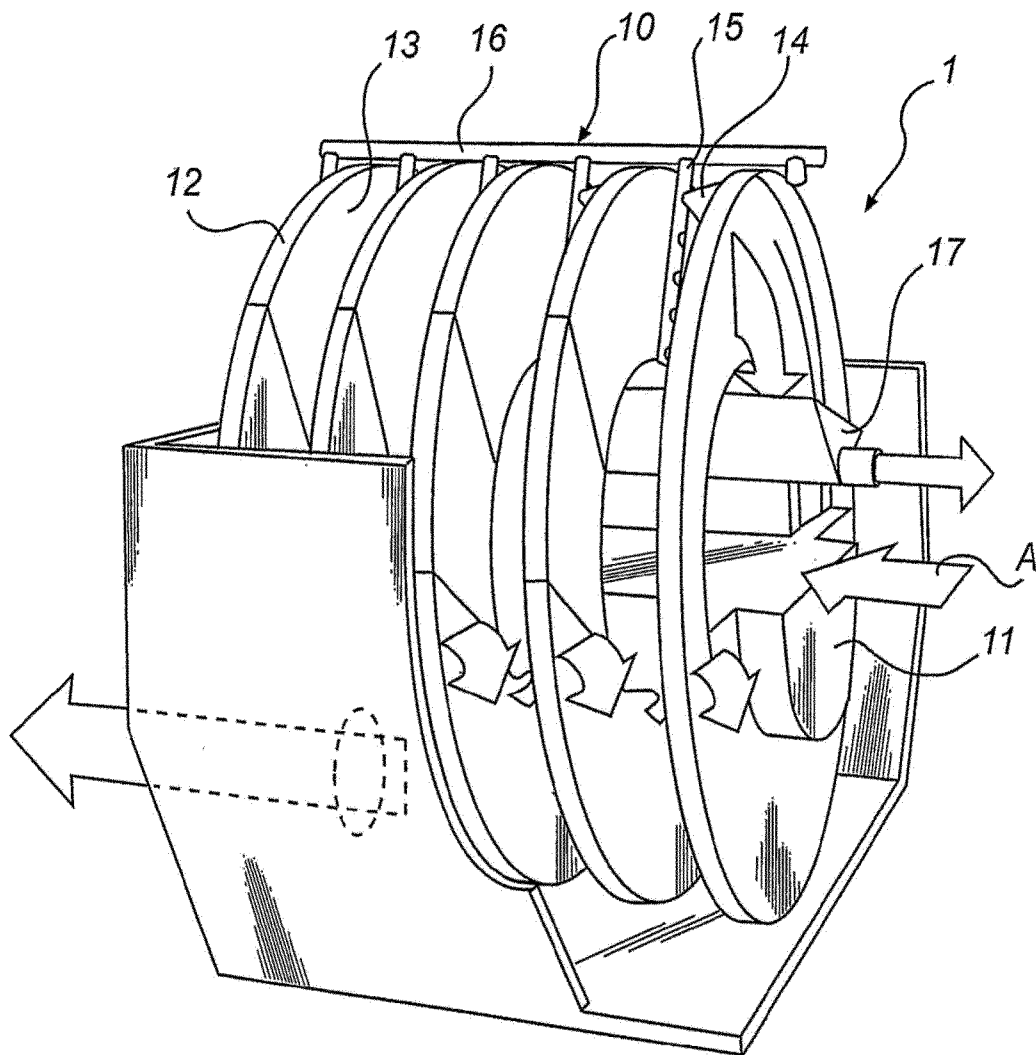


Fig. 1

PRIOR ART

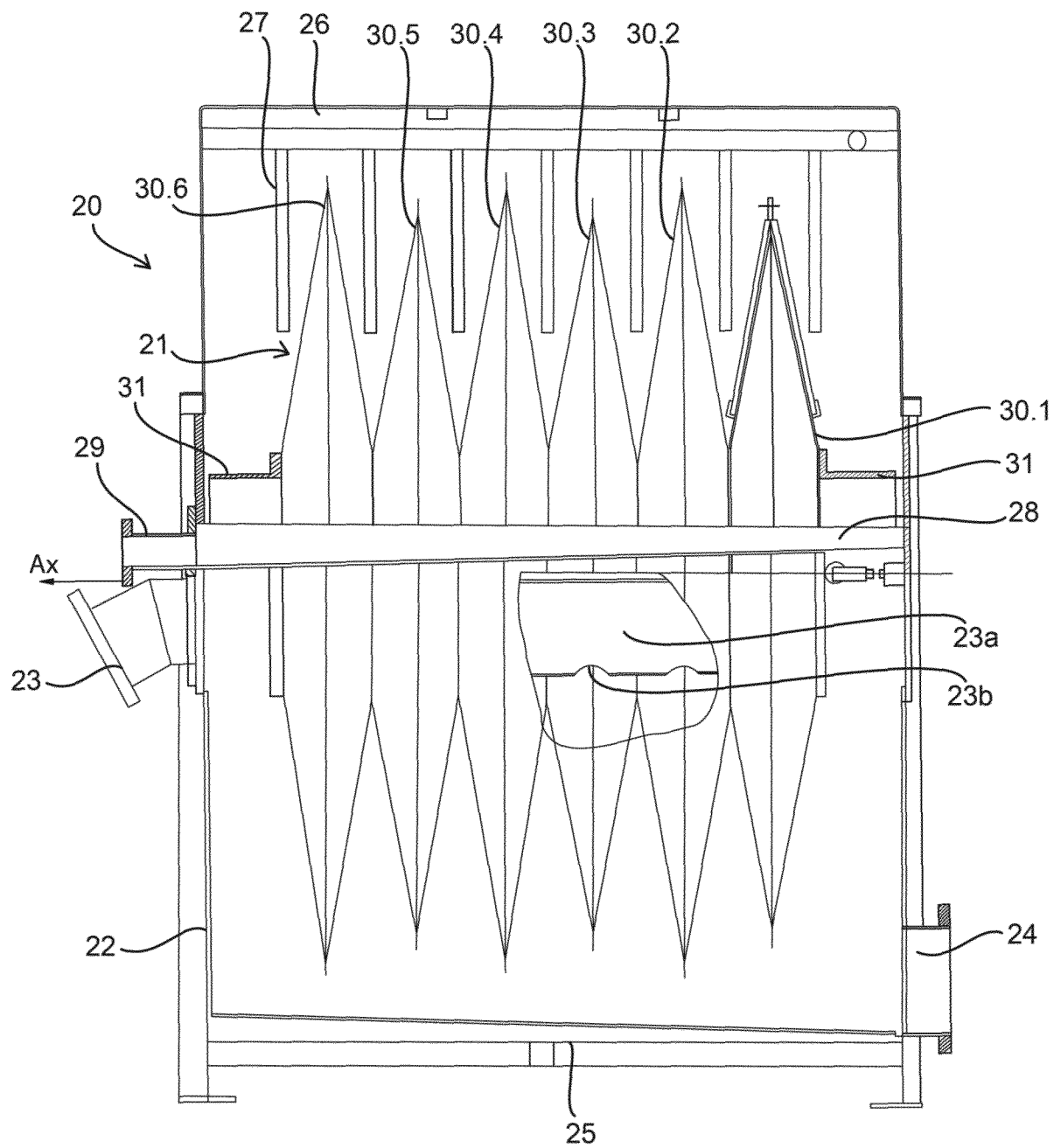


FIG. 2

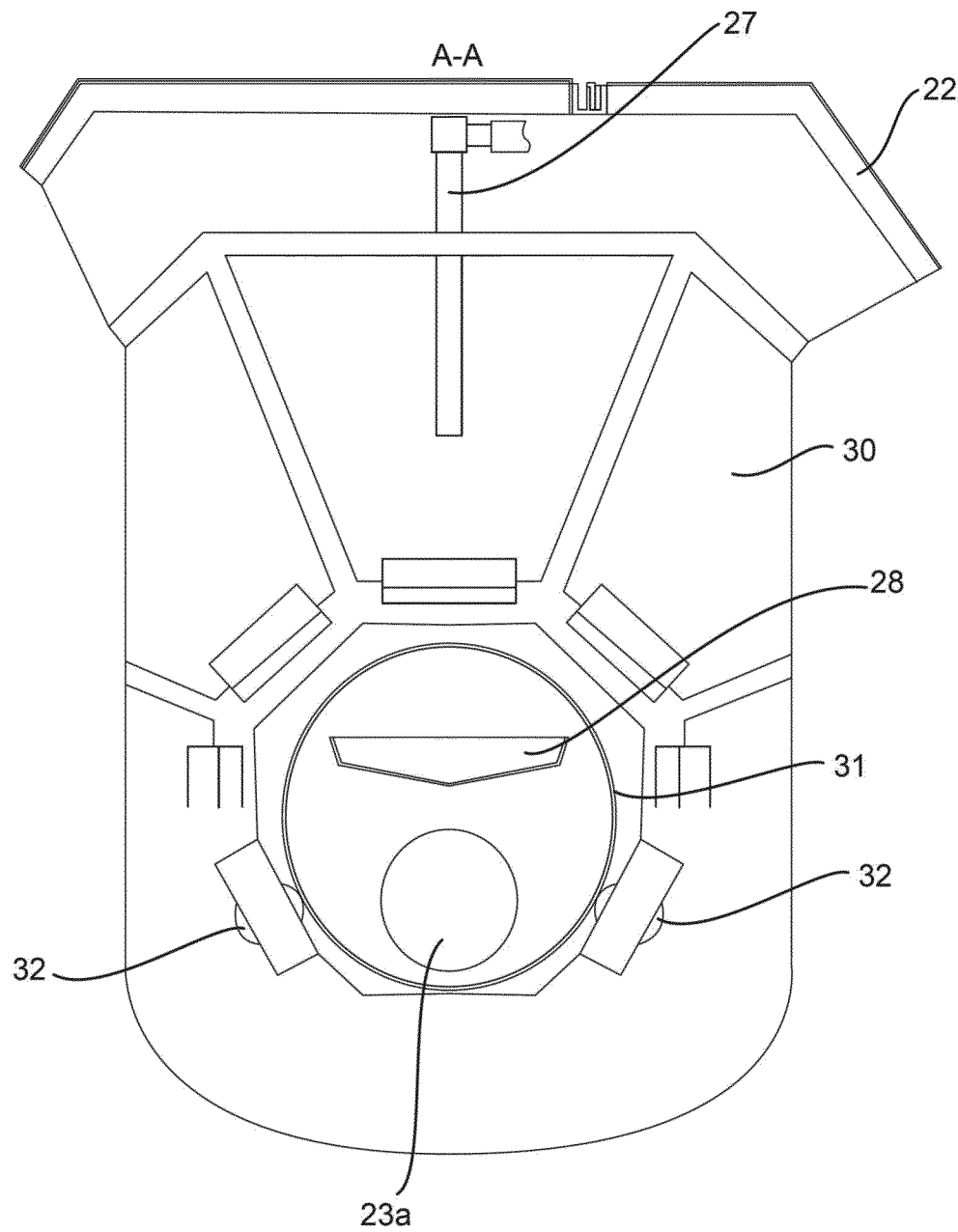


FIG. 3

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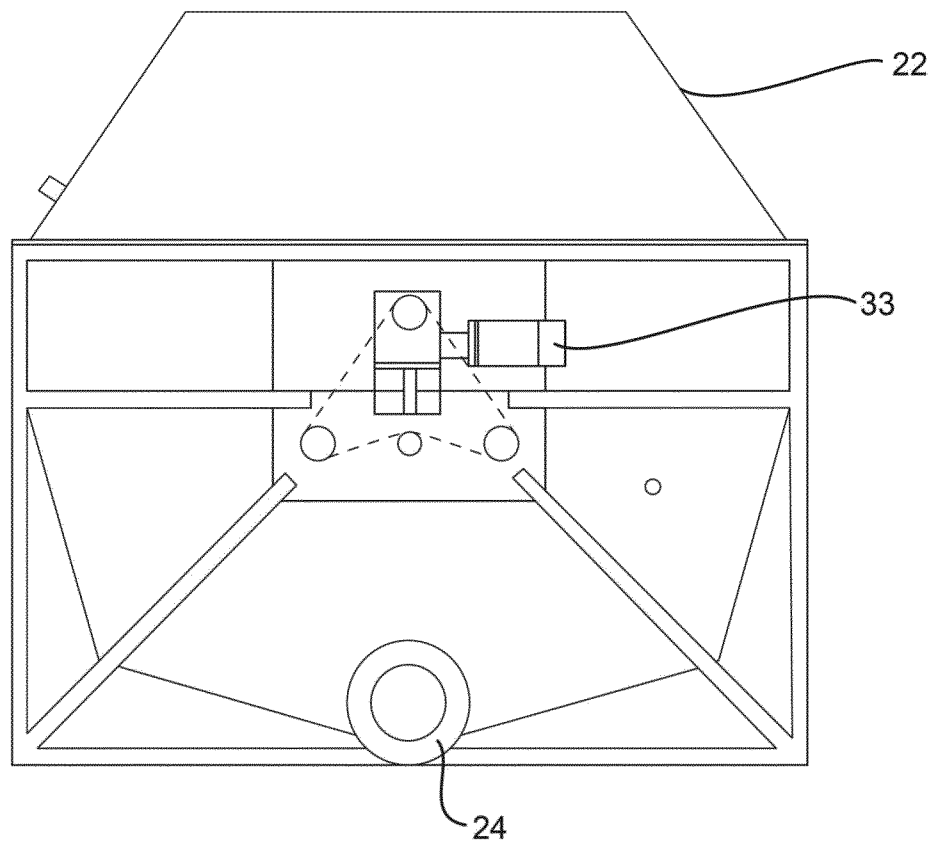


FIG. 4

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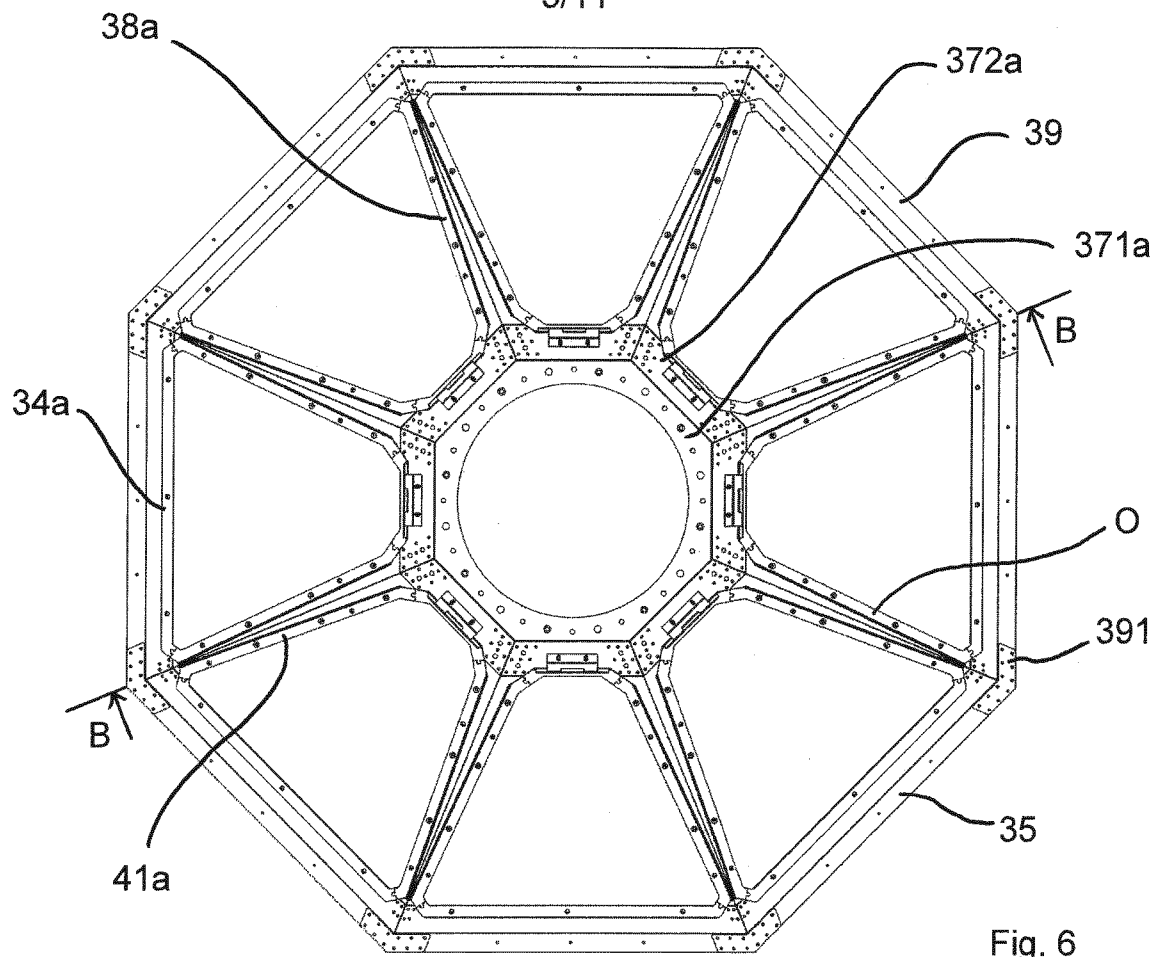


Fig. 6

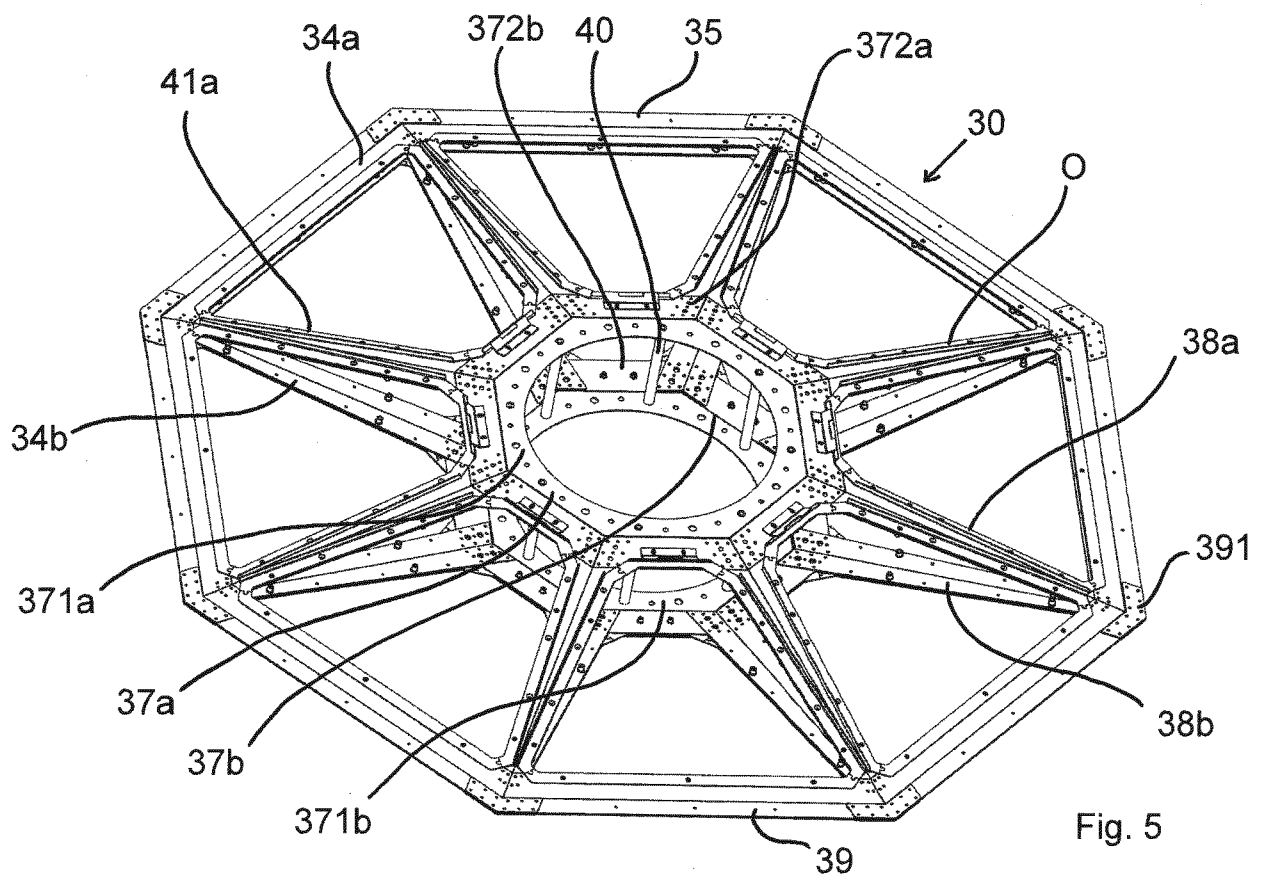


Fig. 5

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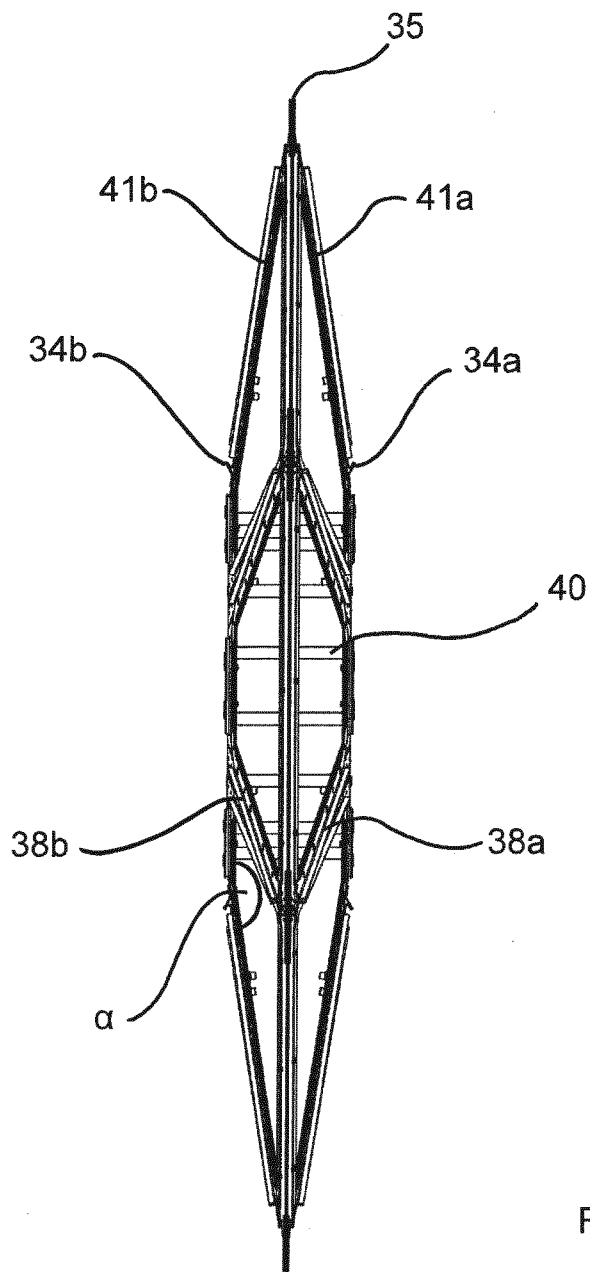


Fig. 7

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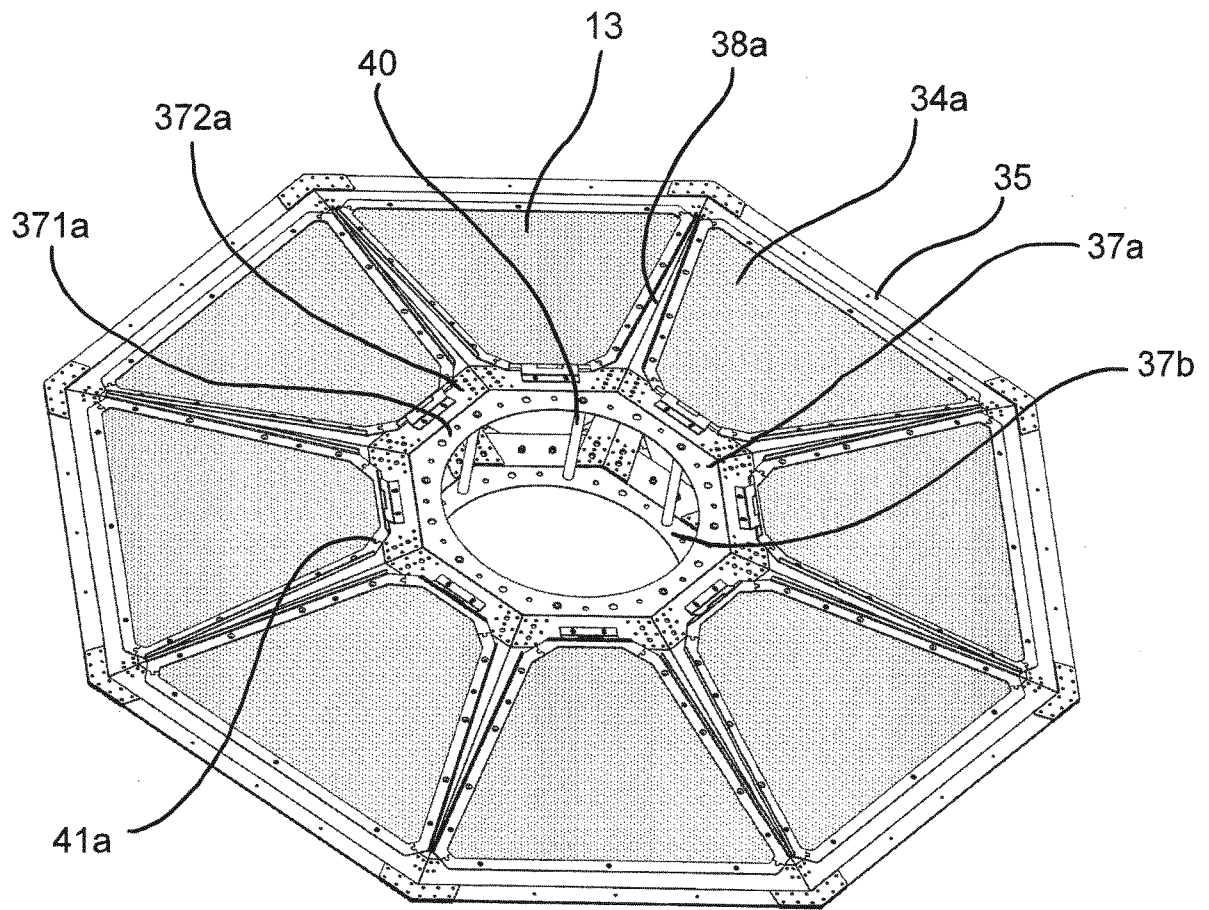


Fig. 7a

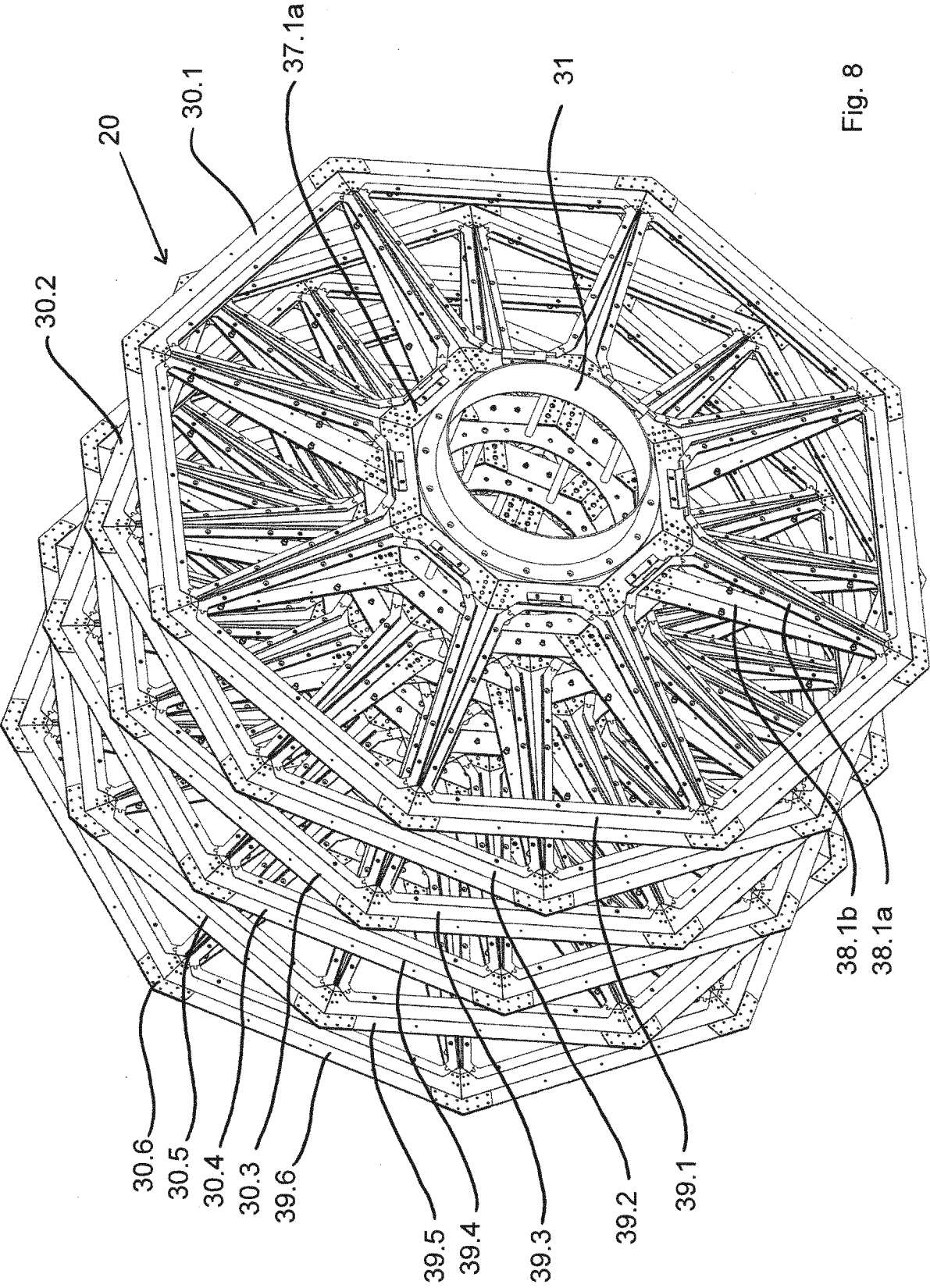


Fig. 8

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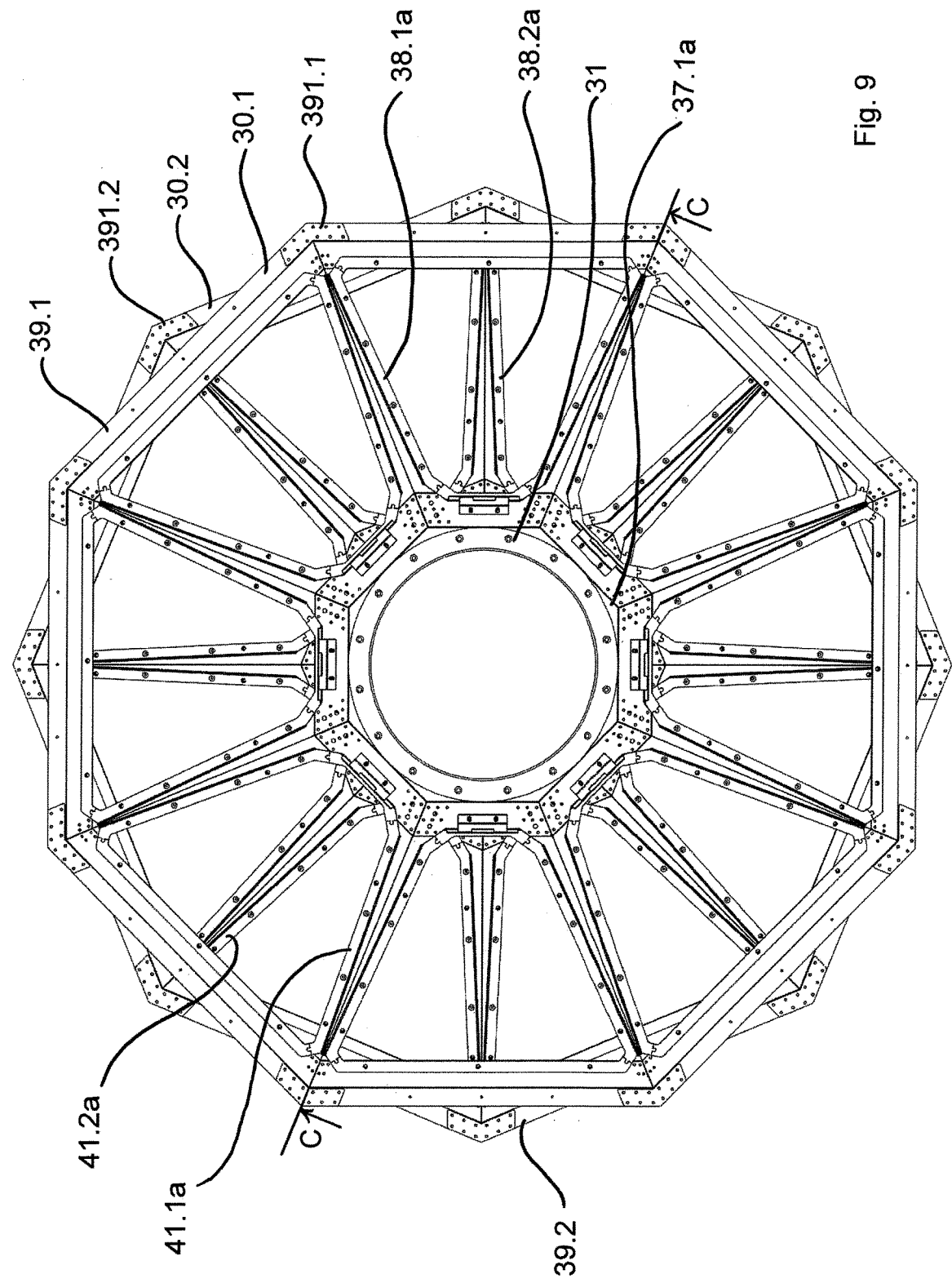


Fig. 9

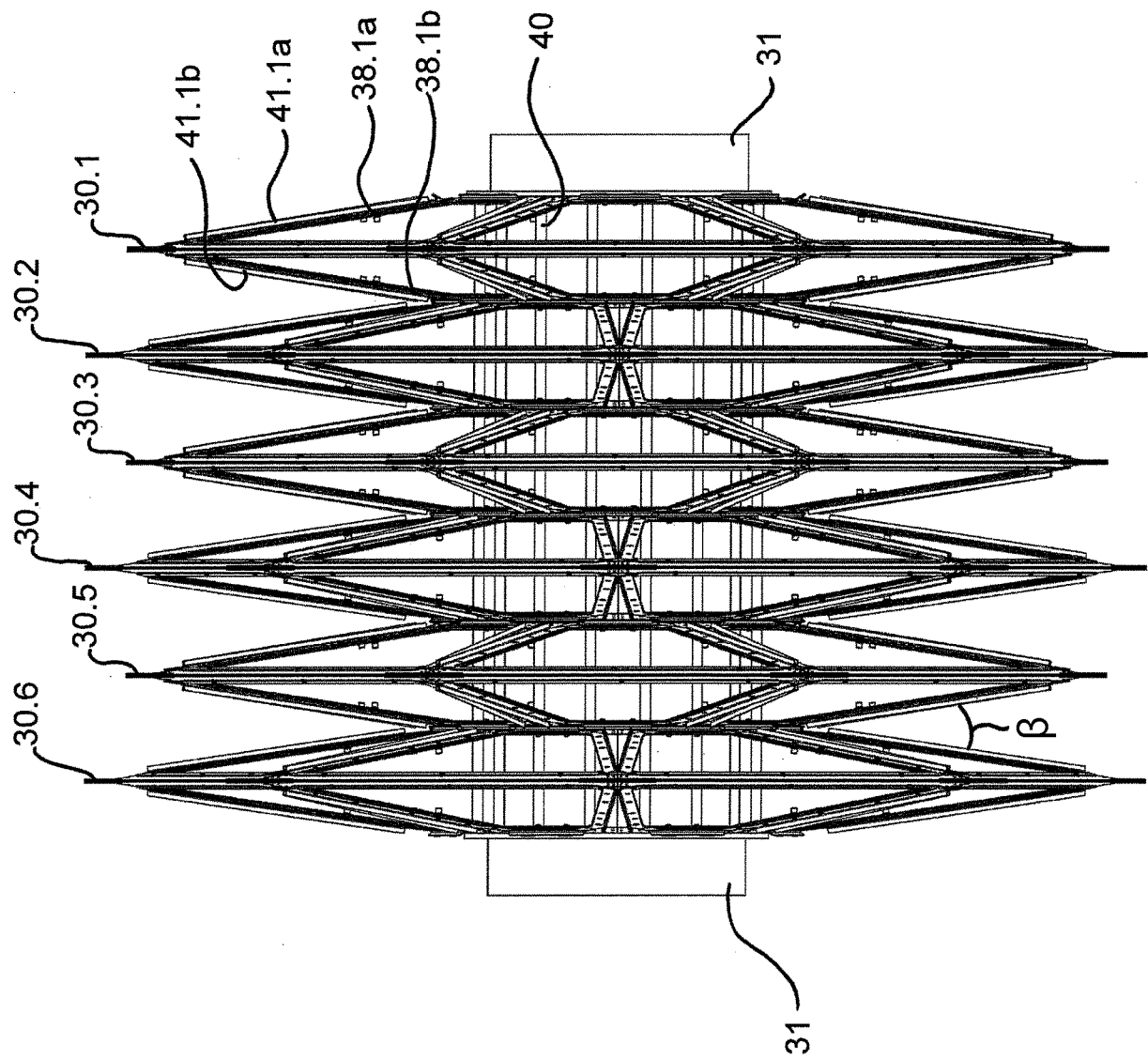


Fig. 10

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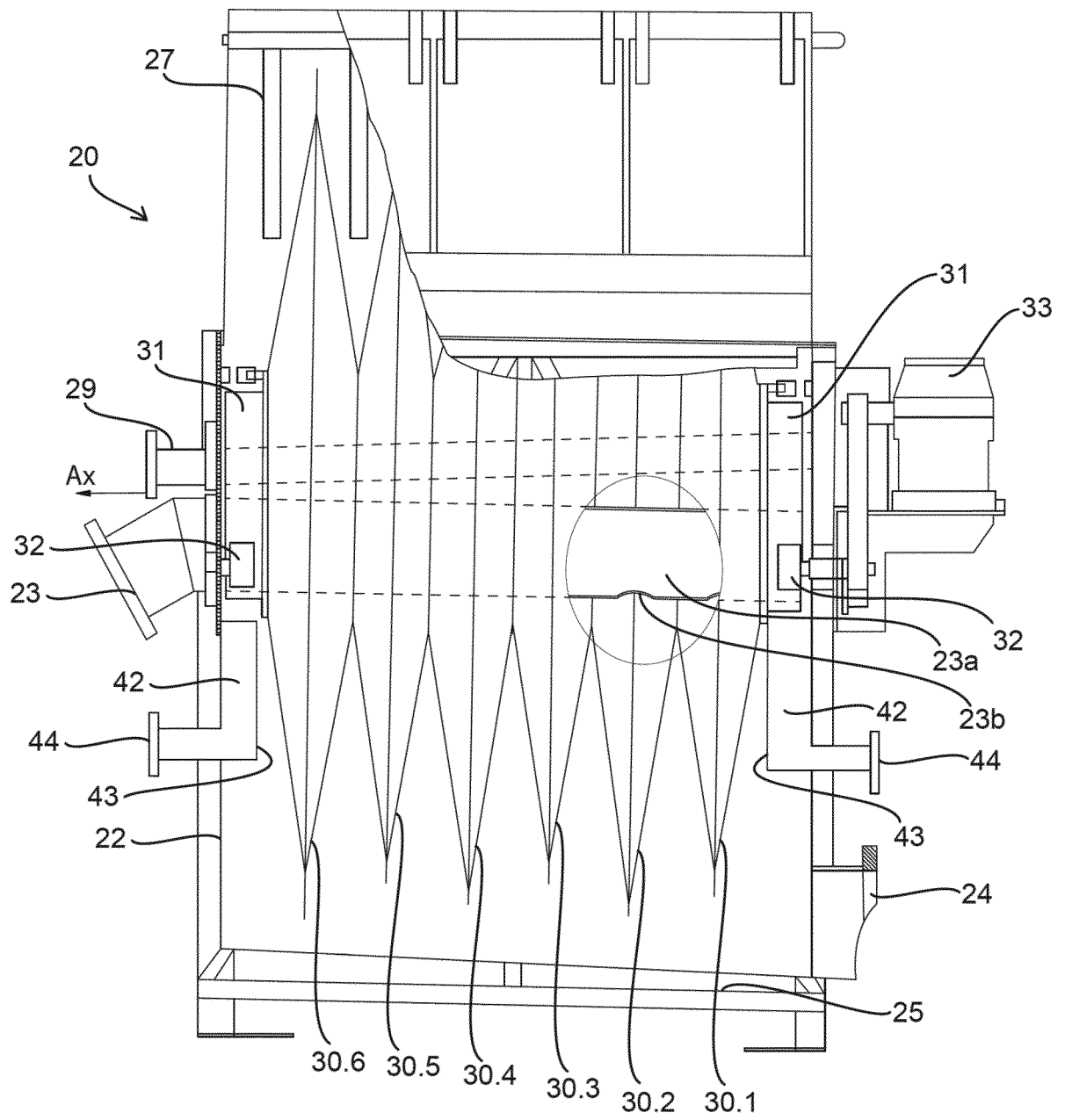


FIG. 11